LANGUAGES AND LINGUISTICS

ATTENTION AND MEANING

THE ATTENTIONAL BASIS OF MEANING

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THE ATTENTIONAL BASIS OF MEANING

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CONTENTS

INTRODUCTION

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Among the cognitive processes involved in the construction of any kind of meaning (whether linguistic, pragmatic, or non-linguistic), attention is fundamental in determining what, how and why we mean. Attention plays a primary role in: the process of learning the meanings of words and more generally of acquiring knowledge; signification, discourse and persuasion; perceiving, representing and (re)framing reality; shaping the attitudes of the audience; conveying values and ideologies. Conversely, the meanings of words and more in general of signs convey the condensed instructions for the attentional operations one has to perform in order to consciously experience what is expressed through and by them. Language, by addressing and guiding attention in specific ways, helps to select, amplify and support certain semantic components and concepts, and construct and communicate knowledge and values.

The close link between attention and meaning was first acknowledged by some authors already between the end of the nineteenth century and the beginning of the twentieth century. In his *Cahiers*, Paul Valéry (1973) hinted that attention was a possible mechanism for meaning creation. Following on the footsteps of the German psychologist Narziss Kaspar Ach (1871-1946), Vygotskij (1935) highlighted in a more general way that the original function of words is to direct attention toward something.

However, these authors did not develop their ideas into a systematic attempt at analyzing meaning construction in attentional terms. To the best of our knowledge, the first who made such an attempt was Silvio Ceccato (1964, 1966, 1968, 1969, 1970, 1972, 1974, 1987, 1988, 1990; Ceccato and Zonta, 1980; Ceccato and Oliva, 1988), who in general largely theorized the relationship between attention and mental activity, and more specifically systematically investigated the meanings of words in attentional terms.

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Ceccato's project was taken up and pursued by a group of scholars (Amietta and Magnani, 1998; Benedetti, 1999, 2001, 2006, 2011; Benedetti et al., 2010; von Glasersfeld, 1989; Marchetti, 1993, 1997, 2006, 2009, 2010, 2014; Parini, 1996; Vaccarino, 1974, 1981, 1988), who are mainly Italian, with the notable exception of Ernst von Glasersfeld, the founder of *Radical Constructivism* (2007), who was Austrian origin[1].

The importance of attention for meaning construction has progressively been acknowledged by many other scholars of various disciplines around the world, so much so that new and original theoretical frameworks explicitly dedicated to the systematic and comprehensive analysis of meanings in attentional terms have been developed (Carstensen 2001, 2002, 2007, 2011; M. Lampert, 2009, 2011; 2013; Oakley, 2004, 2009; Scheider and Kuhn, 2011; Talmy, 2007, 2008).

It is interesting to note that these scholars came to recognize the importance of attention for meaning construction, and developed their own theoretical frameworks for the analysis of meaning in attentional terms, mostly independently and unaware of the work performed by the Italian scholars. This can be directly ascertained by reading the accounts they give of their personal research journey (Carstensen, in this book; Oakley, 2004, 2009). In describing their dissatisfaction with previous and current research approaches, and explaining the reasons that led them to take attention into account in their research program, they make no mention at all about any kind of possible influence on them of the Italian scholars' thought. This is also confirmed by an inspection of the works and research traditions that the scholars not belonging to the Italian school of thought refer to the as origin of their works (see for example, M. Lampert, 2009; Talmy, 2007, 2008): no reference is made to the theoretical framework developed by the Italian scholars, and the analyses they performed. This comes with no surprise, given the progressively lower participation of the Italian scholars in the international scientific arena, the limited availability of their publications in a language other than Italian, and the almost complete absence of empirical research in their scientific activity: factors which, among others, have obviously contributed to restrain and hinder the accessibility of the international scientific community to their works and ideas.

The fact that scholars from different backgrounds and belonging to different research traditions, undertook, independently of each other and at different periods, research programs aimed at *systematically and comprehensively* analyzing meaning construction in attentional terms, is very significant. It shows that what could seem to be just a possible hypothesis, that is, that attention and meaning are somehow related, is actually a fruitful, scientifically and empirically investigable matter of study.

And that this is actually so, is also substantiated by a series of experiments performed in various scientific fields which, even though not originally linked to these specific research programs, directly prove the existence of the relationship between attention and meaning. Let us consider just some of them.

Logan (1995) showed that linguistic cues like "below", "above", "left" and "right" are used to direct attention from one object to another. Logan hypothesizes that: (i) such linguistic cues require the subject to impose a reference frame before the deictic relation they express can be computed (a reference frame is a set of coordinate axes that defines a three-dimensional space. A reference frame has four parameters: an origin, an orientation, a direction, and a scale. Subjects can adjust the orientation of the reference frame voluntarily:

[1] Von Glasersfeld spoke Italian however, and worked for some years together with Ceccato.

for example, a reference frame can be moved or rotated around the display by simply instructing the subject to treat different parts of the display as the top); (ii) some regions of the space are easy to access from the reference frame and others are not. For example, objects cued on the above-below axis are more accessible than objects cued on the front-back axis, which in turn, are more accessible than objects cued on the left-right axis (these differences can be understood in terms of the support the different relations receive from the environment – gravity – and from bodily asymmetries). In Logan's opinion, the reference frame is an attentional mechanism because it possesses the kind of flexibility that is generally associated with attentional mechanisms like spotlights and spatial indices: it can be moved around and oriented at will.

His experiments confirm his hypotheses. For example, Experiment 7 shows an advantage (in terms of reaction times) of the above-below axis over the left-right axis in all orientations (that is, regardless of whether the subjects were told to treat the left side of the display, the right side of the display or the bottom of the display as the top). Moreover, his experiments show that whereas deictic relations (such as "above", "below", "left" and "right") require a subject to impose or extract a reference frame before computing the relation they express, basic relations (such as "there") do not. Logan clearly concluded that: "The semantics specify the computational goals that the attention system must satisfy" (*ibid*., p. 169).

Taube-Schiff and Segalowitz (2005) show that grammaticized elements of language (conjunctions, prepositions, bound morphemes and other grammatical devices that express tense and aspects, definiteness, spatial and temporal relationships, etc.) act as an attention-directing mechanism by demonstrating that when they force an individual to refocus his or her attention, a shift cost is involved. They observe that when individuals engage in a conversation, the rapid stream of sentences requires the speakers to engage their attention control processes to allow shifting between the various ideas being expressed. For example, a sentence such as "The food remained on the plate because the boy wasn't hungry" requires a person first to focus his attention on the spatial relationship between "food" and "plate" (triggered by "on") and then to shift his attention to the causal connection between the upcoming second clause and the first clause (triggered by "because"). The attentional shift implies a cost that varies depending on whether the grammaticized elements require attention to be refocused on a different or a similar aspect of the mental representation of the meaning contained in a phrase. For example, the shift costs implied by the sentence "The food remained on the plate because the boy wasn't hungry" are higher than the shift costs implied by the sentence "There was food and a plate and a boy and the boy wasn't hungry".

Estes et al. (2008) showed that object words referring to objects that typically occur in particular locations (such as "head" and "foot") orient the attention to the object's typical location. Likewise, in the field of sentence comprehension, Altmann and Kamide (2007) and Salverda and Altmann (2011) demonstrate that linguistic processing influences the allocation of attention in the visual system very rapidly and automatically.

The close link between attention and meaning has also been evidenced by studies on sentence production. For example, Tomlin's (1997) study was intended to investigate the role of the direction of attention in the choice of syntactic subject position in English narrative. He used an animation program called "The Fish Film", in which a dark and a light fish approach each other until one swallows the other; an explicit visual cue in the form of an arrow directed the participant's attention toward one of the two fish; participants were instructed to direct their gaze to the cued fish only and describe the interaction between the two fish in any

preferred way. Tomlin found that when the dark fish was cued and then eaten by the light one, participants produced passive voice sentences (such as "The dark fish was eaten by the light fish"); when the cue was on the light fish, and then the light fish ate the dark one, participants produced active voice sentences (such as "The light fish ate the dark fish"). The study supports the hypothesis that the grammatical subject is assigned to the referent that is in the speaker's attentional focus (for a general review of the works dealing with the role of attention in sentence production, see Myachykov et al., 2009).

In the field of Second Language Acquisition (SLA) studies, evidence continues to accumulate that attention is crucial for second and foreign language learning (Schmidt, 2010).

The importance of attention for word-learning, and more in general knowledge acquirement, is progressively acknowledged in the field of developmental psychology (L. B. Smith at al., 2010).

The role played by attention in meaning construction and word usage is also attested in the field of text analysis. Tausczik and Pennebaker (2010) clearly acknowledge the fact that not only content words explicitly reveal where individuals are focusing, but that function words, such as personal pronouns, also reflect attentional allocation. Moreover, they recognize that attention can reveal not just who or what someone is attending to, but how they are processing the situation.

Finally, it should be noted that even linguists who have not developed comprehensive theoretical systems explicitly devoted to the analysis of meanings in attentional terms, partially acknowledge the importance of some form of attention for some word categories. For example, Diessel (2006, 2014) argues that demonstratives function to coordinate the interlocutors' joint focus of attention.

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The aim of this book is to present the status of extant research on the relationships between attention and meaning. The contributions collected here (a) offer an overview of the most prominent theories and models developed so far that aim to comprehensively explain how attention determines meaning construction, and (b) present some of the analyses and experimentations that have been carried out on the basis of such theories and models.

The book opens with a chapter by a scholar from the Italian group, Giulio Benedetti. Benedetti's theory – Operational Linguistics (OL) – follows in the footsteps of the research approach originally developed by Silvio Ceccato, which was based on the assumption that the meanings of words can be analyzed in terms of the various combinations of one single elemental mental operation, i.e., the attentional state. Compared to Ceccato's work, OL introduces the important innovation of a larger set of elemental mental operations (almost all are operations commonly described in cognitive psychology), among which attention continues to play a key role but is no longer the only elemental operation. Additionally, while Ceccato's original program intended to analyze the meanings of all kinds of words, OL specifically focuses on the semantics of grammatical elements (adpositions/cases, conjunctions, pronouns, main verbs and adverbs, negative, interrogative etc.) and terms ("subject", "object", "noun", "verb" etc.). Benedetti's chapter offers a general introduction to OL, its origin, its fundamental theses and analytical methods, and a comparison with other linguistic approaches. As an exemplification of the kinds of analyses that can be carried out within such a research program, it presents the analyses of the genitive, the preposition

"with", the verbs "to have" and "to get", and the grammatical concept "noun". Benedetti also illustrates the theses of OL about fundamental problems in the philosophy of language such as the innate or acquired origin of language and the reasons for the huge difference between human language and animal communication. Finally he mentions a possible practical application of OL, i.e., a device to improve the quality of machine translation conceived by Ceccato (described in detail in Benedetti, 2005).

Another scholar who has followed in Ceccato's footsteps is Giorgio Marchetti (1993, 1997, 2010). Marchetti (2006, 2009, 2010) has reviewed Ceccato's approach in detail by incorporating two additional levels of analyses (consciousness and unconscious/non-conscious) to the original one adopted by Ceccato (attention). Consequently, Marchetti has also adopted a larger set of elemental mental operations.

According to Marchetti, the term "meaning" identifies in general the knowledge built from the continuous interaction between the person and other entities: an interaction that is consciously experienced, specifies the relations existing between the person and other entities, and is guided by the hierarchy of principles, rules and goals of the person. By making the person experience directly how other entities relate to him, consciousness is the privileged way for the person to acquire and construct his knowledge of the world. In this sense, consciousness (and self-consciousness) can be defined as the organ of meaning. Specifically, linguistic meanings isolate, decontextualize, "freeze" and classify, in the articulated system of words and grammars, the ever-changing and multiform stream of the conscious experiences that human beings have of their relations with other entities. The meanings of words are composed of the sequence of invariable elements that, independently of any individual occurrence of a given conscious experience, are responsible for the production of any instance of that conscious experience. The elements composing the meanings of words are attentional operations: each word conveys condensed instructions of the attentional operations one has to perform if one wants to consciously experience the relations that are expressed through and by it. Words are tools to pilot attention.

In this context, Marchetti's (2006, 2010) theory - Attentional Semantics - aims to find the attentional instruction conveyed by the meanings of words. To achieve this goal, the theory: i) identifies the sequence of the elementary conscious experiences of the relations that invariably accompany, and are prompted by, the use of the word being analyzed; ii) describes these conscious experiences in terms of the attentional operations that are responsible for their production; and iii) identifies the unconscious and non-conscious operations which, directly or indirectly, serve either as the support that allows the attentional operations to take place, be completed, and occur in a certain way, or as the necessary complement that makes it possible to execute and implement the activities determined and triggered by the conscious experiences.

Hugo Mari's chapter further extends Marchetti's approach to reading experience and text comprehension. Mari highlights the fact that the words that make up a text may not be the only device employed by the reader when reading the text. Text comprehension may need attentional movements or changes during the reading process in addition to the ones implied by the comprehension of the single words: the process of reading a text requires something more than a collection of semes, of features that make up lexical items. For example, in order to understand an indirect use of lexicon, the reader must resort to his social and contextual knowledge. Therefore, a proper understanding of the processes involved in text comprehension also requires that some other operations be taken into account, such as *sign*

migration and *meaning dissemination*. Mari offers some examples of how, during text comprehension, these two operations contribute to meaning production by allowing for continuous adjustments in the potential significance of lexical items.

Remarkable similarities with Benedetti's Operational Linguistics and Marchetti's Attentional Semantics can be found in Kai-Uwe Carstensen's Cognitivist Attentional Semantics (CAS), at least as far as the role of attention in determining the meaning of words is involved, despite the fact that Carstensen, as outlined above, developed his work independently of the one performed by the Italian scholars.

In his chapter, Carstensen specifically deals with locative prepositions. He shows how other approaches to locative semantics fail to recognize important distinctions (e.g., explicit/implicit), fall prey to some misconceptions of the relation of language and space, and on the whole are descriptive at best. He argues that neither regions or vectors, nor image schemas or functions, are of primary importance for locative semantics. Rather, according to him, locative prepositions designate perspectivations of space that are determined by how we selectively attend to our preconceptual perceptual representations of space.

The core of the CAS analysis is the observation that attention serves as a selective mechanism, which operates by enhancing processing of information at some place (space-based attention) or with regard to pre-attentively processed information (object-based attention) in working memory and gating this information to sites of further processing. It is the *changes/shifts* of attentional engagement that are necessary and constitutive for explicit spatial relations. The changes may occur in different cognitive reference systems which couple/associate information from different modalities/sites. For example, allocentric and gravitational information is coded in spatial reference systems, egocentric and vision-based information in visual reference systems. Attention-based spatial relations can be described as qualitative couplings of an attentional shift with regard to (some axis of) some reference system where the attended entities may be of different ontological types. The range of possible qualitative couplings corresponds to possible micro-perspectives of a given implicit relation and is therefore defining for the types of explicit relations that may exist and be expressed in language.

The analyses performed by Benedetti (2006, 2011, this volume), Marchetti (2006, 2009, 2010, 2014) and Carstensen (2007, 2011, this volume) are particularly suited to be verified by an empirical approach centered on the notion of operation and its combinatorial power. In fact, these analyses describe in a sufficiently detailed way the operations (such as the combination or sequence of certain attentional shifts, attentional focalization, etc.) that must be performed in order to obtain certain forms of consciousness. As shown in Benedetti et al. (2010), the Fingelkurts brothers' Operational Architectonics (OA) (Fingelkurts and Fingelkurts, 2001, 2005; Fingelkurts et al., 2009, 2010, 2012, 2013) offers such an empirical approach. According to OA, simple cognitive operations that present some partial aspect of an object/scene/concept or thought are presented in the brain by local 3D-fields produced by discrete and transient neuronal assemblies, which can be recorded by an EEG (electroencephalogram). More complex operations that constitute the whole object/scene or thought are brought into existence by joint (synchronized) simple operations in the form of coupled 3D-fields – so called Operational Modules of varied complexity. OA does not put forward specific analyses in operational terms of phenomenological contents and forms. However, because of the hierarchical organization implied by its theoretical framework, OA

is very suited to verify precisely the kinds of analyses implied by the research programs of Benedetti, Marchetti and Carstensen.

In their chapter, Andrew and Alexander Fingelkurts try to conceptualize two main forms of attention, that is, bottom-up and top-down attention, within the theory of the OA of brain and mind functioning. Their aim is to provide a plausible theoretical basis for the neurophysiological understanding of how these forms of attention are brought to existence in the living brain. Their analysis shows that bottom-up attention arises as a result of self-organized formation of neuronal assemblies whose operations are divided by rapid transients that signify the breakpoints of attention ("rapid transitional processes/periods" or RTPs). The duration of these operations is determined by external stimuli and modulated by arousal as well as affective reinforcement. Top-down attention emerges due to a binding of multiple operations responsible for sensory percepts or motor programs in a context-dependent way as a function of a saliency, priori knowledge and expectancies. During this process, the ever changing and multiform stream of cognition and conscious experiences is somehow 'frozen' and 'classified', thus representing focused attention.

Todd Oakley has been developing his autonomous research on meaning construction since the beginning of this century (Marchetti, 2004; Oakley, 2004). In his chapter, Oakley offers an overview of his theory, as well an exemplification of the analyses that can be performed on its basis.

According to Oakley, attention is the *condicio sine qua non* of human meaning construction, and language is a semiotic system for directing and harmonizing the attention and intentions of others. Such a view has led him to design a model of attention - which he calls *the greater attention system* - capable of accounting for how human beings construct meanings and how language is experienced in real life. The greater attention system consists of three distinct but interdependent systems: the *signal system*, the *selection system*, and the *interpersonal system*. These three systems are comprised of eight elements of attention: *alerting* and *orienting* comprise the signal system; *detecting*, *sustaining*, and *controlling* comprise the selection system; and *sharing*, *harmonizing*, and *directing* comprise the interpersonal system. Taken together, these eight elements capture the phenomenology of human attentional engagements with the entirety of mental and conscious life.

The greater attention system offers a consistent starting point for relating language to the broader conscious mental lives of those who use it. The signal system determines the conditions by which a signal can become a communicable sign, thus the different intensities of a signal alert us to the presence of something meaningful, while certain grammatical categories provide us with the temporal, spatial, and cultural frames of reference from which all meanings take shape. The selection system determines the range of semantic domains against which particular meanings emerge and also dictates the expressive conditions by which we can focus and concentrate on a task while ignoring other competing tasks, or by providing us with the means to switch and oscillate between tasks. The interpersonal system determines the boundary conditions of interaction; we can attend to others as other beings with only minimal engagement with them (sharing), or we can direct and harmonize our attention states for extended periods of time.

As noted by Benedetti (this volume), Oakley's approach differs from Benedetti's in that Oakley generally analyzes the whole sentence or text, not the single linguistic elements (as instead OL does), because he considers the context as decisive for the construction of meaning, and as prevailing over the basic meaning of each single word.

Sandra Cavalcante and Josiane Militão elaborate on and complement Oakley's theory by showing that not only attention but also emotion are at the heart of meaning construction, and, what is more, that emotion and attention are structured by the same functional and systemic criteria.

To this aim, Cavalcante and Militão put forward a preliminary model of emotional engagement that relates systematically to the elements of Oakley's greater attention system. According to them, the basic features of emotions are: the organism-environment relevance value; the motivational force generating readiness to act; the engagement of the "whole" organism in the action; and the claiming of priority to control behavior and experience. These features may be related to the main elements comprising the greater attention system in a common framework that explain and describe the parallel and complementary role of attention and emotion in the production process: the relevance value lines up with alerting, detecting, sharing and harmonizing; the motivational force lines up with orienting; and the action control lines up with sustaining, controlling and directing. In order to illustrate this parallelism between emotional and attentional experiences, Cavalcante and Militão analyze a fragment of an interview marked by the rhetorical strategy of the fictive travel.

Another important research program specifically aimed at investigating the role played by attention in meaning selection and construction has been developed by Leonard Talmy (2007, 2008): *Linguistic Attention*. As highlighted by Martina Lampert (this volume), *Linguistic Attention* accounts for a wide range and multifaceted set of attention-based cognitive effects in language. *Linguistic Attention* is not just a replica of general attention but manifests a highly differentiated language-specific inventory of individual mechanisms that capture particular attention effects that are inbuilt in lexical items and allow, in a very systematic and principled way, to differentiate between competing forms. Facing the fundamental insight that not all aspects of the linguistic material to be conveyed in a given discourse can be uniformly and simultaneously attended to, *Linguistic Attention* is designed to account for attentional variability and diversity via a relatively closed, universally available inventory of about a hundred basic attention factors so far identified. Each attention factor involves:

> a particular linguistic mechanism that increases or decreases attention on a certain type of linguistic entity. The mechanisms employed fall into some ten categories, most with subcategories. The type of linguistic entity whose degree of salience is determined by the factors is usually the semantic referent of a constituent, but other types occur, including the phonological shape of a constituent, or the local delivery of the utterance. Each factor contrasts a linguistic circumstance in which attention is increased with a complementary circumstance in which it is decreased. A speaker can use a factor for either purposes – or in some cases for both at the same time. For some factors, increased attention on a linguistic entity is regularly accompanied by additional cognitive effects, such as distinctness, clarity, and significance, while decreased attention correlates with such converse effects as meldedness, vagueness, and ordinariness (Talmy 2007, pp. 264-265).

These mechanisms are defined and explicated to individually combine and integrate into a comprehensive and highly flexible system of attention-sensitive patterns whose linguistic manifestations provide speakers/writers with an inventory of alternatives to differentially

direct hearers'/readers' attention; and hearers/readers, largely on the basis of the speaker's/writer's selection, will accordingly allocate their attention in particular patterns over the linguistic material to differentially yet variably respond to informational and communicative demands at any given moment, functionally and flexibly adapting to their limited cognitive processing resources.

M. Lampert's (2009, 2011, 2013) work exemplifies the discriminating potential of Talmy's model of attention in language. In her chapter, she investigates the impact of attention on the meaning constitution of lexical items and their context selection by analyzing six items from different lexical categories in English: *continue*, *remain*, *stay*, *keep*, *still*, and *on*. Her analysis tackles both the internal semantic componentiality of these items and the critical division between their semantic core and increasingly less defining associated meaning sectors such as presupposition or context. As M. Lampert shows, the meaning potentials of *continue*, *remain*, *stay*, *keep*, *still*, and *on* may be conceived as manifestations of multiple cross-domain interactions whose attentional characteristics result from the interface of the substantive and operational system link-up of two systems, Attention and Force Dynamics.

Talmy's (2000) theory of attentional windowing, along with *critical discourse analysis* (CDA), are used by Ahlam Alharbi and Mona Bahmani to empirically examine the role of attention in (re)framing events and how attention is directed, shifted or diverted in discourse to (re)shape reality and encode ideologies. By analyzing 83 articles in 62 newspapers reporting the death of Neda Agha-Soltan (Nedā Āghā-Soltān), a 26-year-old Iranian woman who was killed during the Iranian election protest on June 20th 2009, Alharbi and Bahmani show that journalists manipulated readers' attention mainly through: (i) causal chain event-frame as a primary means of reporting the news; (ii) (open) path event-frame within the causal chain event-frame to describe (and window) the details of Neda's death and to report her death indirectly; (iii) the figure-ground reversal to shift and direct attention through foregrounding, on one hand, and backgrounding, on the other; (iv) the reduction of Neda's death as an 'agent (or author)-causation' to 'event-causation'.

While the majority of the scholars so far considered investigate the role of attention in meaning construction by analyzing (the use of) linguistic and symbolic units - whether they are morphemes, single lexical items, whole texts or else - whose meaning is *already formed* and conventionally established, the developmental psychologist Jean Mandler has developed an ontogenetic theory of how meanings (which she equates to concepts) *originate and form* in human beings, and how they become associated with a symbolic form: which, even though it does not directly address the role of attention in language learning itself, it does however help to explain the necessary bases for language acquisition.

J. Mandler's hypothesis is that meanings originate in attention to what is perceived. More precisely, meanings are abstractions that are initially derived from the perception of the world by means of *spatial attention*. She substantiates her hypothesis by illustrating infant concept formation in the first months of life. As she highlights, human beings are born with attentional proclivities. From birth, infants attentively follow moving objects, focusing more on their path of motion than their details; discriminate biological from inanimate motion, and prefer to look at the former; prefer some motions to others (for example, objects moving contingently with one another are preferred to objects moving randomly); pay more attention to what happens when motion ends than to what happens when motion starts. On the basis of such spatial attentional preferences, infants build their early meanings, which J. Mandler calls

"primitives" because they form the foundations of the whole conceptual system. That these early meanings are built on what infants spatially attend, is evidenced by the fact that infants use the attended events (what objects do, the path they follow, the result of their motion, etc.) rather than the objects themselves in order to make their first inferences, and that they recall motion events better than the objects taking part in them.

It is interesting to note that J. Mandler's claim about the primacy of spatial attention (over other forms of attention, such as feature or object attention) for meaning formation, seems to find an empirical explanation in the primacy of spatial attention (over other forms of attention) for the occurrence of phenomenal consciousness in general. Koivisto et al.'s (2009) experiments clearly indicate that the earliest electrophysiological correlate of phenomenal consciousness, that is, "visual awareness negativity" or VAN, is dependent on spatial attention, rather than on other forms of attention. That is, spatial attention provides the medium for phenomenal experience: "spatial attention is a prerequisite for phenomenal consciousness where the contents must be first available and represented in some spatial position in order to be selected into further reflective processes on the basis of features or feature conjunctions (objects)" (*ibid*., p. 2898). If it is spatial attention (rather than other forms of attention) that allows for the occurrence of the basic form of consciousness (on which more elaborate forms of consciousness can subsequently be built), then it seems intuitive that early, primitive meanings are principally built on such a form of attention (and consciousness) because it is the one which is first and foremost available.

Another scholar who highlights the tight link between attention, space (and more in general, perception) and meaning is Edmund Blair Bolles. Bolles observes that linguistic meaning can be understood as a way of directing the speaker and auditor's joint attention toward a topic (which he represents by means of a *linguistic triad*). Topics need not be perceivable, but utterances must always be organized as if they were referring to a concrete, sensible perception, which is predominantly structured spatially.

Bolles offers various pieces of evidence to support his hypothesis that perception is the source of the topics contemplated via attention. Most notably it is a series of distinctive traits shared exclusively by natural language and perception: case relationship, the possession of a point of view, and the scope of the focus.

Case relationship arises from the ability to shift focus from one object to another. Case relationships are perceptible and expressed by language as though they occurred in space. Language translates all non-visual relationships into spatial relationships.

Just as perception presupposes a perceiver's point of view, so language presupposes a speaker's point of view: Which again implies that both perception and language are spatially structured.

Similarly, just as perception can broaden or shrink the foreground, language too can serve as a kind of zoom lens changing the size of what is put in the foreground.

According to Bolles, since language is a tool for drawing attention to topics, its evolution must have included the emergence of a hierarchy of new powers of attention. Bolles provides a possible account of how our ability to focus attention on topics evolved. The steps of this evolutionary process include: the integration of two separate attentional systems (anterior and posterior attention systems), which allows speakers to coordinate their joint attention and use complete sentences; the evolution of a working memory, which led to the ability to speak about topics and subtopics without losing the thread of conversation; the possibility to attend to imaginary references, subjective references, substitutes, and cultural symbols.

In the final chapter, Simon Scheider and Christoph Stasch also resort to the concept of a triadic interaction to explain in general how meanings form, and in particular how humans attribute meaning to technical sensor observations. An agent (the guide) draws the attention of another agent (the follower) by focusing on something. Such a drawing of attention supplies the basic pattern of a speech act that allows for the establishment of meanings and referents of symbols. According to Scheider and Stasch, there is a close analogy between human attention and sensor observation, and such analogy makes it possible to found a semantics of sensor observations. This semantics can be described in terms of an attentional process in which a technical observer draws the attention of another observer, in a twofold triadic way, to the technical focus of its technical device as well as to some referent which is denoted by its symbol output.

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As the reader will realize by reading the contributions to this book, different theories and models have been developed thus far to investigate how attention determines the construction of meaning. These different theories and models sometimes not only originate from different cultural backgrounds and research traditions, but also imply different viewpoints, approaches and methods. We thought that it was right to take stock of these in order to offer an overview of the results achieved and the possible directions that research in this specific field can take in the future.

REFERENCES

Altmann, G., & Kamide, Y. (2007). The real-time mediation of visual attention by language and world knowledge: Linking anticipatory (and other) eye movements to linguistic processing. *Journal of Memory and Language, 57(4)*, 502-518.

Amietta P. L. and Magnani S. (1998), *Dal gesto al pensiero*. Milano: Franco Angeli.

Benedetti, G. (1999). La categoria di "spazio". In: AA. VV. *Studi in memoria di Silvio Ceccato*. Roma: Società Stampa Sportiva.

Benedetti, G. (2001). *Semantica operativa. La semantica in termini di operazioni mentali. Parte prima. Principi generali, metodologia e tecnica di analisi*. Retrievable from: www.mind-consciousness-language.com

Benedetti, G. (2005). A device in order to improve the quality of machine translation, based on the correlational theory of thought. www.mind-consciousness-language.com

Benedetti, G. (2006). Operational Noology as a new methodology for the study of thought and language: theoretical aspects and possible practical applications. *Cognitive processing, 7*, 217-243.

Benedetti, G. (2011). *An Enigma in Language. The Meaning of the Fundamental Linguistic Elements. A Possible Explanation in terms of Cognitive Functions: Operational Semantics.* New York: Nova Science Publishers.

Benedetti, G., Marchetti, G., Fingelkurts, A. A., & Fingelkurts, A. A. (2010). Mind operational semantics and brain operational architectonics: A putative correspondence. *The open neuroimaging journal, 4*, 53-69.

Carstensen, K.-U. (2001). *Sprache, Raum und Aufmerksamkeit [Language, space, and attention]*. Niemeyer Verlag.

Carstensen, K.-U. (2002). Location and distance in language: An attention-based approach. Paper presented at the 3rd Annual Language & Space Workshop 'Resolution and Granularity in Language and Space'. ZIF, Univ. Bielefeld. 8./9.7.2002.

Carstensen, K.-U. (2007). Spatio-temporal ontologies and attention. *Spatial Cognition and Computation 7(1),* 13-32.

Carstensen, K.-U. (2011). Toward cognitivist ontologies. *Cognitive Processing, 12 (4*), 379-393.

Ceccato, S. (1964). *Un tecnico tra i filosofi. Come filosofare.* Padova: Marsilio.

Ceccato, S. (1966). *Un tecnico tra i filosofi. Come non filosofare.* Padova: Marsilio.

Ceccato, S. (1968). *Cibernetica per tutti. Vol. I.* Milano: Feltrinelli.

Ceccato, S. (1969) (ed.). *Corso di linguistica operativa.* Milano: Longanesi.

Ceccato, S. (1970). *Cibernetica per tutti. Vol. II.* Milano: Feltrinelli.

Ceccato, S. (1972). *La mente vista da un cibernetico*. Torino: ERI.

Ceccato, S. (1974). *La terza cibernetica.* Milano: Feltrinelli.

Ceccato, S. (1987). *La fabbrica del bello.* Milano: Rizzoli.

Ceccato, S. (1988). *Il perfetto filosofo*. Roma-Bari:Laterza.

Ceccato, S. (1990). *Lezioni di linguistica applicata*. Milano:Clup.

Ceccato, S. and Zonta, B. (1980). *Linguaggio consapevolezza pensiero*. Milano: Feltrinelli.

Ceccato, S. and Oliva, C. (1988). *Il linguista inverosimile*. Mursia. Milano.

Diessel, H. (2006). Demonstratives, joint attention, and the emergence of grammar. *Cognitive Linguistics, 17*, 463-489.

Diessel, H. (2014). Demonstratives, frames of reference, and semantic universals of space. *Language and Linguistics Compass, 8/3*, 116-132

Estes, Z., Verges, M., Barsalou, L. W. (2008). Head Up, Foot Down. Object Words Orient Attention to the Objects' Typical Location. *Psychological Science, 2*, 93-97.

Fingelkurts, A. A., and Fingelkurts, A. A. (2001). Operational architectonics of the human brain biopotential field: towards solving the mind-brain problem. *Brain Mind, 2*, 261–296. doi:10.1023/A:101442782273

Fingelkurts, A. A., and Fingelkurts, A. A. (2005). "Mapping of the brain operational architectonics". In: F. J. Chen (Ed.), *Focus on Brain Mapping Research*. New York: Nova Science Publishers, Inc., 59–98.

Fingelkurts, A. A., Fingelkurts, A. A., and Neves, C. F. H. (2009). Phenomenological architecture of a mind and operational architectonics of the brain: the unified metastable continuum. *J. New Math. Nat. Comput. 5*, 221–244. doi:10.1142/S1793005709001258

Fingelkurts, A. A., Fingelkurts, A. A., and Neves, C. F. H. (2010). Natural world physical, brain operational, and mind phenomenal space–time. *Phys. Life Rev. 7*, 195–249. doi:10.1016/j.plrev.2010.04.001

Fingelkurts, A. A., Fingelkurts, A. A., and Neves, C. F. H. (2012). "Machine" consciousness and "artificial" thought: an operational architectonics model guided approach. *Brain Res., 1428*, 80–92. doi:10.1016/j.brainres.2010. 11.079

Fingelkurts, A. A., Fingelkurts, A. A., and Neves, C. F. H. (2013). Consciousness as a phenomenon in the operational architectonics of brain organization: criticality and self-organization considerations. *Chaos Solit. Fract. 55*, 13–31. doi: 10.1016/j.chaos.2013.02.007

Glasersfeld, E. von (1989). *Linguaggio e comunicazione nel costruttivismo radicale*. Milano: CLUP.

Glasersfeld, E. von (2007). *Key Works in Radical Constructivism.* Rotterdam: Sense Pub.

Koivisto, M., Kainulainen, P., and Revonsuo, A. (2009). The relationship between awareness and attention: evidence from ERP responses. *Neuropsychologia, 47*, 2891–2899.

Lampert, M. (2009). *Attention and Recombinance: A Cognitive-Semantic Investigation into Morphological Compositionality in English*. Frankfurt am Main: Lang.

Lampert, M. (2011). Attentional Profiles of Parenthetical Constructions: Some Thoughts on a Cognitive-Semantic Analysis of Written Language. *International Journal of Cognitive Linguisitcs, Vol. 2 (1)*, 81-106.

Lampert, M. (2013). Cognitive Semantics goes multimodal: Looking at quot(ativ)es in face-to-face-settings. *International Journal of Cognitive Linguisitcs, Vol. 4 (2).*

Logan, G. D. (1995). Linguistic and conceptual control of visual spatial attention. *Cognitive Psychology, 28*, 103-174.

Marchetti, G. (1993). *The Mechanics of the Mind.* Roma: Espansione.

Marchetti, G. (1997). *La macchina estetica. Il percorso operativo nella costruzione dell'atteggiamento estetico.* Milano: Franco Angeli.

Marchetti, G. (2004). Commentary on Todd Oakley's "A Grammar of Attention. A Treatise on the Problem of Meaning". Retrievable from: www.mind-consciousness

Marchetti, G. (2006). A presentation of Attentional Semantics. *Cognitive Processing, Vol. 7, No. 3*, 163-194

Marchetti, G. (2009). Studies on time: a proposal on how to get out of circularity. *Cognitive Processing, Vol. 10, No. 1*, 7-40

Marchetti, G. (2010). *Consciousness, Attention and Meaning*. Hauppauge, NY: Nova Science Publishers.

Marchetti, G. (2014). Attention and working memory: two basic mechanisms for constructing temporal experiences. *Frontiers in Psychology, Vol. 5, Nr 880*, 1-15.

Myachykov, A., Garrod, S. Scheepers, C. (2009). Attention and syntax in sentence production: A critical review. *Discourse, 4*. Retrievable from: http://discours.revues.org/index5842.html

Oakley, T. (2004). *Elements of Attention: A new Approach to meaning Construction in the Human Sciences.* Retrievable from: www.mind-consciousness-language.com

Oakley, T. (2009). *From attention to meaning: Explorations is semiotics, linguistics, and rhetoric*. European Semiotics Series, Volume 8. Bern: Peter Lang Verlag.

Parini, P. (1996). *I percorsi dello sguardo.* Jesi: Artemisia.

Salverda, A. P., & Altmann, G. (2011). Attentional capture of objects referred to by spoken language. *Journal of Experimental Psychology: Human Perception and Performance, 37(4)*, 1122.

Scheider, S. and Kuhn, W. (2011). Finite relativist geometry grounded in perceptual operations. *Spatial information theory: 10th international conference, COSIT 2011, LNCS 6899*, 304–327.

Schmidt, R. (2010). "Attention, awareness, and individual differences in language learning." In: W. M. Chan, S. Chi, K. N. Cin, J. Istanto, M. Nagami, J. W. Sew, T. Suthiwan, & I. Walker (Eds.), *Proceedings of CLaSIC 2010, Singapore, December 2-4*. Singapore: National University of Singapore, Centre for Language Studies. 721-737.

Smith, L. B., Colunga, E., & Yoshida, H. (2010). Knowledge as process: contextually cued attention and early word learning. *Cognitive science, 34 (7)*, 1287-1314.

Talmy, L. (2000). *Toward a cognitive semantics Volume I: Concept structuring system*. Cambridge, MA: MIT Press

Talmy, L. (2007). "Attention Phenomena." In: D. Geeraerts and H. Cuyckens (Eds.), *Oxford Handbook of Cognitive Linguistics*. New York: Oxford University Press, 264-293.

Talmy, L. (2008). "Aspects of attention in language." In: P. Robinson and E. C. Nick (Eds.), *Handbook of Cognitive Linguistics and Second Language Acquisition*. New York & London: Routledge, 27-38.

Taube-Schiff, M. & Segalowitz, N. (2005). Linguistic Attention Control: Attention Shifting Governed by Grammaticized Elements of Language. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31*, 508-519.

Tausczik, Y. R., & Pennebaker, J. W. (2010). The psychological meaning of words: LIWC and computerized text analysis methods. *Journal of language and social psychology, 29(1)*, 24-54.

Tomlin, R. S. (1997). "Mapping Conceptual Representations into Linguistic Representations: The Role of Attention in Grammar." In: J. Nuytsand and E. Pederson (Eds.), *Language and Conceptualizations*. Cambridge: Cambridge University Press, 162-189.

Vaccarino, G. (1974). *La mente vista in operazioni*. Messina-Firenze: G. d'Anna.

Vaccarino, G. (1981). *Analisi dei significati*. Roma: Armando Armando.

Vaccarino, G. (1988). *Scienza e semantica costruttivista.* Milano: CLUP.

Valéry, P. (1973). *Cahiers*. Ed. by J. Robinson-Valéry. Paris: Gallimard.

Vygotskij, L.S. (1935). *Problemy psichičeskogo razvitija rebënka*. (Italian translation, 1984: *Lo sviluppo psichico del bambino*. Roma: Editori Riuniti).

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Chapter 1

OPERATIONAL LINGUISTICS: A BRIEF INTRODUCTION

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ABSTRACT

This chapter is an extremely brief introduction to a new theory in the philosophy of language, called Operational Linguistics (OL). OL deals mainly with the semantics of grammatical elements (adpositions/cases, conjunctions, pronouns, main verbs and adverbs, negative, interrogative etc) and terms ("subject", "object", "noun", "verb" etc), and is based on the fundamental presupposition that their meaning is mainly given by *operations* within cognitive functions, amongst which those of attention play a key role. Therefore, the meaning of grammatical elements and terms is defined in *extra*linguistic terms, i.e., based on something *other* than language. The theory is unitary, in that it accounts for all the grammatical elements and terms on the basis of the same (few) theoretical presuppositions.

1. INTRODUCTION

Semantics is a fundamental aspect in the study of language, and a fundamental part of semantics is surely that of grammatical elements, since they are essential for *the very existence* of language.

This chapter deals mainly with the semantics of these elements. It must be stressed that this subject is dealt with here *with a reference to language, not single languages*. I assume that the fundamental grammatical elements in the various languages indicate abstract grammatical meanings (such as the genitive, negative, interrogative, for example) that are common to all or almost all languages (in our opinion, the existence of shared meanings is demonstrated by the fact that translation from any language into any other language is almost

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always substantially possible). In this chapter, when referring to a particular grammatical meaning (for example, the genitive), *I do not intend to refer to the meaning of a particular linguistic element in a language* (for example, the morphological marks of the Latin, Greek, Russian etc genitive, or the English preposition "of", or the French preposition "de"), *but to an abstract meaning*, which is probably present in all languages. Therefore, the problem of the meaning of grammatical elements is dealt with here from the standpoint of the philosophy of language.

Obviously, the problem of the meaning of grammatical elements has been tackled by both traditional and modern linguistics. What can be said about the results that have been achieved? In some cases, such as certain prepositions that are strictly related to space, the definitions seem, or may seem, rather satisfactory (see, for example: Cooper, 1968; Bennett, 1975; Herskovits, 1981, 1986; Jackendoff, 1983, 1990; Lakoff, 1987; Di Tomaso, 1996; Tyler, Evans, 2003)[1]. But in many other cases, such as the genitive, negative, verbs such as "to have" and "to be", etc. things seem to be very different. Actually, the results achieved by traditional linguistics in attempting to account for these meanings seem to be unsatisfactory. These results are essentially of the two following kinds.

1) The attempt to account for a meaning leads to tautological or circular definitions: for example, "not" is defined as "negative", "all" is defined as "totality". Clearly, definitions of this kind are totally unsatisfactory.
2) The linguistic element being considered is said to have different meanings according to the context, and the supposed meanings can be many. An emblematic example is the genitive, which would indicate various kinds of possession and association, the relationship indicated by the noun being modified, belonging to a group, composition, containing, participation in an action (as an agent or as a patient), origin, cause, purpose, etc. Other typical examples are verbs such as "to have", "to get" and "to make", which are commonly defined by means of synonyms for each supposed meaning (e.g., *to have*: to possess, to own, to keep, to get, to obtain, etc).

Such are essentially the results of traditional linguistics, which can be found in dictionaries and grammar books. Modern linguistics, as we will see, does not seem to have led to a radical change.

This chapter introduces a new theory that provides a unitary solution to the problem of the meaning of the fundamental grammatical elements. I have called this theory *Operational Linguistics* (OL) (in my former works, I used the name *Operational Semantics*, which now I consider too restrictive; furthermore, there was a problem of homonymy with a concept in computer science, which has nothing to do with OL).

OL is based on a conception of the human mind that can be considered a moderate form of constructivism. Indeed, unlike idealistic philosophy and radical forms of constructivism (e.g., Glasersfeld's constructivism [Glasersfeld, 1989, 1998]), in this conception the existence of a reality independent from the mind is explicitly acknowledged, but the mind is conceived as having a strong *active* or *constructive* character (unlike the more *passive* conception of the mind as a "reflection" of reality, a conception that is rather widespread in the philosophic

[1] Yet see the in-depth critical revision of this literature by Carstensen (this volume, and 1995, 2002, 2007), who stresses the problems of traditional approaches to the semantics of locative expressions.

tradition). According to OL, language -which is a fundamental and distinctive feature of the human mind - is not a mere "labeling" of objects and their reciprocal relationships, but also has a *constructive* character. In order to account for grammatical meanings, it is therefore necessary to not only consider the *objective* situation, but also (or, in some cases, above all) what *the subject actively does* with his/her mind. According to OL in fact, these meanings are mainly made up of *sequences of mental operations, amongst which those of attention play a key role*. Therefore, this theory accounts for grammatical meanings in *extra*linguistic terms, i.e., based on something that is *outside* language, i.e., *operations* (the name "Operational Linguistics" derives from this) within *cognitive functions*.

Not only does OL deal with the meaning of grammatical elements, it is *a general theory of language and linguistic thought* that, as we will see, also offers solutions to other general problems in the philosophy of language (such as the reasons for the difference between human language and animal communication, if language has an innate or acquired origin etc).

The exposition of this theory (which accounts for the meaning of *all* the fundamental grammatical elements) requires the space of a book. Therefore, in this chapter I have concentrated on very few meanings only, in order to give a quick idea of the theory and its novelty and difference from existing theories. Interested readers can find a broader exposition in Benedetti (2009, 2010, 2011).

In this chapter, because of lack of space, the comparison between OL and other theories has been kept to the minimum. An extensive and in-depth comparison can be found in Marchetti (2010b).

After these general considerations, we can start to expound the theory. I think that the best way to go about this is not to first expound its principles and then provide concrete examples of their application, but to use a concrete example as the starting point.

2. THE MOST EMBLEMATIC CASE OF A SUPPOSED EXTENSIVE POLYSEMY: THE GENITIVE

The most emblematic case of a supposed extensive polysemy is surely the genitive - which can be expressed by means of a case mark, an adposition ("of", in English), word order (genitive-noun order, in English: e.g., "safety belt"), etc. Grammar books and dictionaries contain long lists of the kind showed in Table 1.

Whether explicitly stated or not, these would be the meanings of the genitive. This solution has probably often been considered unsatisfactory, since in the history of linguistics there have been various attempts to account for the meaning of the genitive (in one language or in general) in a monosemic, or at least, in a less polysemic, way. These proposals cannot be examined in depth here. Therefore, I will only mention them, also because they have no analogy with OL's proposal, as we will see. The Byzantine grammarian Maxime Planude (13th-14th century) was the first to develop a so-called "localistic" theory of (Greek) cases, i.e., a theory (also) based on "spatial" concepts, such as "movement to" and "movement from" (the term "spatial" is used in its most abstract sense, because it can refer to both real spatial relationships and grammatical relationships, such as the fact that the genitive is said to indicate the origin of the action in relation to the verb) (Agud, 1980; Hjelmslev, 1935). The so-called "Modists" or "speculative" scholastic grammarians (12th-14th century) founded

grammar epistemologically on an Aristotelian basis, as a discipline that was abstract and valid for all languages, and described cases in semantic terms only (that is, without using the concept of grammatical relationship): Peter Helia, Simon of Dacia and Martin of Dacia accounted for the Latin cases by using the concepts of "substance" and "action" and the localistic concepts of "origin" (*principium*) and "end" (*terminus*) (Agud, 1980; Serbat, 1981; Blake, 1994; Marmo, 2004).

Table 1.

– *possession, various kinds of*	John's eyes, John's car, the diameter of the sphere
– *association, various kinds of*	the scent of roses, Raphael's paintings, 1929 recession
– *relationship indicated by the noun being modified*	Bob's wife
– *belonging to a group*	three of us
– *composition*	marble statue, group of men
– *containing*	a glass of water
– *participation in an action, as an agent or as a patient*	John's arrival, the discovery of America
– *origin*	men of Rome
– *cause*	to die of tuberculosis
– *purpose*	safety belt
– *quantity*	a height of 100 m
– *quality*	man of honor
– *denomination*	the city of Rome
– *plenty or lack*	full/devoid of malice
– *topic*	grammar book
– *in respect to*	slow of speech
– *fault, accusation and the like*	guilty of murder
– *age*	a child of four years

In the rationalistic and universalistic approach that predominated in the 17th and 18th centuries, Sanctius and Scioppius defined cases syntactically, i.e., on the basis of the dependence relationships of nouns with the verb, noun, and preposition (the genitive was defined as the case that depends on an expressed or understood substantive) (Serbat, 1981); Port-Royal grammatical theory (Arnauld, Lancelot, 1660) also considered cases (which it stated to be universal, even if each language expresses them in a specific formal way) as related to syntax, even if it often defined them semantically in a rather traditional way. Structuralism accounted for cases in terms of relationships of opposition to each other: within this approach, Hjelmslev (1935, 1937) defined cases (which he considered abstract and general universal entities, which are expressed in various ways in the various languages) on a semantic basis, by modifying the localistic theory by Maxime Planude; Jakobson (1936) defined the Russian cases by using a combination of semantic features; de Groot (1939, 1956) and Kuryłowicz (1949, 1964) defined the Latin and Indo-European cases respectively, both in semantic and syntactic terms; Rubio (1966) defined the Latin cases by using a distinction between the semantic and functional character of the noun (the genitive is said to be

semantically a noun, but functionally an adjective); Benveniste accounted for the meaning of the Latin genitive in terms of a syntactic transposition of a verb phrase into a noun phrase. Fillmore (1968) introduced the concept of "deep case", which is a syntactic-semantic relationship of the noun phrase with the verb, which is expressed at the surface level in various ways (morphological cases, adpositions and other ways) in the various languages. The "abstract cases" by Chomsky (1981) are instead pure syntactic relationships, which any noun phrase is provided with. Anderson (1977, 2006) described cases (which he considered in a universalistic way, like Hjelmslev) semantically on a cognitive basis (by resorting to a combination of spatial concepts). Another attempt with a semantic basis was made by Perret (1965, p. 477), according to whom the genitive is the case of lax determination (as opposed to the accusative, which would be the case of strict determination).

As a general consideration, none of the aforesaid theories has been so successful as to widely substitute the traditional idea that the genitive is very polysemous. Therefore, this solution continues to be substantially accepted in almost all the works where the problem of the meaning of the genitive is somehow involved (see, for example, Shumaker, 1975; Durieux, 1990; Rosenbach, 2002; Vikner, P. A. Jensen, 2002; Kreyer, 2003, amongst the various quotable works).

Is it credible that the genitive has all these meanings, i.e., is the solution to the problem of the meaning of the genitive such an extensive polysemy? In order to give an answer to this question, a number of things should be considered.

1) In English, the preposition that expresses the genitive, i.e., "of", is the fourth most-used lexeme (Oxford English Dictionary). Moreover, the genitive is also expressed by means of the possessive case or word order.
2) The only well-ascertained polysemy is when a word has one meaning plus very few other meanings, namely the figurative, extended etc. ones, that derive from the first meaning for easily understandable reasons (e.g., the term "nose" means a part of the face, but also snout, muzzle, shrewdness, the opening of a tube etc, a spy). In the case of the genitive, its (supposed) polysemy is very different: there is not a main meaning plus some other meanings that derive from the first for easily understandable reasons, but there would be *many different meanings that have nothing to do with each other*.
3) The supposed meanings of the genitive are *extremely heterogeneous*. Why should relationships that are so different from each other be expressed by the same linguistic element? Homonymy definitely does not come into play here.
4) The relationships are so many that one could say that *no relationship seems to be excluded*. In fact, this seems exactly the case. What relationship does not fall into any of these categories?
5) The supposed meanings of the genitive are substantially the same in many languages. This is a very strong argument against the thesis that the genitive is polysemous. Indeed, in commonly-found polysemy, the polysemy of a given word is generally not the same across the various languages. For example, in English, as mentioned, the word "nose" can also mean a spy, but this does not happen in Italian. If the answer to the problem of the meaning of the genitive were really the polysemy that is supposed, *why should this* (moreover, such extensive) *polysemy be substantially the same for many languages*?

In brief, the situation is the following. An extremely important element of language is supposed to have a huge amount of meanings, which would be unrelated to and completely different from each other (unlike the kind of polysemy that is commonly found). The polysemy is extremely extensive (no relationship seems to be excluded) and substantially the same in many languages (while in commonly-found polysemy, the polysemy of a given word is generally different across the various languages).

Well, bearing these considerations in mind, can the right solution to the problem of the meaning of the genitive really lie in this huge polysemy? My answer is no, by no means. The traditionally proposed solution implies a situation that is really too paradoxical.

Let us examine the (completely different) solution suggested by OL to the problem of the meaning of the genitive. According to OL, *the solution to this problem should not be searched for at the level of the particular relationships between the things that are related by the genitive*, i.e., the relationships in Table 1. These are not the meanings of the genitive. *These are the cases where the genitive can be used*, which is a very different thing. The genitive can be used in all cases where there is a relationship between two things. Therefore, the relationships between things related by the genitive are *all the possible relationships* (hence, this seeming huge polysemy). Yet *the function of the genitive is not to designate all these relationships*. Designating such a big variety of relationships by means of the same linguistic element makes no sense. *The function of the genitive* (*i.e., its meaning*) *is to induce the listener's attention to focus on something,* A, *by means of the relationship that* A *has with something else,* B, *and to bear in mind the existence of this relationship*. In other words, *the genitive indicates the attentional focalization of something,* A, *while bearing in mind that* A *has been previously focused on together with something else,* B.

Examine the examples in Table 1. One can probably sense that the meaning of the genitive is all in this focusing the attention on something while keeping present that this something has some relationship with something else. For example, the phrase "John's car" does not simply and specifically express the relationship of possession. If we want to do this, we say "John *has* a car". If we say "John's car", we want the addressee to focus his/her attention on a certain car (while keeping present the fact that the car is possessed by John), in order to say something about this car (for example, that it "is red"). The same can be said of the phrases "marble statue", "glass of water", "Bob's wife", etc. With the genitive we are *not* simply and specifically designating the relationship of composition, containing, the conjugal relationship, etc, respectively. These things are indicated *by the expression as a whole or the context*, not by the genitive. The best proof of this is that an expression such as "my friend's picture", if it is isolated, is *ambiguous* as regards these relationships, because it can indicate a picture *possessed by*, or *painted by*, or *that shows*, a friend of the speaker (moreover, one should note that, in particular contexts, this expression may indicate other kinds of relationships too: for example, amongst pictures that are chosen, indicated, sold, restored etc by different persons, the expression "my friend's picture" may indicate these relationships). But *it is not at all ambiguous* that we want to talk about a "picture", while bearing in mind that it is in some way associated with "my friend", that is, *we want to talk about something, while bearing in mind that that something is in some way associated with something else*. This is the meaning of the genitive. Only and simply this. Therefore, a phrase such as "my friend's picture" does not mean "the picture possessed by my friend" or "the picture painted by my friend" or "the picture that shows my friend". It means "the picture *that has some*

relationship (relationship *that is known on the basis of the general knowledge or the context*) with my friend". The same can be said of all the phrases with the genitive.

The reason for the existence of the genitive is its huge practical usefulness. Indeed, indicating something, *A*, while bearing in mind the relationship that *A* has with something else, *B*, is used for at least two very important purposes: a) identifying A amongst the various possible items of the same class ("John's car"); b) speaking about *A* together with something else we are interested in, such as a quality of it ("marble statue"), its function ("safety belt"), cause ("to die of tuberculosis"), agent or patient, if *A* is an activity ("John's arrival", "the discovery of America"), etc.

As we can see, OL changes the traditional approach radically, since OL investigates the meaning of the genitive at a *completely different* level from the other approaches. The other approaches:

(a) have sought to account for this meaning by providing a list of the possible relationships between things that are related by the genitive, or looking for something so general as to include all these relationships; or else,
(b) have considered the genitive a mere syntactic relationship.

In other words, the meaning has been searched for, so to say, "in the things", i.e., in the *objective* situations where the genitive is used. OL uses a completely different approach: it mainly investigates the meaning of the genitive at the level of the mental operations performed by the speaker, i.e., the *subject*.

As a result, the hardly believable wide polysemy of the genitive has been reduced to absolute monosemy, in agreement with the fact that the linguistic element that expresses the genitive is unique (of course, the fact that some languages can express the basic meaning of the genitive in more than one way, as happens in English—possessive case, preposition "of", word order—does not matter: here we are not interested in the possible secondary differences of these forms, but in their common basic meaning).

3. OPERATIONAL LINGUISTICS IN BRIEF

I have introduced my analysis of the genitive before outlining its underlying theory. At this point however, the most general outlines of the theory should be presented.

3.1. The Origins of OL

OL derives from Silvio Ceccato's (1914-1997) thought, of which it preserves several theses. Nevertheless, OL is a broad and innovative development of Ceccato's thought and noticeably different from it in part.

Ceccato's thought started developing in the 1950s and reached its full maturity in the 60s and 70s (Ceccato, 1964, 1966, 1968, 1969, 1970, 1972, 1974; Ceccato, Zonta, 1980). Ceccato used various names for his theory. The name *Operational Methodology* (OM) is the one that has prevailed in his School, the *Scuola Operativa Italiana* (*SOI*) [Italian Operational School].

Ceccato was well-known in Italian philosophical circles since the 40s and directed important projects involving the application of his theories, namely: a) one of the very few machine translation projects in Europe and the only one in Italy in the first phase of research in this field (funded by the U.S. Air Force, 1959-66; described in Ceccato, 1969); b) the so-called 'mechanical reporter' project, i.e., a machine that had to be able to observe and describe a scene made up of seven objects arranged in various ways on a stage (Italian National Research Council, 1958-66; described in Ceccato, 1969). Nevertheless, his thought has not received much attention. This can be due to various reasons, which cannot be examined here. Yet I believe that the work of Ceccato and his School (Glasersfeld, 1989, 1998; Parini 1996; Vaccarino, 1988, 1997, 2000; Amietta, Magnani, 1998), while requiring an in-depth critical revision, includes many original and valuable ideas and intuitions, which deserve to be taken into consideration again and developed. This is precisely where I have focused my work ever since the second half of the 90s (Benedetti, 1999, 2004, 2005a, 2005b, 2005c, 2005d, 2006, 2008, 2009, 2010, 2011). In the early 90s, another researcher from the *SOI*, Giorgio Marchetti, began a remarkable critical revision and development of Ceccato's thought (Marchetti, 1993, 1997, 2001, 2003, 2005a, 2006, 2009, 2010a, 2010b). Since 2003, there has been a tight collaboration between Marchetti and myself.

In this chapter, there is the problem of distinguishing Ceccato's original theses from those of the author. Therefore, in the text I will indicate which are Ceccato's main original theses and which are the author's. When this is not provided, the thought exposed is the author's own, with influences from Ceccato. The above exposed analysis of the genitive is entirely the author's own, as well as the way of exposing the subject, which differs entirely from Ceccato's.

3.2. The Fundamental Theses of OL

As mentioned, the fundamental thesis of OL is that *grammatical elements designate sequences of mental operations amongst which the ones of attention play a key role* (this thesis is Ceccato's own). Therefore, we may say that *grammatical elements are "tools to pilot attention"* (Marchetti, 2003, 2006) *and other cognitive functions* of the listener.

Ceccato called these sequences of mental operations "mental categories", because they have some analogies with the categories of Kant's philosophy. OL has adopted this name as well[2]. We call the mental operations that make up the mental categories *elemental mental operations* (EOMC). Therefore, defining the meaning of a linguistic element that designates a mental category means, according to OL, identifying the structure of that mental category, i.e., the sequence of elemental mental operations that make it up. We call this task "analysis of a mental category". The system of EOMC I propose, which is very different and much more complex than Ceccato's, is the following:

[2] We must point out that the meaning OL gives to the term "category" is *completely different* from the meaning that cognitive psychology and linguistics give to the same term. Typically, cognitive psychology and linguistics use the term "category" to highlight the fact that, since many objects of the physical world share common features, but are not identical, we create *classes* (that is, *categories*) by means of a mental process of abstraction (Barsalou, 1999; Lakoff, 1987; Rosch, 1973, 1978). On the contrary, OL uses the expression "mental categories" to indicate the meanings of the linguistic elements that do not designate physical (or psychical) things.

1) *Operation of attentional focalization* (*AF*) – This operation has the fundamental property of "selecting", or "highlighting" its object with respect to all the rest (James, 1890). Inside AF we can distinguish various sub-operations.
   a) AF can widely *vary in extension* (*AFext*): it may concern an object, or a part of it, or several objects.
   b) The focus of attention can *move* (*AFmov*) from one object to another, or from a part of the field to which it is applied to another.
   c) AF can *last for variable*, though limited, *amounts of time* (*AFdur* [dur = duration]).
   d) The extension, movement and duration of attentional focalization can be estimated in quantitative terms (*AFext-estim*, *AFmov-estim* and *AFdur-estim*, respectively).
   e) AF can vary in intensity (*AFint-var*), that is, we can pay more attention to one object instead of another.
2) *Presence keeping* (*PK*) – This is the term I will use for the fundamental operation of "bearing in mind" something that has been focused on by attention, *A*, while the attention focuses on something else, *B*. If, for example, we hear the expression "bottle *and* glass", we keep the meaning "bottle" present when we add the meaning "glass", which we would not do if these two words were isolated, i.e., not related by the conjunction "and". The operation of presence keeping is surely strictly related to the well-known concept, developed by cognitive psychology, of "working (or active) memory", whether in the classic Baddeley-Hitch model (Baddeley, Hitch, 1974; Baddeley, 2000) or in more recent models, such as Cowan's or Oberauer's (Cowan, 2001, 2005; Oberauer, Süß, Schulze, Wilhelm, Wittmann, 2000; Oberauer, 2002), which highlight the tight interaction between working memory and attention. Some models of attention even explicitly include working memory as an essential part of attentional processing (Knudsen, 2007).
3) *Operation of attentional discarding* (*AD*) – If we say "glass *or* bottle", we can sense that both objects are focused on by attention and kept present, but when our attention focuses on the bottle, we must *exclude*, *discard* the glass. This operation is completely different from simply stopping to focus our attention on an object in order to pass on and focus on another object. In our case, we must bear an object in mind while somehow excluding it. I call this operation "attentional discarding".
4) *Operation of representation* (*R*) – The operation of representation is the act of thinking about something that is not present at the moment. This is what we do when, for example, hearing a word, we pass on to its meaning, which was previously memorized. Obviously, attention is also involved in the operation of representation (which is proven by the fact that when we imagine something it is difficult to pay attention to something else), but in representation the attention focuses on what this operation produces (that is, attention is not alone, but accompanies the other operation).
5) *Operation of comparison* (*C*) – Our mind performs comparisons very frequently. Every time we use typically relative words, which concern properties of an object (like "high/low", "strong/weak", "heavy/light" etc) or express a judgement (like "good/bad", "normal/abnormal" etc), we make comparisons. Obviously, when we perform this operation, we focus our attention on the objects compared and we bear

them in mind. Even though comparison implies operations of attentional focalization and presence keeping, I believe that it has to be considered a separate function.

6) *Operations of memory* (*MO*) – Memory surely plays a key role in our mental life: by means of it, we fix and recall both brief and long-term memories continuously. Apart from all of this, I think that memory operations are part of the structure of some mental categories (Benedetti, 2005b, 2006). Therefore, I list memory operations amongst the basic mental operations that make up mental categories.

Almost all of the operations that I consider EOMC have been repeatedly described in cognitive psychology[3]. *The new idea we are putting forward is that by means of these operations we can account for* the meaning of grammatical elements.

The reader could ask what this list is based on, i.e., why I propose this particular list and not a different one. I rejected the (restricted) "official" system of analyses by Ceccato (which was based on two attentional states only and memory) for many reasons, which cannot be illustrated here but which are addressed in-depth in Benedetti (2004) (however, Ceccato himself questioned this system in his last work (Ceccato, 1996)). I considered the operations that are most commonly described in cognitive psychology as regards attention, memory, representation etc, and I tried to understand which operations make up grammatical meanings by using techniques of slowing down mental operations (such as the use of touch instead of sight), and other techniques. A history of these attempts and a discussion about the methods I have used is absolutely beyond the scope of a brief writing like this, but they can be found in Benedetti (2006, 2008). Here, I can only say that I proceeded substantially by trial and error. I believe that there was no other choice: I think there is no way to know beforehand which operations are involved. Finally, I accounted for the fundamental grammatical meanings by using the set of elemental operations that I am now proposing. I am the first to say this is only an initial attempt and that something better could be proposed (see also the conclusion of the chapter). Some experimental evidence showing that the operations I have proposed are actually involved is highly desirable of course: as regards this, see further on.

4. Another Case of Supposed Extensive Polysemy: Preposition "With"/Verbs "To Have" and "To Get"

The preposition "with" and the verbs "to have" and "to get" (these three meanings are based on the same core of operations, as we will soon see) are other examples of words that are traditionally believed to be polysemous. Indeed, grammar books and dictionaries state that the preposition "with" "indicates several relationships" (or similar expressions), and provide lists that are similar to that in Table 2.

[3] As regards attention, see for example James (1890), Jonides (1983), La Berge (1983, 1995), Pashler (1998), Posner (1980, 1994), Posner, Cohen (1984); as to representation, see Braga-Illa (1997, 2006), Denis (1989); as to memory, see Baddeley (2000), Baddeley and Hitch (1974), Cowan (2001, 2005), G. A. Miller (1956), Oberauer (2002), Oberauer et al. (2000); in general, see Benjafield (1997), S. K. Reed (1992).

Table 2.

–	*company or union*	John with his wife, cup with handle
–	*means or instrument*	to write with a pen
–	*manner*	with ease
–	*cause*	to shiver with fear
–	*quality*	man with a moustache
–	*time*	swallows migrate with the cold season
–	*opposition*	to fight with the enemy
–	*in comparisons*	to compare your work with mine
–	*relationship*	business dealings with Japan
–	*concessive meaning*	with all his faults, I like him
–	*etc.*	

Things are not very different in modern linguistics. Prepositions are generally said to be polysemous (see, for example: Rizzi, 1988; Zelinsky-Wibbelt, 1993; Di Tomaso, 1996; Yule, 1996; Graffi, Scalise, 2002; Saint-Dizier, 2006; in Tobin, 2008) and, whether explicitly stated or not, these would be the meanings of the preposition "with". Once again, we should ask ourselves: can such a frequently used and essential word have so many different meanings? Is not it much more convincing to think that this word has *only one, more general meaning* (which is why it is so difficult to determine) and as such lends itself to express the many relationships grammar speaks about?

In this case too, as in that of the genitive, this meaning is so general because, in our opinion, it does not lie at the level of the aforesaid more particular relationships grammar speaks about, but at a much more abstract level, i.e., the level of operations within cognitive functions that the described situation induces or allows to be performed. According to OL, the preposition "with" means that we focus our attention (AF) on something, *A*, then, keeping it present (PK), our attention is also extended (AFext) to something else, *B*, because *B* is related to *A* in such a way that our attention tends to include *A* and *B* in a single focalization[4] (for example, we say "bottle with cork" if the cork is in the neck of the bottle; we cannot use this expression if the cork is far from the bottle).

This analysis clearly explains why in many languages this preposition is used to express two very different relationships i.e., the relationship of company or union between two things and the relationship of means or instrument between an activity and an object. Indeed, whether we say, for example, "cup with handle" or "to write with a pen", what appears to our attention are two things that are related in such a way that our attention, when focused on *A*, tends to include *B* in the same focalization as well. In fact, the handle is joined to the cup and therefore as long as we look at the cup we also see the handle; and as long as we watch the action of writing we see the pen.

The analysis also clearly explains why the preposition "with" can be used in cases where the other aforesaid relationships (manner, cause, quality, time, opposition etc) are involved. In all the above-quoted examples the attention, while focusing on something, is also extended to something else (from an activity to the way this activity is performed, from an event to

[4] This analysis is my (substantial, from a certain point of view) modification of the original analysis by Ceccato ("two things are focused together by attention and then they are divided by it").

another one that happens at the same time, from the act of opposing someone/something to that someone/something etc.).

Therefore, the preposition *does not designate the many relationships* that are listed in grammar books and dictionaries, that is, these relationships are not *its meanings* (which would be too many). The preposition designates a *much more general* relationship, i.e., *A* is in such a relationship with *B* that attention, when focused on *A*, is also led to "embrace" *B*. This very general relationship can include various more specific relationships (company or union, means or instrument, manner, simultaneousness, cause, etc), which depend on the two related things, but the meaning of the preposition is only the first relationship, *not the second ones*. Therefore, *there is only one meaning for the preposition*, in agreement with the fact that there is only one corresponding word.

Therefore, in this case too, as in that of the genitive, a *simple presupposition* ("grammatical elements designate sequences of mental operations, amongst which the ones of attention play a key role") allows us to reduce a supposed (but hardly believable) *wide polysemy* to an *absolute monosemy*, *in perfect agreement with data* (there is a *unique* word, i.e., "with", not various words), and *in a simple way* (the structure that has been proposed for the preposition is very simple).

Remark — A consideration should be made here about the extreme simplicity of the structures of cognitive operations that I propose as the meanings of the fundamental grammatical elements. In linguistics and the philosophy of language the fundamental grammatical elements are sometimes considered to have a complex meaning and to need a complex theory to be accounted for. I would like to stress that children begin to understand and use these elements as early as the age of 2-3 years. Therefore, I believe that the meaning of these elements cannot be something very complicated, rather, it must be something simple. Surely, the elements that make up this meaning cannot be something obvious and easy to be identified (otherwise, it would have been simple to do this). However, once this is done, the structures at stake *must* be simple, because even children this young learn to build them by simply listening to adults, without obviously having any possibility of "reading" the adults' mind, but, at best, with the only help of the gestures that adults sometimes use to facilitate the learning of language by children (these structures can be supposed to be something complex if they are supposed to be not learnt, but innate: nevertheless, I have always rejected this hypothesis for various reasons (Benedetti, 2004), the main of which is that it involves the big problem of explaining how children can understand which of the supposed innate structures corresponds to the word that designates it in their future mother tongue).

Similarly to the preposition "with", the two verbs "to have" and "to get" are traditionally believed to be highly polysemous. In fact, dictionaries usually try to capture their meanings by defining each verb with a long list of other verbs (Table 3).

However, one can easily note that these lists are nothing else but collections of more "specialized" verbs, whose meanings are included in the more general meanings of "to have" and "to get". In fact, the verbs "to have" and "to get" can always substitute all the verbs that make up the respective collection, while each of the latter can substitute "to have" or "to get" in some cases only.

Table 3.

–	***to have*** *= to possess, to own*	John has a new car
–	» » *= to keep*	he has a knife in his pocket
–	» » *= to get, to obtain*	May I have some tea, please?
–	» » *= to receive*	he had a letter from the bank this morning
–	» » *= to dispose of*	the rebels have anti-tank missiles
–	» » *= to spend*	we had a week by the seaside in June
–	» » *= to suffer*	he had a serious loss
–	» » *= to give birth to*	she's having a baby in the autumn
–	***to get*** *= to obtain*	she got a degree in economics
–	» » *= to purchase*	he used to get "The Times"
–	» » *= to catch*	the dog got the ball in his mouth
–	» » *= to receive*	he got a bicycle for his birthday
–	» » *= to understand*	he didn't get the joke
–	» » *= to become*	you'll get wet without an umbrella
–	» » *= to arrive*	how long does it take to get to Liverpool?

The meanings of "to have" and "to get" are so general because both these verbs designate the same relationship as the one designated by the preposition "with", i.e., that two distinct things, *A* and *B*, are related in such a way that our attention, when focusing on *A*, tends to include *B* in the same focalization as well. The difference with the preposition "with" is that, in the case of these two verbs, as in all verbs, we see the situation from the temporal point of view, which entails focusing our attention continuously or repeatedly on the *same* situation (according to OL, a meaning of a verbal kind is something that requires a prolonged or repeated attentional focalization to be acknowledged, also see further on). In the case of the verb "to have", the result is something static. For example, "that man has a moustache" means that when we focus our attention on his face we also see a moustache and this remains constant throughout time. On the contrary, in the case of the verb "to get", the result is something dynamic. For example, "to get the pen" means that our hand enters into such a relationship with the pen that, if we look at the hand, we also see the pen (the pen is *in* the hand), while this relationship did not exist before. This analysis can be verified with the other examples in Table 3. In all these cases two distinct things, *A* and *B*, are or become, respectively, related in such a way that our attention, when focusing on *A*, tends to include *B* in the same focalization as well. The reader can verify if this also happens for the other examples cited in dictionaries.

Remark: Before going further on, I would like to make a general consideration about the meaning of the preposition "with" and the verb "to have". In some cases, the relationship between two things that is designated by an adposition seems to be very specific (think of certain adpositions that are strictly related to space, such as "over/under" or "in front of/behind"). On the contrary, in the case of the preposition "with" and the verb "to have", the relationship that these designate, according to our analysis, is extremely general. One could think that such a general meaning would be of no use. My answer to this objection is that the expressions based on the preposition "with" or the verb "to have" take on a precise meaning (which differs from case to case) thanks to our general knowledge, that is, based on our

knowledge of the relationships that there can be between the two related things. Let us consider, for example, the two expressions "man with/having a stick" and "man with/having a moustache". According to our analysis, these expressions simply mean that the stick or the moustache, respectively, are in such a relationship with the man that our attention, when focusing on the man, tends to also include these in the same focalization. Starting from this, our general knowledge leads us to represent precise relationships: the stick is in the hand of the man, who holds it along his lower limb to stand, and the moustache is on the upper lip of the man. In countless other cases, too, (see many of the expressions in Table 2 and Table 3 for example) our general knowledge leads us to represent precise relationships (which differ in the various cases) when starting from the extremely general meaning that we hypothesize to be indicated by the preposition "with" and the verb "to have": this is the reason why this meaning is not too general to be useful. In case of any ambiguity, it is always possible to explicitly indicate the relationship involved (for example, if the man in our example "man with a stick" is not using the stick to stand, but is brandishing it threateningly, we can explicitly say this).

5. A GRAMMATICAL CONCEPT DIFFICULT TO BE DEFINED: "NOUN"

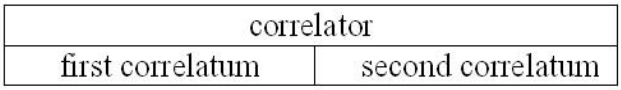
A grammatical concept that has proved difficult to be defined is the concept of "noun". OL offers a *simple* and *clear* definition of this concept. In order to give this definition, some other general outlines of the theory should be introduced however.

According to OL, linguistic thought is made up of two fundamental kinds of elements:

1) correlators
2) correlata

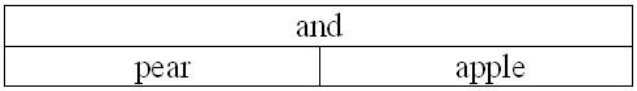
Correlators are the elements whose specific function is to tie (or, in other words, to *correlate*) the other elements of thought: these are the mental categories designated by adpositions (or the corresponding cases) and conjunctions. *Correlata* are the elements that are tied by a correlator: these are nouns, adjectives, pronouns, articles, verbs and adverbs. According to OL, even though the meanings of isolated words (such as "apple") are a kind of thought, actual linguistic thought occurs only when we correlate more than one meaning to each other, i.e., when we say, for example, "apple and pear", "red apple", etc.

The two correlata that are tied by a correlator are called *first correlatum* and *second correlatum*, respectively, according to the temporal order in which attention focuses on them. We call the whole structure that is thus formed *correlation* or *correlational triad* and we represent it graphically in the following way:

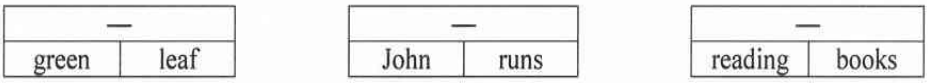


in order to visually suggest the idea that a correlation is a whole where two meanings (the correlata) are tied together by the mental operations that make up the correlator.

In the case of the example "pear and apple", we will have this correlation:



Besides adpositions (or the corresponding cases) and conjunctions, there is another extremely important correlator. Its structure is the same as for the conjunction "and" (attention focuses on *A* and *A* is borne in mind while attention focuses on *B*), with the difference that *A* and *B* do not remain separate, but are "combined" together. This is due to the fact that the attentional focalization does not stop in the passage from *A* to *B* because *A* and *B* are in some way complementary. For example, *A* is an object that can exist on its own and *B* a possible feature of it (correlation substantive-adjective); or *B* is what may happen to *A* in time (correlation subject-verb); or *A* is a verb and *B* its object (correlation verb-object[5]); etc. We call this correlator *presence keeping* and we represent it graphically by means of a horizontal bar:



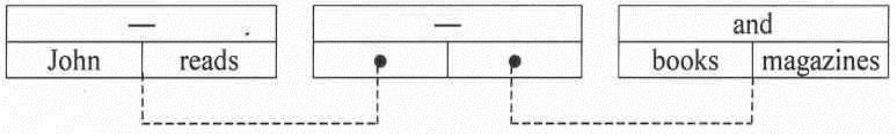
Since this correlator is, as we can easily understand, the most used of correlators, it is convenient not to express it with a word and to indicate its presence either by simply putting the two words that it correlates one after the other (when this is possible) or using marks of the words (English has very few marks of this kind, but many languages have several of them: for instance, in the Italian sentence "*bottiglia di vino nuova*", which means "new bottle of wine", the two "a" that are underlined are marks of the feminine gender, which indicate that the adjective *nuova*, "new", is related to *bottiglia*, "bottle", not to *vino*, "wine").

According to OL, correlation is the minimal and basic unit of linguistic thought. "Minimal unit" means that a linguistic thought is made up of at least one correlational triad (this implies that even in a clause or phrase made up of two monomorphemic words, such as "I run" and "yellow flower", the elements are not two, but three, namely, the two words and the "presence keeping" correlator, which is expressed by putting the two words one after the other[6]). "Basic unit" means that linguistic thought is generally a "network" formed by various correlations (*correlational network*) in which a correlation acts as a correlatum of another

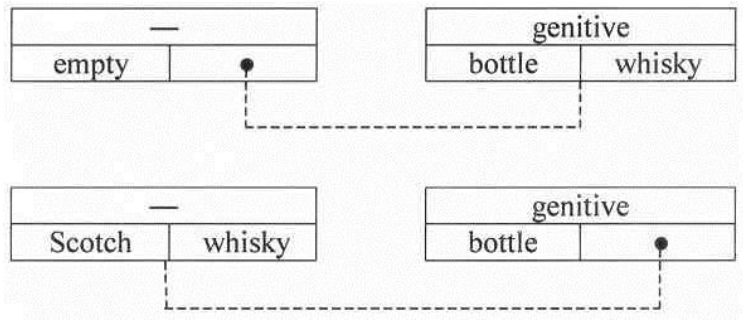
[5] The definition of "verb" according to OL has already been given (p 13). OL also offers precise definitions of "subject" and "object", which nevertheless are not introduced here (they can be found in Benedetti, 2008, 2009, 2010, 2011).

[6] The intuition that in such cases the elements are not two but three can be found in Tesnière (Tesnière, 1959), who based his syntactic theory on the concept of "connection" (*connexion*). This concept is nevertheless very different from the concept of "correlator", because the "connection" referred to by Tesnière is: a) an implicit link, while OL's concept of "correlator" includes implicit links, links that are indicated by morphological marks, adpositions and conjunctions; b) something very hierarchical, unlike correlator (see further on). Moreover, in Tesnière an analysis in terms of cognitive operations is missing.

correlation. Therefore, the sentence "John reads books and magazines", for instance, has the following structure of thought:



(the dotted line starting from the line that separates the two lower boxes of a correlation and ending with the symbol "•" placed in one of the two lower boxes of another correlation indicates that the first correlation is one of the correlata of the second correlation). This graphic representation (in Ceccato's original form, where the correlational triads are not on the same line), when there are various correlations, resembles a network, hence the expression "correlational network". However, irrespective of the graphic representation, *it must be very clear that the structure of linguistic thought is not a simple linear structure where the elements are added one after the other*. The elements (that is, the meanings) that make up thought are surely loaded one after the other in working memory, and the previous elements are kept present while the next ones are added. The result, however, is a *non-linear* structure, which can be different even when the words are spoken in the same order. For example, the two sentences "empty whisky bottle" and "Scotch whisky bottle" are, from a certain point of view, identical (they are made up of a first word, which, albeit different, is in both cases an adjective, plus two identical words in the same order), but the two corresponding correlational networks are different:



(in the two triads where the correlator is the genitive, the order of the two correlata is inverted compared with the speech order because English can invert the two correlata to express the meaning of the genitive; this would not have happened if the genitive had been expressed with the preposition "of").

The theory of the structure of linguistic thought that has just been outlined (which is Ceccato's own) is called *correlational theory of thought*. The fact that, despite the (necessarily) linear order of speech, all the elements of a sentence are kept mentally present was also pointed out by a 19th century scholar, Steinthal, even if not in the same cognitive terms as OL (he resorted to the concept of "vibrating representations" [*schwingende*], see Steinthal, 1860, pp. 102-112). The concept of difference between the linear order of speech and the non-linear order of thought was also proposed as early as the 1950's by Chomsky (1957), Tesnière (1959) and Guillaume (1971-2010 [based on 1938-1960 lectures, author's

note]). Ceccato formulated this same concept more or less in the same years, almost surely quite independently. Nevertheless, the conception of the structure of thought by Ceccato is noticeably different from the others, as we will see more clearly further on.

At this point our definition of "noun" can be introduced. As mentioned, the definition of this concept has proved difficult. Nouns are traditionally defined in a semantic way by stating that nouns are the words that indicate "persons, animals, vegetables, unanimated objects". Some grammar books also add "qualities, quantities, ideas", or "places, events" and so on. The "verb" category (which is the main category in contrast with the "noun"; nevertheless, the infinite forms of the verb, i.e., the infinitive, the participle and the gerund, are commonly called "nominal forms") is also generally defined in a semantic way: verbs are said to designate "processes or states". Modern linguistics is perfectly aware that these semantic definitions are unsatisfactory: for example, a word such as "birth" designates a process, but it is a noun, not a verb; words such as "to be born" and "outside" are a verb and an adverb respectively, but they designate an "event" and a "place" respectively, which are among the things that nouns are supposed to designate. In general, we can say that many languages have a great many pairs of words which, like "to be born" and "birth", have the same meaning, where one is a verb and the other a noun (unlike English, where there are fewer such morphologically different pairs and often the same word has both functions).

Modern linguistics has therefore tried to go beyond these semantic definitions. Often, it has tried to give functional definitions and/or definitions based on the relationships among the parts of speech. The noun, for example, is said to be what occurs with articles and attributive adjectives (that is, the adjectives that are part of a noun phrase headed by the noun they modify, such as "happy" in "happy years") and can be the head of a nominal phrase. Nevertheless, these definitions are partially not applicable in some languages (for example, Russian and Latin do not have articles), are partially tautological ("*nominal* phrase") and easily end up being circular (the noun is defined in terms of its relationships with the article and/or adjective, and the latter two are defined, either directly or indirectly, in terms of their relationship with the noun).

Apart from this, even if a definition of this kind works (i.e., it identifies words that are sensed as nouns), the two following objections are still valid: a) we can say that the definition works exactly because *we already sense* very well which words in a sentence are nouns, even if we do not know how we do this (the theory that we record these reciprocal relationships and/or functions unconsciously is not very convincing, because it involves an unconscious elaboration that is rather complex and incompatible with a circular identification of the various parts of speech); b) the fact that nouns occur with certain other parts of speech does not explain *what nouns are*, i.e., what their *nature* is.

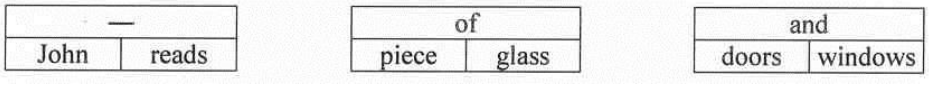
The fact is that the real problem is not giving a definition of "noun" that works, i.e., that always identifies which words in a sentence are nouns. *The real problem is understanding why we sense very well that in speech there are words that all belong to the same class*, which is called the class of "nouns". If we understand this, the definition of "noun" comes automatically.

OL provides a simple and natural solution to this problem. We have to note that:

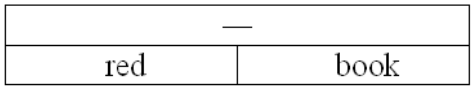
1) conjunctions, adpositions and the verb in the personal form are never nouns;
2) the verb in the infinitive forms is a noun instead (for example, "*reading* books");

3) the adjective has always been considered a noun (the present-day substantive/adjective distinction was absent in Greek and Latin grammar but was introduced during the Middle Ages and the expressions "substantive nouns" and "adjective nouns" have been used for a long time since then (R. H. Robins, 1997, p. 106-7 It. ed.); in linguistics, adjectives are commonly considered "nominal forms" as are substantives).

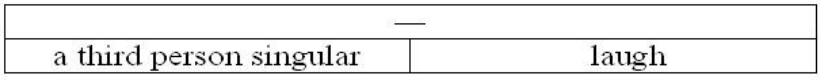
According to OL, the grammar category of "noun" is based on the fundamental distinction between *correlators* and *correlata*, i.e., between elements of linguistic thought with the function of linking and elements that are linked by the former. Nouns are the *mere correlata*, i.e., the words that designate something that has no correlating function, unlike the linguistic elements that designate a correlator or *also* (see below) a correlator. Nouns are therefore the meanings that, in the graphic representation of the correlation triad we use, are *exclusively* placed in one of the two lower boxes, unlike the meanings that are placed or are also placed in the upper box (this definition is Ceccato's own). Therefore, according to OL the grammatical category of "noun" *can be defined only by using the position the word has in the correlational network (i.e., its* function*) as a criterion of classification, not by basing ourselves on a semantic criterion*. For example, the words "John", "piece", "glass", "doors" and "windows", which are mere correlata in the following correlations:



are nouns. The adjective (as a theme, i.e., apart from the marks of gender, number and case that some languages apply to it) also indicates a mere correlatum, as we can see in this example:



Instead, the verb in the personal form is never a "noun", because it does not simply indicate a correlatum (thus it is not a "*mere* correlatum") but designates that this correlatum (the "bare" meaning of a verb, i.e., the meaning of its theme) is related (as a second correlatum) to what grammar calls a "person" (that is, the agent or the addressee of a linguistic act, or another person/thing [Graffi, Scalise, 2002, p. 193]) by means of a correlator, presence keeping (therefore, the verb in the personal form indicates *both a correlatum and a correlator*). For example, the personal form of the verb "to laugh" *laugh-s* indicates that the (verbal) meaning "laugh" is related to a third person singular. Therefore, "laughs" is not a *mere* correlatum, but designates a *whole correlation*, i.e. the following:



Remark: In English, the fact that the personal verb indicates a whole correlation is less evident than in other languages. In English the personal verb cannot be used alone, but must always have an explicitly expressed subject. The reason for this is that the verb in English has very little morphology according to the person. Therefore, if we used the verb alone, it would be impossible to understand which person it refers to. However, in many other languages the morphology of the personal verb differs according to the person. In several of these languages, the verb in the personal form can also be used alone, i.e., without an explicitly expressed subject. For example, in Latin the personal verbal forms *amo* (I love), *amas* (you love), *amat* (he/she/it loves) not only express the meaning of the verb 'to love', but also the person the verb refers to (besides the tense, mood etc), and can therefore be used alone. Consequently, in these languages it is more evident that the personal form of the verb does not express a correlatum only, but a whole correlation.

Instead, the verb in the infinitive mood is a mere correlatum, as in the following examples:

Therefore, in this case the verb is a noun. Thus, *the noun/verb distinction does not have a semantic basis, but depends on the function that the meaning at stake has in the correlational network.*

Now, it is worthwhile to consider OL's definitions of "noun" and "personal verb" once again, and compare these to each other and to some others.

- **noun**: as just stated, the concept of "noun" cannot be defined on a semantic basis, but only with a functional criterion, that is, on the basis of the position that a word has in the correlation network: nouns are the mere correlata, that is, the words that designate something that has no correlating function, unlike the linguistic elements that designate a correlator or also a correlator. Nouns include substantives, adjectives (for the definition of these two categories, see below) and the infinitive forms of the verb (the infinitive, the participle, the gerund), the latter which are indeed also called "nominal forms" of the verb.
- **verb**: what requires a prolonged or repeated attentional focalization to be acknowledged (i.e., is not instantaneously recognizable, as instead happens for the substantive, see below) is a ***meaning of a verbal kind***. This is clear for "processes" (the first of the two things that the verb is traditionally said to be), but is also true for the second, i.e., "states" (it is not possible to say that something, for example, "is still", without looking at it for a certain time). A good example to clearly sense the difference between substantive and meaning of a verbal kind (a dynamic or static one) is imagining a ship on the horizon: the ship (i.e., a substantive) is perceived instantaneously, while its moving or being still (i.e., verbs) only with a prolonged observation. Words with a meaning of a verbal kind are, for example, "(he/she/it) breathes", "breathing", "breath", "operation", "discussion", "development",

"passage", "arrival" etc. If a word designates a meaning of a verbal kind and the fact that this is related (as a second correlatum) with a grammatical person (therefore, the word designates both a correlatum and a correlator), it is a ***verb in a finite mood***; if a meaning of a verbal kind is a mere correlatum, it is *a* ***nominal form of the verb*** (for example, "to breathe", "breathing") or a ***noun having a meaning of a verbal kind*** (for example, "breath") (we will not discuss what distinguishes the latter two, for example "breathing" and "breath", since this is a minor difference). It is not incorrect to say, as it has been traditionally said, that verbs designate "processes" or "states", but this is not a satisfactory definition of "verb". The traditional definition, instead of really defining verbs, simply lists the two main categories in which verbs can be distinguished (i.e., verbs that designate a process and verbs that designate a state). OL's definition instead is an extralinguistic definition, based on cognitive operations. But the main flaw of the traditional definition is that this definition cannot explain why certain words (for example, "breath"), even if they designate processes, are nouns. The traditional definition cannot explain this fact because it does not clearly distinguish, as OL does, "verb" from "meaning of a verbal kind", and does not grasp the fact that *the real opposition is not between "noun" and "verb", but between "meaning of a verbal kind" and "meaning of a substantival kind"* (or, simply, "substantive"). OL defines the substantive in the following way.

- **substantive**: the substantive designates something that is acknowledged in an instantaneous way (i.e., without any need to follow the situation over time, as instead happens for meanings of a verbal kind) and is acknowledged or considered independently from other things (unlike adjectives): for example, all of this applies to words such as "bird" and "flower" (i.e., substantives), but not to words such as "to fly" (i.e., a verb) and "red" (i.e., an adjective). Therefore, OL defines the adjective in the following way.
- **adjective**: the adjective designates something that is acknowledged in an instantaneous way (therefore, like substantives and unlike meanings of a verbal kind) by separating this something from something else (and therefore, not independently, as the substantive does). For example, the word "red" designates something that is instantaneously acknowledged and that does not exist independently, but is necessarily tied to something else (something red), from which it is isolated by means of the selective ability of attention.

The definitions that have been just proposed, except that of 'noun', are the author's own.

Once we have given our definition of "noun", we can add some considerations about the correlational theory of thought and the concept of "correlation".

1) The fact that OL conceives the structure of linguistic thought as made up of elements having an equal structure, i.e., the correlational triads (where, moreover, the correlator is often the same, i.e., the simple "presence keeping") should not make one think that the concept of correlation is too general or that OL does not accept traditional grammatical concepts such as predication, agreement etc. On the contrary, OL, too, accepts these concepts (generally speaking, *OL accepts all the traditional grammatical concepts*—with only marginal modifications—and tries to account for

them). Simply, OL maintains that many correlations are based on something common (i.e., the operation of presence keeping, which we believe to be substantially the loading of a meaning in working memory), and *the difference amongst these correlations is determined not as much by the correlator as by the correlata*. For example, the fact that "John reads" is a "subject-verbal predicate" correlation is determined not by a particular correlator that is different from the correlator of a "substantive-adjective" correlation, for example, but by the two correlata "John" (which is the first correlatum of a verb in the personal form, which, according to OL, makes it a grammatical subject) and "reads" (which is a verb in the personal form, which necessarily involves a subject)[7].

2) It is instead true that the correlational theory of thought differs deeply from the other linguistic theories about sentence structure for at least two reasons.
   a) First, according to the correlational theory of thought the fundamental concepts of language are "correlation" and "correlator", while in many other theories the concepts of subject/predicate or nominal phrase/verbal phrase are central. This does not mean that OL rejects the latter. OL simply considers these less central than the concepts of "correlation" and "correlator". According to the correlational theory of thought, what is absolutely necessary in any phrase or sentence are correlators (which are expressed, as mentioned, by putting the words one after the other, or by adpositions, conjunctions, morphological marks, a particular word order— for example, the expression of the genitive by means of the inversion of the order of the two nouns—, or are implicit). Therefore, according to OL, the analysis of a phrase or sentence consists of identifying the correlators and the structure that these form when linking the various correlata. Once we have identified this structure, we can also speak of "subject" and "predicate", "noun phrase" and "verb phrase" etc, but this is less important than identifying the correlational network. Indeed, in some languages a finite verb is not always necessary in order to form a sentence (Graffi, Scalise, 2002, p. 176). Moreover, even in languages, such as English, where this is said to be necessary, linguistic expressions without a subject and a finite verb, such as certain exclamations, titles, labels, captions, are actually found. What instead cannot be missing in any phrase or sentence are correlators, and because of this correlators are considered central by OL. A consequence of this conception is that adpositions (or the corresponding cases) and conjunctions, i.e., parts of speech that have traditionally received less attention than the noun and the verb, become the central parts of speech.
   b) Secondly, the correlational theory of thought *conceives the structure of linguistic thought as less hierarchical* than many other theories do. For example, the expression "scent of roses" is not described, in our theory, as a noun that governs a prepositional phrase, but as a correlational triad that is made up of a correlator ("of") that ties two correlata (the meanings of the two nouns), which are substantially in a condition of parity, except for the temporal order in which they

[7] Similarly to generative grammar, OL defines subject and object syntactically on the basis of their position with respect to the verb in the deep structure of the sentence, where, according to OL, the order of subject, verb and object is always SVO (Benedetti, 2006, 2008, 2009, 2010, 2011).

are focused on by attention and loaded in working memory (therefore, *the traditional tree structures* or similar representations *cannot absolutely be used* to represent the structure of thought according to our theory: this subject cannot be addressed in depth here, but is addressed in Benedetti, 2005d, pp. 4-9, and Benedetti, 2006, pp. 18-19).

3) The correlational theory of thought easily explains why a certain sequence of words in a given language is grammatical or not, which is a central problem in generative grammar. This subject requires a great deal of space to be addressed and is therefore completely out of the scope of a brief writing such as this. Here, we can only say that the correlational theory of thought uses the distinction between correlators and correlata, and the fact that two correlata are necessarily tied by an (explicit or implicit) correlator to decide if a string of words is grammatical or not (nevertheless, the syntactic rules of the language should also be considered).

6. THE OTHER MAIN FEATURES OF OL IN BRIEF

Only a few analyses of mental categories have been introduced but others will not be added since these are sufficient to present our theory. Here we will instead illustrate the other main features of the theory very briefly. The ideas introduced in this section are almost all my own, except point 5.

1) As mentioned, OL accounts for *all* the fundamental meanings we have called "mental categories", and does this in a unitary manner, i.e., on the basis of very few general presuppositions and in a very natural way, without any forcing, exceptions etc.
2) OL provides, in a very natural manner, a new solution to a central question in the philosophy of language and psycholinguistics, i.e., whether language is an evolutionary product of increased human intelligence over time and social factors, or if language exists because humans possess an innate ability, an access to what has been called a "universal grammar" (the first view is well represented by the mentalistic theories of Piaget, the empiricism of Carnap etc; the second point of view can be said to have begun with Chomsky [Chomsky, 1959]). Indeed, OL presupposes that it is *only the ability of carrying out the EOMC* that *is innate*, while, on the contrary, *the ability of making up mental categories by means of these operations*, and of building the structure of thought by means of the mental categories, *is acquired* and culturally transferred, from generation to generation. According to OL, which mental categories are built with the (few) EOMC (which are innate) and which structures of thought are built with these mental categories (in other words, *grammar*) *does not depend on an innate device, but on the* ***usefulness*** *of these mental categories and structures of thought in satisfying the communicative needs* of human beings (needs that are more or less the same for all human beings). This assumption implies that said mental categories and types of structures of thought are widely common (consequently, translation from any language into any other language is always substantially possible), but also that, since *there is no innate universal*

grammar, there can be differences across languages. This is exactly what happens, as we all know. For example, making a distinction between the things that exist (or are considered) independently, i.e., in an isolated manner (as mentioned, according to OL these are the meanings of substantives) and what happens to these things over time (the meanings of verbs) is too much useful and important to be missing in a language: indeed, having substantives and verbs is a linguistic universal (Yule, 1996, p. 277 It. ed.; Graffi, Scalise, 2002, p. 117; Frigerio, 2011, p. 14). On the contrary, for example, making a distinction, by means of two different demonstrative adjectives, between when something is far from both the speaker and the addressee and when something is far from the speaker but close to the addressee, is not that essential, so that there can be languages that do this (such as Latin, with the *ille/iste* pair) and others that do not (such as English, which uses the demonstrative adjective *that* in both cases).

The thesis of OL on the innate or acquired origin of language is simple and natural. In fact, the existence of a small innate component only (i.e., operations within cognitive functions) is a completely plausible hypothesis and one that avoids the difficulties that derive from hypothesizing the existence of an innate "deep" universal grammar, namely a) the little intrinsic plausibility of this hypothesis and b) the need to reduce the differences found across the grammars of the various languages to a unique universal grammar. On the other hand, resorting to the cultural factor alone without hypothesizing anything innate is probably insufficient to explain the analogies, which far exceed the differences, across languages, and the huge difference between human thought/language and animal thought/communication.

3) OL, with its description of linguistic thought in terms of operations of attention and other cognitive functions, makes it clearer what the essence of human/thought language is and allows us to better account for the huge difference between human thought/language and animal thought/ communication (which is another fundamental issue in psycholinguistics). In brief, according to OL human thought/language is based on two fundamental processes. The first process is a *fragmentation* of the experience, a fragmentation that is allowed by the selective ability of attention. This fragmentation leads to the formation of a large number of meanings (for example, the perception of an object with its color, say a green leaf or a red apple, is a unitary experience, but human attentional ability allows humans to isolate the shapes of the leaf and the apple from the color green and the color red, thus creating the four meanings "leaf", "green", "apple" and "red"; the same happens in countless other situations, such as the isolation of the action of "flying" from the object "bird", the meaning of the adjective "hard" from the object "stone", etc). The second process is a *recombination* of these many single different meanings that is carried out thanks to the correlators and that leads to the formation of the correlational networks, i.e., the sentences (which can be made up of many of these meanings). In this way humans, by means of a number of words that is *limited* (even if rather big: the words that designate the aforesaid many meanings that have been created, i.e., the lexicon of a language), can produce an *unlimited* number of utterances, that is, they can describe *any* experience. For instance, with the words of the aforesaid example, they can describe, besides a green leaf and a red apple, a green apple and a red leaf too. According to OL, the huge difference between human thought/language and animal

thought/communication is due, among other things, to the very fact that: a) animals, even if many probably have perceptual abilities (hence, are able to have experiences) that are not very different from ours, probably have an attentional ability that is much less sophisticated than the human one, and does not allow the aforesaid process of fragmentation; b) animals are not probably provided with the ability to produce the mental categories of relationship, i.e., the correlators (hence, the correlational network), a task that definitely requires a big capacity of working memory. Therefore, OL ascribes the difference between human language and animal communication, among other factors that have been highlighted by previous literature (which OL does not reject at all), not to a substantial difference between the cognitive abilities of humans and those of animals, but to a different development of the same abilities, thereby recognizing that there is no fracture between human beings and animals, but only a different degree of evolution.

Another issue in psycholinguistics to which *SOI*'s theoretical approach has been applied is research into the possibility of a partial learning of human language by animals. In fact, as part of the Lana Project (USA, 70's) into the possibility of linguistic communication between man and animal (the animal was a female chimpanzee, named Lana), a *SOI* member, E. von Glasersfeld, created an artificial language based on Ceccato's theories. This language (comprising some mental categories) allowed the chimpanzee to show that she had acquired the mental abilities to produce sentences, which were grammatically correct and had a sense, even if very simple (Glasersfeld, 1989).

As regards the application of psycholinguistic methods to OL, the eye tracking method, used in psycholinguistics to study the cognitive processes related to spoken language (Tanenhaus, Spivey-Knowlton, Eberhard, Sedivy, 1995), was also used by Ceccato as early as the 60's.

4) I believe that the theses of OL can be verified introspectively, that is, *subjectively*. Nevertheless, there also are several *objective* confirmations, which are given by linguistic data (such as the aforementioned linguistic data that agree with our analyses). A wide range of experiments, which nevertheless require time and resources, have been planned to also provide *experimental evidence* (something of this kind already exists, but to a very limited extent).
5) OL is an approach to the study of language, hence something strictly *theoretical*. Nevertheless, OL could also have at least one practical spin-off. In fact, the correlational theory of thought has led to conceive a device for the implementation of an innovative machine translation[8] program, which might allow us to achieve a better translation quality than that of the programs available today. This device is described in detail in Benedetti (2005d). This device was conceived by Ceccato and his collaborators in this project (Ceccato, 1969; Glasersfeld, Pisani, 1970).
6) We should point out the limits of OL too. OL allows us to understand the nature and structure of the processes of linguistic thought *only partially* and *only up to a certain level of "depth"*. Even if it is possible to identify the meaning of the mental categories, it is instead impossible to go *beyond* this level. In fact, OL defines, or

[8] The references for the history and the state-of-the-art of machine translation are: Hutchins (1986, 1992, 1999, 2001a, 2001b, 2002, 2003).

describes, the meanings of the aforesaid linguistic elements in terms of operations of attention, memory etc, but it cannot tell us how these functions are carried out and what supports them. Moreover, OL allows us only to "see" what we may call, to use a metaphor, the "bare skeleton" of linguistic thought, that is, the mental operations we perform on, and that are elicited by, *our subjective phenomenal experience.* OL cannot account for phenomenal experience and, consequently, the words that designate it. For example, if we consider the expression "the colors of flowers", OL can only account for the meaning of the word "of" and the ending "-s", but not the words "color" and "flower".

7. A COMPARISON BETWEEN OL AND OTHER APPROACHES

Since an in-depth comparison between OL and other approaches is well beyond the scope of a brief writing such as this, here I will just mention the main approaches that can be considered.

The reader can easily understand that OL is substantially incompatible with generative grammar. First of all, because in generative grammar syntax is central, while according to OL what is central is semantics and syntax is nothing else but an aspect of semantics. The other major difference with generative linguistics is the fact that, as mentioned in the previous section, OL conceives no innate ability or device specific for language. OL maintains that the only (even if fundamental) innate component of language are cognitive functions (amongst which attention plays a key role), which therefore are not at all specific for language itself. As for the rest, language is essentially a cultural product, and the fundamental factor that determines the meanings present in it is the *usefulness* of these meanings in satisfying the communicative will of humans. Therefore, OL's conception is radically different from that of language as an innate and universal ability of humans, which is typical of the generative tradition. In a certain sense, one can say that the two conceptions are opposite: according to generative linguistics, language originated *from* something, which is *specific* (i.e., the appearance, in an evolutionary sense, of a specific device), while according to OL language originated *for* something (i.e., a purpose, that of satisfying the communicative will of humans), based on preexisting *non-specific* functions. Besides the fact that both theories, like others, are mentalistic, the only analogy can perhaps be the fact that OL, too, conceives a structure of linguistic thought, i.e., a deep level, which: a) is always different, as regards a certain aspect, i.e., its non-linear structure, from the surface structure, which is necessarily linear, and b) can be different in some cases, for example from the superficial SVO order, as mentioned in note 7. OL is also incompatible with logical-formal approaches originating from the work by Russell, Frege, Wittgenstein and Tarski, such as truth-conditional semantics, Montague grammar, etc. OL is also substantially different from the structuralist approach, where grammatical elements are often accounted for in terms of relationships of opposition to each other, or sometimes considered to substantially lack a meaning and take various meanings according to the context[9]. OL also substantially differs from distributional approaches, which account for linguistic elements in terms of relationships of occurrence with each other. On the contrary, OL has something in common with cognitive linguistics (Lakoff

[9] A comparison with logical-formal and structuralist approaches can be found in Marchetti 2006 pp 191-192.

[1987], Langacker [1987, 1991, 2008], Talmy [2000a, 2000b, 2007; also see M. Lampert, this volume], and others), such as the conception that language is not based on an *ad hoc* device but on cognitive functions, and the recurrence of the concepts of "construction" and "operations", so that OL could even be considered a theory within cognitive linguistics, even if the two approaches originated in a completely independent way from each other. Nevertheless, there also are important differences. Cognitive linguistics, indeed, extensively deals with the lexical meanings (which OL does not), and seems to focus more on the influence that the cognitive operations have on the whole sentence or the choice of a word inside the sentence, while OL provides an *analysis in terms of "atomic" component*s of the meaning of the single grammatical elements. The basic presupposition of OL that attention plays a key role in the construction of meaning can also be found in Oakley's work (2004, 2009). Indeed, even if Oakley bases his semantic analyses on the "Mental Spaces and Blending Theory" originally developed by Fauconnier and Turner, he conceives the operations relevant to such spaces as attentional phenomena. However, Oakley too, as the others cognitive linguists, generally analyzes the whole sentence or text, not the single linguistic elements (as instead OL does), because he considers the context as decisive for the construction of meaning, and as prevailing over the basic meaning of each single word. Undoubted analogies with OL's approach can be found in the semantic analyses of locative expressions by Carstensen (this volume, and 2002, 2007), who resorts to the concept of attentional operations performed by the subject (such as "shift", "zooming", see the concept of movement of attentional focus included in the EOMC (section 3.2) and my analyses of locative terms in Benedetti 2006, 2008, 2009, 2010, 2011). Something similar to the distinction between correlators and correlata can be found in the classification of the "grammatical concepts" made by Sapir, who divided them into two main categories depending on whether they concerned the "material content" or the "relationship", and also stated that two subcategories of these two categories are essential to any form of language (Sapir, 1921). In Sapir this distinction seems to refer more to the level of language than that of thought, is not expressed in cognitive terms, and is less central. Nevertheless, Ceccato and Zonta (1980) explicitly acknowledge that Sapir's approach to the classification of the parts of speech is "the closest" to OL's.

As a general consideration, while some similarities between OL and the other approaches can be found, they are very limited and sporadic: if OL is compared with the other theories *as a whole*, OL proves to be something deeply different.

CONCLUSION

This chapter aims to introduce a new theory that deals mainly with the problem of the meaning of the fundamental grammatical elements *of language* (*not single languages*). I have introduced the general outlines of the theory only, in order to give a general idea in the space of a chapter. The theory is based on the fundamental presupposition that *the meaning of grammatical elements has to be searched for* not, or not only, at the level of the particular objective situations where these linguistic elements are used, but at the top level of abstractness, i.e. *at the level of the cognitive operations performed by the subject, amongst which those of attention play a key role*. The theory, albeit systematic and, from a certain

point of view, complete, is nevertheless a first attempt in this direction and as such may contain mistakes or may need to be widened or modified. Nevertheless, this theory seems to take us, in a simple and natural way, towards a *unitary* solution of the problem *as a whole*. This leads me to suppose that this is *at least the right direction* to follow in order to solve this problem in the philosophy of language.

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REFERENCES

Agud, A. (1980). *Historia y teoría de los casos*. Madrid: Gredos.

Amietta, P. L., Magnani, S. (1998). *Dal gesto al pensiero*. Milano: Franco Angeli.

Arnauld, A., Lancelot, C. (1660). *Grammaire générale et raisonnée*. Paris [It. ed. by R. Simone (1969). *Grammatica e Logica di Port-Royal*. Rome: Ubaldini Editore].

Baddeley, A. D., Hitch, G. J. (1974). "Working memory". In: G.A. Bower, (Ed.), *Recent advances in learning and motivation*, vol. 8. New York: Academic Press, 47-90.

Baddeley, A. D. (2000). The episodic buffer: a new component of working memory? *Trends in Cognitive Sciences, 4*, 417-423.

Barsalou, L. W. (1999). Perceptual symbol systems. *Behavioral and Brain Sciences 22*, 577-660.

Benedetti, G. (1999). "La categoria di spazio", and "Tavole sinottiche delle analisi di categorie mentali tratte dalle opere di S. Ceccato". In: AA. VV., *Studi in memoria di Silvio Ceccato*. Roma: Società Stampa Sportiva.

Benedetti, G. (2004). *Semantica operativa*. www.mind-consciousness-language.com

Benedetti, G. (2005a). A presentation of Operational Methodology. www.mind-consciousness-language.com

Benedetti, G. (2005b). Basic mental operations which make up mental categories. www.mind-consciousness-language.com

Benedetti, G. (2005c). On Giorgio Marchetti's commentary on my book "Semantica Operativa" [Operational Semantics], vol. I, 2004. www.mind-consciousness-language.com

Benedetti, G. (2005d). A device in order to improve the quality of machine translation, based on the correlational theory of thought. www.mind-consciousness-language.com

Benedetti, G. (2006). Operational Noology as a new methodology for the study of thought and language: theoretical aspects and possible practical applications. *Cognitive Processing, 7*, 217-243.

Benedetti, G. (2008). A semantics "outside language": Operational Semantics. A new semantic theory, based on the nature and structure of thought. www.mind-consciousness-language.com

Benedetti, G. (2009). The meaning of the basic elements of language in terms of cognitive operations: Operational Semantics. *Advanced Studies in Biology, Vol. 1, no. 5-8,* 255-305.

Benedetti, G. (2010). "A semantics of the fundamental structural elements of language, based on cognitive functions: Operational Semantics." In: G. Salvati, & V. Rabuano (Eds.), *Cognitive Psychology Perspectives*. Hauppauge, New York: Nova Science Publishers, pp. 1-61.

Benedetti, G. (2011). *An enigma in language - The meaning of the fundamental linguistic elements. A possible explanation in terms of cognitive functions: Operational Semantics*. Hauppauge, New York: Nova Science Publishers.

Benjafield, J.G. (1997). *Cognition*. Englewood Cliffs: Prentice-Hall International.

Bennett, D.C. (1975). *Spatial and Temporal Uses of English Prepositions: An Essay in Stratificational Semantics*. London: Longman.

Benveniste, E. (1962). Pour l'analyse des fonctions casuelles: le génitif latin. *Lingua, 11*, 10-18.

Blake, B. J. (1994). *Case*. Cambridge: Cambridge University Press,

Braga-Illa, F. (Ed.), (1997). *Livelli di rappresentazione. Percorsi tra il naturale e l'artificiale*. Urbino: QuattroVenti.

Braga-Illa, F. (Ed.), (2006). *A proposito di rappresentazioni. Alla ricerca del senso perduto*. Bologna: Pendragon.

Carstensen, K.-U. (1995). "Semantic and Conceptual Aspects of Local Expressions: Critical Remarks on the 'State of the Art'". In: M. Bierwisch, & P. Bosch (Eds.), *Semantic and Conceptual Knowledge, Workshop-Proceedings of the SFB 340 "Sprachtheoretische Grundlagen für die Computerlinguistik"*. Report Nr. 71, 117-126.

Carstensen, K.-U. (2002). Location and distance in language: An attention-based approach. Paper presented at the *3rd Annual Language & Space Workshop 'Resolution and Granularity in Language and Space'*. ZIF, Univ. Bielefeld. 8./9.7.2002.

Carstensen, K.-U. (2007). Spatio-temporal ontologies and attention. *Spatial Cognition and Computation, 7(1)*, 13-32.

Ceccato, S. (1964). *Un tecnico fra i filosofi vol. I, Come filosofare*. Padova: Marsilio Editori.

Ceccato, S. (1966). *Un tecnico fra i filosofi vol. II, Come non filosofare*. Padova: Marsilio Editori.

Ceccato, S. (1968). *Cibernetica per tutti, 1*. Milano: Feltrinelli (edited by Barosso G.).

Ceccato, S. (Ed.), (1969). *Corso di linguistica operativa*. Milano: Longanesi.

Ceccato, S. (1970). *Cibernetica per tutti, 2*. Milano: Feltrinelli (edited by Giuliani M.V., Zonta B.).

Ceccato, S. (1972). *La mente vista da un cibernetico*. Torino: ERI.

Ceccato, S. (1974). *La terza cibernetica.* Milano: Feltrinelli (edited by Zonta B.).

Ceccato, S. (1996). *C'era una volta la filosofia*. Milano: Spirali.

Ceccato, S. and Oliva, C. (1988). *Il linguista inverosimile*. Milano: Mursia.

Ceccato, S. and Zonta B. (1980). *Linguaggio consapevolezza pensiero*. Milano: Feltrinelli.

Chomsky, N. (1957). *Syntactic Structures*. The Hague: Mouton.

Chomsky, N. (1959). A review of B. F. Skinner's Verbal Behavior. *Language, 35 (1)*, 26-58.

Chomsky, N. (1981). *Lectures on government and binding*. Dordrecht: Foris.

Cooper, G.S. (1968). *A Semantic Analysis of English Locative Prepositions*. Bolt, Beranek & Newman report 1587.

Cowan, N. (2001). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. *Behavioral and Brain Sciences, 24*, 87-185.

Cowan, N. (2005). *Working memory capacity*. New York, NY: Psychology Press.

Denis, M. (1989). *Image et cognition*. Paris: Presses Universitaires de France.

Di Tomaso, V. (1996). Un'analisi semantica di alcune preposizioni italiane. *Studi Italiani di Linguistica Teorica e Applicata, 25 (2)*, 257-290.

Durieux, F. (1990). *The Meanings of the Specifying Genitive in English. A Cognitive Analysis*. Antwerp.

Fillmore, Ch. J. (1968). "The case for case." In: E. Bach, & R. T. Harms, (Eds.), *Universals in Linguistic Theory*. New York: Holt, Rinehart and Winston, pp. 1-88.

Frigerio, A. (2011). *Filosofia del linguaggio*. Milano: Apogeo.

Glasersfeld, E. von, and Pisani, P. P. (1970). The multistore parser for hierarchical syntactic structures. *Communications of the ACM, 13 (2)*, 74-82.

Glasersfeld, E. von, (1989). *Linguaggio e comunicazione nel costruttivismo radicale*. Milano: Cooperativa Libraria Universitaria del Politecnico.

Glasersfeld, E. von, (1998). *Il costruttivismo radicale*. Roma: Società Stampa Sportiva.

Graffi, G. and Scalise, S. (2002). *Le lingue e il linguaggio*. Bologna: Il Mulino.

Groot, A. W. de, (1939). "Les oppositions dans les systémes de la syntaxe et des cas." In: *Mélanges de Linguistique offerts à Charles Bally*. Genève: George et Cie, pp. 107-127.

Groot, A. W. de, (1956). Classification of the uses of a case illustrated on the genitive in Latin. *Lingua, 6*, 8-66.

Guillaume, G. (1971-2010). *Leçons de linguistique* (20 volumes). Quebec: Presses de l'Université Laval.

Herskovits, A. (1981). On the Spatial Use of Prepositions in English. *Linguisticae Investigationes, 2*, 303-327.

Herskovits, A. (1986). *Language and Spatial Cognition*. New York: Cambridge University Press.

Hjelmslev, L. (1935-1937). La catégorie des cas: première partie and deuxieme partie. *Acta Jutlandica* VII, IX (1,2).

Hutchins, W. J. (1986). *Machine translation: past, present, future*. Chichester: Ellis Horwood Series in Computers and their Applications.

Hutchins, W. J. and Somers, H. L. (1992). *An introduction to machine translation*. London: Academic Press.

Hutchins, W. J. (1999). Retrospect and prospect in computer-based translation. Machine Translation Summit VII, 13th-17th September 1999, Kent Ridge Digital Labs, Singapore. *Proceedings of MT Summit VII "MT in the great translation era"*. Asia-Pacific Association for Machine Translation, Tokyo, 30-34.

Hutchins, W. J. (2001a). Towards a new vision for MT. *Introductory speech at the "MT Summit VIII" conference*. Santiago de Compostela, Galicia, Spain.

Hutchins, W. J.(2001b). Machine translation and human translation: in competition or in complementation? *International Journal of Translation, 13 (1-2),* 5-20. Also in: M. S. Blekhman (Ed.) *Machine translation theory & practice*. New Delhi: Bahri Publications.

Hutchins, W. J. (2002). "Machine translation today and tomorrow." In: G.Willée, B. Schröder, & H-C. Schmitz, (Eds.), *Computerlinguistik: was geht, was kommt? Festschrift für Winfried Lenders*. Sankt Augustin: Gardez! Verlag, 159-162

Hutchins, W. J. (2003). Has machine translation improved? *Proceedings of the Ninth Machine Translation Summit*. AMTA, East Stroudsburg, PA, 181-188.

Jackendoff, R. (1983). *Semantics and Cognition*. Cambridge, Massachusetts: MIT Press.

Jackendoff, R. (1990). *Semantic Structures*. Cambridge, Massachusetts: MIT Press.

Jakobson, R. (1936). Beitrag zur allgemeinen Kasuslehre: Gesamtbedeutungen der russuschen Kasus. *Travaux du Cercle Linguistique de Prague, 6*, 240-288.

James, W. (1890). *The principles of psychology*. New York: Holt (Reprint 1983: Cambridge, MA: Harvard University Press).

Jonides, J. (1983). Further toward a model of the mind's eye's movement. *Bulletin of the Psychonomic Society, 21*, 247-250.

Knudsen, E. I. (2007). Fundamental Components of Attention. *Annual Review of Neuroscience, 30*, 57-78.

Kreyer, R. (2003). Genitive and of-construction in modern written English: Processability and human involvement. *International Journal of Corpus Linguistics, 8*, 169-207.

Kuryłowicz, J. (1949). "Le problème du classement des cas, again printed." In: *Esquisses linguistiques I*, 1973, (2d. ed.), München: Fink, 131-150.

La Berge, D. (1983). The spatial extent of attention to letters and words. *Journal of Experimental Psychology: Human Perception and Performance, 9*, 371-379.

La Berge, D. (1995). *Attentional processing. The brain's art of mindfulness*. Cambridge, MA: Harvard University Press.

Lakoff, G. (1987). *Women, Fire, and Dangerous Things*. Chicago: The University of Chicago Press.

Langacker, R. W. (1987). *Foundations of Cognitive Grammar, vol. 1: Theoretical Prerequisites*. Stanford: Stanford University Press.

Langacker, R. W. (1991). *Foundations of Cognitive Grammar, vol. 2: Descriptive Application*. Stanford: Stanford University Press.

Langacker, R. W. (2008). *Cognitive Grammar: A Basic Introduction*. Oxford: Oxford University Press.

Marchetti, G. (1993). *The mechanics of the mind*. Roma: Espansione.

Marchetti, G.,(1997). *La macchina estetica. Il percorso operativo nella costruzione dell'atteggiamento estetico*. Milano: Franco Angeli.

Marchetti, G. (2001). A theory of consciousness. www.mind-consciousness-language.com

Marchetti, G. (2003). Foundations of attentional semantics. www.mind-consciousness-language.com

Marchetti, G. (2005a). The importance of non-attentional operations for Attentional Semantics. www.mind-consciousness-language.com

Marchetti, G. (2005b). Commentary on Giulio Benedetti's "Semantica Operativa", vol I, 2004. www.mind-consciousness-language.com

Marchetti, G. (2006). A presentation of attentional semantics. *Cognitive Processing, 7*, 163-194.

Marchetti, G. (2009). Studies on time: a proposal on how to get out of circularity. *Cognitive Processing, 10*, 7-40.

Marchetti, G. (2010a). "A New perspective on Human Consciousness." In: G. Salvati, V. Rabuano (Eds.), *Cognitive Psychology Perspectives*. Hauppauge, New York: Nova Science Publishers.

Marchetti, G. (2010b). *Consciousness, Attention and Meaning*. Hauppauge, New York: Nova Science Publishers.

Marmo, C. (2004). *Semiotica e linguaggio nella scolastica. Parigi, Bologna, Erfurt (1270-1330). La semiotica dei Modisti*. Roma: Istituto Storico Italiano per il Medioevo.

Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological Review, 63*, 81-97.

Oakley, T. (2004). *Elements of Attention: A new Approach to meaning Construction in the Human Sciences*. Partly available from: www.mind-consciousness-language.com/articles oakley1.htm

Oakley, T. (2009). *From Attention to Meaning. Explorations in Semiotics, Linguistics, and Rhetoric*. Bern: Peter Lang.

Oberauer, K. (2002). Access to information in working memory: exploring the focus of attention. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 28*, 411-421.

Oberauer, K., Süß, H. M., Schulze, R., Wilhelm, O., & Wittmann, W. W. (2000). Working memory capacity—facets of a cognitive ability construct. *Personality and Individual Differences, 29(6)*, 1017-1045.

Parini, P. (1996). *I percorsi dello sguardo*. Ancona: Edizioni Artemisia.

Pashler, H. E. (1998). *The psychology of attention*. Cambridge, MA: MIT Press.

Perret, J. (1965). La signification du génitif adnominal. *R.E.L., 43*, 466-482.

Posner, M. I. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology, 32*, 3-25.

Posner, M. I. (1994). "Attention in cognitive neuroscience: an overview." In: M. Gazzaniga, (Ed.), *The cognitive neurosciences*. Cambridge, MA: MIT Press.

Posner, M. I. and Cohen, Y. (1984). "Components of performance." In: H. Bouma, & D. Bowhuis, (Eds.), *Attention and performance*. Hillsdale, NJ: Erlbaum.

Reed, S. K. (1992). *Cognition. Theory and applications*. Belmont, CA: Wadsworth.

Rizzi, L. (1988). "Il sintagma preposizionale". In: L. Renzi (Ed.) *Grande grammatica italiana di consultazione, vol. I*, ed. L. Renzi (Il Mulino, Bologna, pp. 507-531.

Robins, R. H. (1997). *A short history of linguistics*. London: Addison Wesley Longman.

Rosch, E. (1973). Natural Categories. *Cognitive Psychology, 4*, 328-350.

Rosch, E. (1978). "Principles of categorization." In: E. Rosch, & B. L. Lloyd (Eds.), *Cognition and Categorization*. N.J.: Lawrence Erlbaum Ass.

Rosenbach, A. (2002). *Genitive Variation in English. Conceptual Factors in Synchronic and Diachronic Studies*. pp. 28-29. Berlin/New York: Mouton de Gruyter.

Rubio, L. (1966). *Introducción a la sintaxis estructural del latin, vol. I*. Barcelona: Ariel.

Saint-Dizier, P. (Ed) (2006). *Syntax and semantics of prepositions*. Dordrecht: Springer.

Sapir, E. (1921). *Language*. New York Harcourt, Brace & World.

Serbat, G. (1981). *Cas et fonctions*. Paris: PUF.

Shumaker, N. W. (1975). The Semantics of the English's Genitive. *American Speech. A Quarterly of Linguistic Usage, 50*, pp. 70-86.

Steinthal, H. (1860)."Assimilation und Attraktion, psychologish beleuchtet". In: *"Zeitschrift für Völkerpsychologie und Sprachwissenschaft", I*, pp. 93-179.

Talmy, L. (2000a). *Toward a Cognitive Semantics. Volume I: Concept Structuring System*. Cambridge, Mass: The MIT Press.

Talmy, L. (2000b). *Toward a Cognitive Semantics. Volume II: Typology and Process in Concept Structuring*. Cambridge, Mass: The MIT Press.

Talmy, L. (2007). "Attention phenomena." In: D. Geeraerts and H. Cuyckens (Eds.), *Handbook of Cognitive Linguistics*. Oxgord: Oxford University Press, 264–293.

Tanenhaus, M. K., Spivey-Knowlton, M. J., Eberhard, K. M., Sedivy, J. E. (1995). Integration of visual and linguistic information in spoken language comprehension. *Science, 268*, 1632-1634.

Tesnière, L. (1959). *Eléments de syntaxe structurale*. Paris: Klincksieck.

Tobin, Y. (2008). "A monosemic view of polysemic prepositions." In: K. Dennis, & S. Adler (Eds.), *Adpositions: Pragmatic, semantic and syntactic perspectives*. Amsterdam, Philadelphia: John Benjamins Publishing Compan, 273-288.

Tyler, A. and Evans, V. (2003). *The Semantics of English Prepositions: Spatial Scenes, Embodied Meaning and Cognition*. Cambridge: CUP.

Vaccarino, G. (1988). *Scienza e semantica costruttivista*. Milano: Cooperativa Libraria Universitaria del Politecnico.

Vaccarino, G. (1997). *Prolegomeni, vol. I*. Roma: Società Stampa Sportiva.

Vaccarino, G. (2000). *Prolegomeni, vol. II*. Roma: Società Stampa Sportiva.

Vikner, C., Jensen, P. A. (2002). A Semantic Analysis of The English Genitive. Interaction of Lexical and Formal Semantics. *Studia Linguistica, 56 (2)*, 191-226.

Yule, G. (1996). *The study of language*. Cambridge: Cambridge University Press.

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Chapter 2

ATTENTIONAL SEMANTICS: AN OVERVIEW

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ABSTRACT

This chapter presents the main tenets of Attentional Semantics. Meaning is defined as the knowledge built from the continuous interaction between us and other entities. This interaction is primarily based on attentional activity, which makes it possible for us to consciously experience the relations existing between us and other entities.

Consciousness is the privileged place for the study of meanings. The meanings that other entities have for us (and we have for ourselves) coincide with the conscious experience of the relations between us and other entities (and between us and ourselves). Analyzing meanings means analyzing the conscious experiences of such relations, and how they form and develop.

The meanings of words afford us the opportunity to have a particular kind of conscious experience: they isolate, decontextualize, "freeze" and classify in an articulated system the ever-changing and multiform stream of the conscious experiences that we have of the relations between us and other entities, between us and ourselves, and between other entities themselves.

The meanings of words are composed of the sequence of invariable elements that, independently of any individual occurrence of a given conscious experience, are responsible for the production of any instance of that conscious experience. The elements composing the meanings of words are attentional operations: each word conveys condensed instructions on the attentional operations one has to perform if one wants to consciously experience the relations that are expressed through and by it. Words are tools to pilot attention.

Attentional Semantics aims at finding the attentional instruction conveyed by the meanings of words. To achieve this goal, Attentional Semantics: i) identifies the sequence of the elementary conscious experiences of the relations that invariably accompany, and are prompted by, the use of the word being analyzed; ii) describes these conscious experiences in terms of the attentional operations that are responsible for their production; and iii) identifies the unconscious and non-conscious operations that, directly

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or indirectly, serve either as the support that allows the attentional operations to take place, be completed, and occur in a certain way, or as the necessary complement that makes it possible to execute and implement the activities determined and triggered by the conscious experiences.

1. CONSCIOUSNESS: THE ORGAN OF MEANING

Consciousness - by letting us directly experience ourselves and other entities (that is, whatever is distinct from us, whether it is another person, an object or something else), the consequences of our actions on other entities, and how other entities affect us - gives us the possibility to form and constitute ourselves, and emerge as persons. At the same time as we emerge as persons, the other entities emerge as something distinct from us.

This process of emergence is made possible firstly by the continuous attentional activity we perform, which allows us to differentiate ourselves from other entities, and secondly by the physical actions and movements we perform. By applying our attention, we consciously experience our actions and movements, and their (sensory, perceptual, physical, social, etc.) consequences, and become aware of our limits and boundaries, of how and to what extent our actions can modify and affect other entities, of how other entities can modify or limit us, etc.; in short, we become aware of ourselves[1].

In the differentiation process that makes us and other entities co-emerge, we continuously relate ourselves - by means of our attention – to other entities. By relating ourselves to other entities, we come to learn and understand: how, when, where and why we relate with other entities; the value, importance and functions that other entities have for us; how we can affect or change other entities; how other entities affect us and make us change or not change. Some of these relations, once experienced, do not change but remain constant; others, on the contrary, can vary and change with time. Subsequently, and on the basis of this first-level knowledge acquired through the conscious experiences of the relations between us and other entities, we can build a second-level knowledge of the relations existing between other entities (for example, we can understand how we can relate one object to the others, or how one object modifies the others).

[1] A comment on the relationship between attention and consciousness is in order. Currently, there is not yet a shared view on the nature of the relationship between attention and consciousness, and the debate is still open about whether attention is really necessary for consciousness (for a review, see Tsuchiya and van Boxtel, 2013). The positions range from those who maintain that attention and consciousness are distinct phenomena that need not occur together (Bachman, 2011; Koch and Tsuchiya, 2006, Lamme, 2003; van Boxtel et al., 2010) to those who maintain that the two are inextricably linked (De Brigard and Prinz, 2010; Mack and Rock, 1998; Posner, 1994a). However, as I have tried to show (Marchetti, 2012a; for a similar criticism, see De Brigard and Prinz, 2010; Koivisto et al., 2009; Kouider et al., 2010; N. Srinivasan, 2008), the view that there can be consciousness without some form of attention originates primarily from the failure to notice the varieties of forms and levels of attention (Alvarez, 2011; Chun et al., 2011; Demeyere and Humphreys, 2007; La Berge, 1995; Lavie, 1995; Nakayama & Mackeben, 1989; Pashler, 1998; Treisman, 2006) and consciousness (Bartolomeo, 2008; Edelman, 1989; Iwasaki, 1993; Tulving, 1985; Vandekerckhove and Panksepp, 2009). Not all forms of attention produce the same kind of consciousness, and vice versa not all forms of consciousness are produced by the same kind of attention. There are cases of consciousness in the absence of a certain form of top-down attention, but in the presence of some other form of top-down attention. There are cases of consciousness in the absence of top-down attention but in the presence of some other form of attention, such as bottom-up attention. But there are never cases of consciousness in complete absence of some form of attention.

All these relations (between us and other entities, and between other entities themselves) contribute to form the meanings that other entities have for us, the meanings that we have for other entities, and the meanings that we have for ourselves.

Some comments about my use of the term "meaning" are in order. Firstly, I use the term "meaning" in its most general sense, comprising both linguistic, pragmatic and non-linguistic meanings.

Secondly, I intend to refer to both the bulk of knowledge that the human species has developed in its phylogenetic evolution, and the personal, specific knowledge that each single person develops during his life. While the former is usually coded into a symbolic system - such as language, mathematics or logic – and therefore is quite easily transferred from individual to individual, and from generation to generation, the latter is usually less structured, not coded into a formal system, and not easily transferrable. In this sense, the term "meaning" identifies all those conscious constructs that condense our experience and knowledge. I say "conscious *constructs*" because usually they are the result of the assemblage and combination of various simpler conscious elements, such as basic sensations, memories, and emotions: for example, the meaning of the word "apple" is composed of visual, tactile, olfactory and gustatory sensations at least. Moreover, I also add the adjective "condensed" because such constructs isolate, reduce and decontextualize the ever changing and multiform conscious experiences constituting the basis out of which they are built into a purely mental form.

Thirdly, and most importantly, my use of the term "meaning" implies that the knowledge each meaning expresses and refers to was (and is being) developed and built on, and thanks to, a continuous interaction between the person and other entities; an interaction that is based on and made possible thanks to attentional activity, specifies the relations existing between the person and other entities, and is guided by the hierarchy of principles, rules and goals of the person. In this sense, my use of the term "meaning" is very akin to Zlatev's (2002, p. 258) definition of meaning:

> **Meaning** (**M**) is the relation between an **organism** (**O**) and its physical and cultural **environment** (**E**), determined by the **value** (**V**) **of E for O**

(However, it should be noted that while I use this notion of meaning only in relation to human consciousness, he also applies it to very elementary forms of life, such as bacteria and worms).

Meanings can refer to entities that are as disparate as physical inanimate objects, subjective feelings, perceptions, living beings, events, situations, actions, outcomes of actions, purely mental operations such as comparing, summing, abstracting, etc. However, whatever meanings refer to, all of them result from, and are based on, our continuous activity of exploration of, and interaction with other entities. This activity originates from the specific purposiveness that characterizes us: a purposiveness that has its source in what I have identified as the algorithm of life (or of the being): "operate in order to continue to operate". Other authors have identified the origin of such purposiveness in some other principle or instinct. For example, Perlovsky (2006, p. 29) speaks of the "knowledge instinct": "Knowledge is not just a static state; it is in a constant process of adaptation and learning. Without the adaptation of concept-models we will not be able to understand the ever-changing surrounding world. We will not be able to orient ourselves or satisfy any of the

bodily needs. Therefore, we have an inborn need, a drive, an instinct to improve our knowledge. I call it *the knowledge instinct*".

Indeed, an object becomes an object and acquires a form and meaning for us only as long as, in some way, we can interact with it and relate it to ourselves (and subsequently to other objects) (for a similar view see Cisek, 1999). By making us experience directly how the object relates to us and to other objects, what kind of effect the object has on us, how the object limits us, and how our activity can modify the object, consciousness is the privileged way for us to acquire and construct our knowledge of the object[2]. It is through consciousness that we understand how an object relates to us and to the other objects, learn how to use it, and get to know it[3]. Consciousness gives us an immediate understanding of the object, and of the meaning that the object has for us. By understanding what relation exists between the object and us, we give a meaning to the object, and the object acquires a meaning for us. The meaning the object has for us corresponds to our conscious experience of the (condensed combinations of the) relations between the object and us.

Conversely, understanding what relation exists between us and the other entities also implies for us to be able to acquire a form and – through self-consciousness – to assign a meaning to ourselves.

We acquire the form that the relation between ourselves and other entities makes possible. An important step in this formation process is represented by the awareness we gain of ourselves as beings who can build an abstract level of knowledge starting from specific, individual conscious experiences. This self-awareness makes us understand for example that we can: group and collect objects and entities in general classes; establish different relations between the same entities (we can imagine or perceive "a man *and* a hat" or "a man *with* a hat" or "the hat *of* the man"); set the same relation between various and different entities; perform various and different (physical, psychological, mental) operations on the same entity (we can physically transform an object A; we can mentally compare or associate an object A with an object B; etc.).

We acquire a meaning when, by self-consciously seeing ourselves as an object, we are able to conceive ourselves as a means or instrument to an end, and consequently to set an end for ourselves. We emerge therefore as an entity having our own form, autonomy, independence, and meaning through a continuous process of differentiation that highlights and establishes the difference between ourselves and the other entities.

The form and meaning we conscious beings have or acquire and the form and meaning the other entities have or acquire are thus closely interwoven. An object exists, has a form and a meaning because we conscious beings exist who give it a form and a meaning, and we conscious beings exist, have a form and a meaning because by acting we have been able to differentiate ourselves from that object.

Therefore, *consciousness and self-consciousness can be defined as the organ of meaning*: they are the fundamental device by means of which: a) objects, events and other beings of the world - becoming the means that make a conscious being take shape - acquire a meaning and

[2] For a similar view, see Fuchs (2011, p. 199): "Consciousness is not a localizable object or state at all, but a *process of relating-to-something*: a perceiving-of, remembering-of, aiming-at, grasping-for, etc."

[3] Some authors have claimed that consciousness is not necessary to place entities in relations to each other, and that unconscious processes are sufficient to make the us understand how entities relate to us and to each other. In Marchetti (2012b), I review empirical psychological evidence that confute such a claim. Futher evidence can be found in Baumeister and Masicampo (2010).

a form for us; b) we conscious beings - differentiating ourselves from other entities - take shape and acquire a meaning.

It could be claimed that the idea of consciousness (and self-consciousness) as the prime organ that allows us to directly know, and assign a meaning to, objects, events and beings of the world by relating them to ourselves and to each other, is too restrictive and does not account for all that consciousness allows us to do. Undeniably, such a claim seems more than reasonable if one considers, for instance, the eighteen functions listed by Baars (1988): definition, context-setting, adaptation, learning, editing, flagging, debugging, recruiting, controlling, prioritizing, access-control, decision-making, executive, analogy-forming, metacognitive, self-monitoring, autoprogramming and self-maintenance. As he argues: "it is doubtful whether any shorter list can do justice to the great and varied uses of conscious experience" (*ibid.*, p. 347). I believe, however, that the variety of functions he lists can be reduced to the one I propose inasmuch as they let us relate ourselves to the objects and events of the world, thus making us understand both ourselves, the objects and the relations between ourselves and the objects. Indeed, all the activities we can consciously perform - reducing and resolving ambiguity of interpretation (definition, context-setting, editing, flagging, debugging, and analogy-forming function), learning and adapting to novel events (adaptation and learning function), setting goals, organizing, carrying out and controlling our mental and physical actions (flagging, recruiting, control, decision-making, and executive function), assigning priorities to the information to be processed (prioritizing and access-control function), and controlling and acting upon our own conscious states (metacognitive, self-monitoring, autoprogramming and self-maintenance function) - allow us to understand how events, objects and other beings of the world relate to us (and to each other): that is, they allow us to define, and assign a meaning to, both them and ourselves.

Conversely, it is precisely because we already have some knowledge of ourselves, as well as of the objects, the events and the other beings of the world, and of the relations between them and us, that we can perform certain actions and set ourselves certain goals. And this holds true even though not everything we do takes us to, or is based on, a full understanding of the objects and events of the world, and of the relations between them and ourselves. After all, a limited, partial, imperfect knowledge or, even worse, a lack of knowledge, represents for us a certain kind of cognitive basis on which we can proceed to construct future, more comprehensive knowledge.

1.1. Additional Comments

Allow me to make a few comments on my view that consciousness and self-consciousness entail a continuous process of differentiation between ourselves and other entities, which allows us to emerge as persons.

Firstly, some people could argue that the capacity to recognize differences and distinguish something from something else cannot be ascribed only to consciousness: even machines that cannot be said to be conscious at all are able to detect limits and differences.

My answer is that while machines that are properly programmed can undeniably detect differences and limits, they cannot set their own aims neither can they develop into, and emerge as, a person. Indeed, only those differences and limits that are consciously detected do allow an organism to emerge as a person: that is, only the distinctions drawn through

conscious and self-conscious processes allow a person to autonomously set his own aims and objectives, thus giving him the possibility of continuously and dynamically redefining and reconfiguring the basis on which to build and delimit him.

Just think, for example, about the difference between heating systems and human beings. A heating system regulates the heating elements on the basis of the differences of temperature it detects in the environment, where detection and regulation are done automatically based on the program devised by the designer. Unless the program is modified by an external operator (or some other kind of agent), the heating system will continue to detect temperature differences and regulate the heating elements in an invariable, inflexible way. When we are little children, we usually behave like machines, reacting instinctively to stimuli when detecting them: we cry, shout, move our arms and legs automatically, etc.; but, thanks to our conscious experiences (which, in the first years of our life are piloted mainly by the scolding, indications and warnings of our parents, relatives, and other adults, and later on by our self-reflections) we learn to *use* the differences that we perceive, in order to: modify our behavior (here, our parents' warnings or scolding are simply their way of making us aware of a difference: we should behave in this way and not in that way, we should follow this model and not that one, the correct thing to do is this and not that, etc.); set new aims (when we realize that we are pursuing an objective that we cannot achieve, we can decide to stop trying to achieve it); consider things from new and different points of view (which implies making new distinctions, perceiving differences where first we could not see any, or conversely, no longer perceiving the differences we used to perceive); etc.

Secondly, someone could note that my idea (that is, thanks to consciousness and self-consciousness, we emerge as persons through a continuous process of differentiation that establishes the difference between ourselves and other entities) is not new. Indeed, there is – to my knowledge - at least another author who holds a similar view: Maturana (1995): "My proposition is that the experience that we connote as we use the word consciousness is one of self-distinction as we distinguish ourselves making distinctions" (*ibid.*, p. 148).

However, I must note that although my proposal shares some features with Maturana's (such as that of conceiving the nervous system as a closed operating system, whose operations change as the system changes), it substantially differs from his for two main reasons:

a) Maturana conceives both consciousness and self-consciousness as being the product of language: "language constitutes the operationality that gives rise to the conditions that make possible the experiences of self-consciousness and consciousness" (*ibid.*, p. 174). In my view, on the contrary, while language may play a fundamental role in self-consciousness, it is not necessary for consciousness: just think for example of all those instances in which we do have a conscious experience of something, but lack the words to express it because the experience is completely new, or of all the forms of non-linguistic thought (Gambarara, 1996).
b) Maturana, defining consciousness and self-consciousness as the product of language, precludes himself any chance of bridging the gap between body and mind. Maturana's definition of consciousness is most probably due to his main (correct) concern of avoiding to analyze consciousness by using a purely physical vocabulary and description: "Consciousness is not localized in the nervous system or in the body in general" (*ibid.*, p. 166). This concern, associated with the lack of (or rather, the

refusal to adopt) an operational model capable of linking consciousness and self-consciousness to the operations of the nervous system ("consciousness … cannot be handled … as an operation in the nervous system" *ibid.*, p. 166), leads him to remain inside one of the domains produced by consciousness, that is, language, This prevents him from providing a possible explanation of how the operations of the nervous system can produce conscious experience. On the contrary, the model of consciousness I have developed (Marchetti, 2001, 2010a, 2010b) provides a way of connecting, though the working of the organ of attention, consciousness (and self-consciousness) to the physical substrate (namely, the nervous system), thus bridging the mind-body gap.

2. THE CONSCIOUS EXPERIENCE OF MEANINGS

Consciousness is the privileged place for the study of meanings. The meanings that other entities have for us (and we have for ourselves) coincide with the conscious experience of the (condensed combinations of the various) relations between us and them (and between us and ourselves). Studying and analyzing meanings means studying and analyzing the conscious experiences of such (condensed combinations of) relations, and how they form and develop.

This approach to the study of meanings has some important implications. Firstly, it conceives meanings as being something produced by the person consciously experiencing and constructing them, rather than something independent of the activity of the person. Secondly, it conceives meanings as being unavoidably characterized by the hallmark of the person's consciousness producing them, in the sense that their qualities and characteristics derive and arise from the person's way of applying and using his attention. Thirdly, it conceives meanings as not something that is necessarily static, fixed for ever, unalterable, but on the contrary as something that can change in time, according to the person's activity and interactions with other entities.

Here, some could argue that meanings, despite being produced in and through consciousness, are not themselves consciously experienced: that is, once they have been built, they become unconscious and work at an unconscious level. In my opinion this is only partially true. I do not deny that when perceiving words we do not unconsciously process them; nor do I deny that the meanings of words can unconsciously operate and elicit some other kinds of conscious or unconscious processes. I too hold that upon consciously perceiving the physical side of a word (its acoustic or visual form), what I have called "the schema of self"[4] *unconsciously* processes it. But I also maintain that: (1) after this step is accomplished, the schema of self makes the organ of attention perform the operations constituting the meaning of the word; (2) once the organ of attention has performed such operations, the person becomes *conscious* of the meaning of the word; (3) and finally, if there is sufficient time, the conscious experience of the meaning can in turn be unconsciously processed by the schema of self: which may imply additional conscious and unconscious processing, thus making the person have further conscious experiences, such as images,

[4] In my model of consciousness, the "schema of self" is the system that incorporates and coordinates all the innate and learned values and schemata needed to keep the organism alive, and that provides all the rules which make our organism perceive, move, act in general and interact with other organisms. See: Marchetti (2010b).

thoughts, etc. (it should be noted that a word can also be unconsciously perceived: see for example Marcel, 1983; in this case, its meaning can subsequently be either consciously or unconsciously perceived).

There are many reasons why I believe that meanings are consciously experienced. When hearing or reading a word or a sentence, the first thing we have in mind is its meaning. If this does not occur, for instance because we have not caught what has been said, or because the meaning of a certain word is unknown to us, then we immediately feel that we are lacking something: a feeling that can sometimes even assume the form of real disappointment, frustration or impotence, since it is usual for us to be aware of the meaning of words after having heard them.

Such a kind of awareness and the relevance that it has to our correctly understanding words and sentences is also very evident in all those instances where words and sentences can be interpreted in more than one way. For example, the sentence "I live near the bank" can be interpreted in at least two ways, depending on whether "bank" is taken to mean "the building where you can keep your money safely", or "the land near the river". Let us suppose that someone tells us they live near the bank, intending "near the river", whereas we understand "near the Chase Manhattan Bank". When we realize that we have misunderstood what they meant, we experience a switch in our consciousness: what was present in our mind and what we were aware of until a moment ago, is no longer present and has now been substituted by a new entity. Now we are aware of a different meaning: we feel that our consciousness is "filled" (La Berge, 1995) with a new object. It is precisely the experience of such a substitution that reveals the presence in our consciousness of the meanings of the word "bank". By the way, this same experience of a switch in our consciousness testifies to the "internal consistency" of conscious experiences (Baars, 1988): we are not able to consciously entertain more than one thought, idea, or perception per unit of time. As the classical experiences with Necker's cube, Ames' room or Rubin's figure show, consciousness gives rise to a unique, selective, and unitary content, however complex it may be: we cannot be conscious of two objects or think of two alternative ideas at the very same instant.

Other cases also clearly demonstrate the conscious existence of meanings, even if this is not specifically occasioned by words. Think of all those cases in which we realize that an object, which usually does not possess other meaning than the one conveyed by the word identifying it, suddenly acquires a new, particular meaning. For instance, a hat is usually seen as a hat: it conveys no particular meaning other than that of being a hat, that is, "a covering made to fit on the head, usually worn out of doors". However, it may happen that someone uses a hat as a sign to represent or indicate something particular that has nothing to do with the usual use of a hat. Let us suppose that criminals use hats to mean: "Watch out, the cops are here". If we do not know that hats can also have such a meaning, we will continue to see and consider them as usual. But when we get to realize that they also have that meaning, we experience a sudden change in our conscious state: the original and usual meaning of hat is now substituted by the new, particular meaning. The hat no longer refers to itself, but to a specific meaning. The conscious perception of the hat gives rise, and leaves room, to a new conscious presence: the consciousness of the meaning assigned to hats by criminals.

Think also of all the cases in which a tip-of-the-tongue state is experienced. Suppose we try to recall a forgotten name, or intend to say so-and-so but do not find the right word. We are fully aware of what we want to say, of its meaning, even if we do not remember the corresponding word or words. As argued by Baars (1988), this state closely resembles any

other conscious state: when occurring, it excludes other conscious contents; it is interrupted by incompatible conscious events; it stops dominating our limited capacities when the right word is found; it must be a complex state, like a mental image or a percept, since it implies our ability to accurately detect matches and mismatches of the candidate word. However, in one respect, the tip-of-the-tongue state differs from all other conscious states: it does not have the experienced qualities – like color, size or warmth – of feelings, mental images, and perceptual experiences.

Denying the fact that we consciously experience meanings would be tantamount to denying the fact that, more in general, we have conscious perceptions, images, ideas, and so on. Understanding the meaning of a word or sentence implies consciously experiencing such a meaning: that is, feeling it in, and through, our mind, having a phenomenal experience of it - however empty, poor or limited such experience may seem -, and consequently being able to differentiate it from other meanings. If we do not have such a subjective experience, we cannot be said to have understood the meaning of the word or sentence, as we cannot be said to have seen or heard a certain object if we have not consciously perceived it. What shows that we are conscious of something, whether a meaning, a perception, or anything else, is precisely the fact that we can recognize it and distinguish it from other things.

However, consciously experiencing meanings (whether linguistic or not) is not the same thing as consciously perceiving, or imagining an object. The phenomenal experience we have in the former case is different from the phenomenal experience we have in the latter. When consciously perceiving an object, we have a qualitative experience that differs radically from the experience we have when we are conscious of meanings. If a friend tells us: "I have bought a car", we can understand perfectly what he means without having to consciously perceive or imagine the car he has bought, its color, size, etc. It may happen that after hearing such a sentence we imagine the car, but our comprehension of the sentence is not strictly dependent on imagining the car. Meanings are experienced differently from perceptions and images: the former do not necessarily have the same rich, clear, concrete qualities of the latter. Whereas perceptual and imaginal experiences are characterized by rich qualitative properties, such as colors, textures, size, location, and so on, meanings are not. Compared to images and perceptions, meanings are, so to speak, immediately perceptible: in order to understand the meaning of a word or sentence, it is not necessary for us to mentally represent them by means of images or other more concrete sensory modalities.

What characterizes the conscious experience of a meaning can be considered a simple feeling compared to the qualitative richness and complexity of perceptual and imaginal experiences. However, such a simple feeling conceals a huge and complex knowledge: each meaning is like a door ready to be opened onto an entire net of relations, images, sounds, emotions, and so on. After having understood the meaning of a word or sentence, it is possible for us to have other kinds of conscious experiences connected or associated with such a word or sentence. After hearing the word "cat", we can, for instance, imagine, think about, have an idea of, or perceive a cat. The conscious experience of the meaning of the word "cat" enables us to go beyond the experience of the pure, strict mental meaning of the word, and have different conscious experiences, such as imagining or thinking extensively about a cat. The "simple" consciousness of the meaning of a word thus reveals a deeper and more articulated reality than what may appear at a first glance.

What features make all meanings share a common conscious form, and distinguish them from images and perceptions? What makes us experience and recognize meanings as

meanings, images as images, and perceptions as perceptions, without mistaking one for the other? Intuitively, the basic difference between meanings, on the one hand, and images and perceptions, on the other hand, lies in the two following factors:

a) the absence in meanings of any qualitative property peculiar to sense-organs or the somatosensory system: we can understand the meaning of the word "yellow" perfectly well, without having to actually perceive or imagine the color (this characteristic is even more evident with words such as "or", "with", "yes", whose meanings do not imply any sensorial characteristic). Images and perceptions, on the contrary, do possess such qualitative properties;
b) meanings do not refer or apply to just one thing, occurrence or event, but to a whole set of things, occurrences or events. The meaning of the word "horse" applies to all sorts of horses, whatever their sex, race, age, and so on; likewise, the word "and" applies to different contexts, whatever the entities or events that it connects. On the contrary, images and perceptions refer to just one specific thing, event or occurrence (apparently, proper names seem to be an exception to this rule, since they refer to only one specific individual. However, if we consider the fact that what we usually see as an individual undergoes continuous physical, cultural and psychological transformations, we will realize that the individual can also be seen as a collection of single and unique entities, each one being different from the others).

In conclusion, we can affirm that meanings can be studied and analyzed by studying and analyzing the conscious experiences that we have when forming, using and understanding them (for a similar view, see also Talmy: "Meaning is a consciousness phenomenon and, if it is to be taken on as a target of research, introspection ... is the relevant instrumentality able to reach its venue", 2007, p. xiii).

Given the preponderance, at least in terms of daily usage, of linguistic meanings over the other kinds of meanings, and the fact that the former are usually better codified in well attested systems (languages, dictionaries, grammars) and more easily available than the latter, in the following part of the book, I will mainly deal with linguistic meanings, and more specifically with the meanings of words.

3. LINGUISTIC MEANING

The meanings of words and sentences have a special weight in the general economy of our consciousness that cannot be underestimated: we live in a world of words from the very beginning of our life; words are continuously used both by others and by ourselves with pragmatic, educational, social, psychological, economic and political intents; words mold our experiences and perceptions. Most of our conscious life is occupied by them.

The meanings of words afford us the opportunity to have a particular kind of conscious experience: they isolate, decontextualize, "freeze" and classify in an articulated system the ever-changing and multiform stream of the conscious experiences that we have of the relations between us and other entities, between us and ourselves, and between other entities themselves.

The basic, linguistic meaning of each word isolates only some elements and some combinations of these elements from all the possible elements and combinations of our daily experience: the word "red" identifies only a certain kind of visual experience, which differs, for instance, from what the word "yellow" identifies.

The meaning of each word decontextualizes the elements and relations it isolates: the meaning of the word "apple" applies to all sorts of apples, whatever their shape, color, qualities, weight, and so on; likewise, the word "or" applies to different contexts, independently of the entities or events that it connects. By abstracting some elements and relations from any context, words can be applied to a whole set of occurrences or events.

The meaning of each word "freezes" the elements and relations it isolates, thus making it univocal, valid for, and shared by, everybody, and, to a certain extent, stable over time: consequently, the communicative function of language is safeguarded. If the other person says "I would like a cup of coffee", we understand perfectly well what he wants, even if he does not specify exactly which kind of coffee he would like, the shape of the cup, and so on. Obviously, the fact that words represent only a decontextualized version of the elements they isolate can sometimes generate ambiguities in the interpretation of what one intends when using them. These ambiguities, which originate from the extended, figurative, metaphorical or unusual use of the word, can only be resolved by resorting to implicit knowledge or to contextual information.

Words classify, in an articulated system of contents and functions, the elements and relations they isolate. Each word has certain relationships with other words, with regard to both content and syntactic function. The word "father", identifying a certain kind of parental entity, bears a certain content relation with the words "mother", "son", "brother", and "grandmother". At the same time, as a noun, it bears a certain relationship with verbs, adjectives, prepositions, other nouns, etc.: it cannot, for instance, acts as a preposition or a verb; it can be qualified by an adjective; and so on.

Therefore, the meaning of each word isolates, condenses, immobilizes and reduces the manifold, multiple and ever-flowing conscious experiences of our life in a stable, decontextualized and shared form. But how can this happen? What is it that makes meanings perform this function? My hypothesis (see Marchetti 1993, 2006, 2010b) is that:

1. each meaning is composed of a sequence of elements: the invariable elements that, independently of any individual, specific occurrence of a given conscious experience, are at the core, and are responsible for the production, of any instance of that conscious experience. The sequence then represents the skeleton that supports and allows the conversion or actualization of the meaning into any of its sensible, perceptible instances, whether they are images, memories or something else;
2. the elements composing the meanings of words are attentional operations;
3. words are tools to pilot attention.

In this view, each word conveys the condensed instructions on the attentional operations one has to perform if one wants to consciously experience – either as a pure meaning, an image, a real perception, a thought process, a concept, or something else – the relations that are expressed through and by it. When people use words and language, either to produce or to understand sentences, speech, and written texts, they perform the attentional operations

conveyed by the words they use. By performing the attentional operations conveyed by words, people consciously experience their meaning.

By saying that words and language pilot our attention, I do not at all intend to imply that they are the only communication system that can do this. Many other communication systems have been created in order to convey instructions on how, when and where to move attention. Some instances are the various artistic genres - plastic and figurative arts, music, cinema, dance, architecture, etc., fashion, advertising, scientific notation, mathematics, logic, and so on. Although some of these have reached such a point of formalization as to become real languages, natural languages hold supremacy over them in terms of usability, economy and potentiality.

Neither is it my intention to contend that only a structured language or communication system can drive our attention. We all experience daily occasional, random events, gestures, images, smells or sounds that make our attention move from where it was towards new courses, and consequently make us perform actions, have ideas, feelings, and so on. Moreover, it sometimes happens that we have a feeling or an idea that we would like to communicate to someone else, but for which we cannot find the adequate words or expression: this shows that language is not the only possible way of conveying instructions on how to move attention. More in general, language does not represent the only form human beings have to organize and process their conscious mental activity: images, perceptions and rudimentary forms of thought are some instances of the alternative possibilities.

Nor do I deny the possibility that we can autonomously pilot our attention without the intervention of codified stimuli, whether words, sounds or others: as a matter of fact, we can move or focus our attention in consequence of a personal sudden impulse or a subjective urge. In this case, we generate the stimulus by ourselves.

What I maintain on the contrary, is, first, that our attention can be controlled and directed; second, that this can be done either through an external stimulus, or through an internal one; and, third, that such stimuli can be either structured or unstructured. The movements of our attention can be caused by what someone else says to us, as well as by what we say to ourselves; but they can also result from the action of artificial languages, as well as from unstructured stimuli such as an unknown, abrupt sound, or a new, sudden emotion. Nevertheless, natural language remains the best structured and most common, economic, and favorite tool human beings use to influence each other's attention and their own.

4. ATTENTIONAL SEMANTICS

If words have the power of piloting the attention of human beings, then it is possible to study and analyze them in terms of the attentional changes they convey. This is precisely the objective of Attentional Semantics (Marchetti, 2006, 2010b). Attentional Semantics aims at finding the attentional instruction conveyed by the meanings of words, that is, the sequence of attentional operations that one has to perform if one wants to consciously experience the relations that words express. To achieve this goal, Attentional Semantics:

1. firstly, identifies the essential, elementary conscious experiences of the relations that invariably accompany, characterize, and are prompted by, the use of the word being analyzed;
2. secondly, describes these conscious experiences in terms of the attentional operations that are responsible for their production.

The first step, the identification of the elementary conscious experiences produced by the meanings of words, can be performed thanks to the fact that any conscious experience implies the possibility of being distinguished and differentiated from the others. We can be said to be conscious of something only if we are able to recognize it and distinguish it from other things. The conscious experience of something, say of a pear, lets us distinguish it from other fruits: it has certain phenomenal qualities – shape, taste, color, etc. - that other kinds of fruits do not have; like other kinds of fruits, but unlike stones, it goes bad; it does not perform the same actions that human beings do. We are conscious that a given object is a pear only if we can distinguish it, on the basis of its shape, color, taste, etc., from other kinds of fruits, or from other objects. This holds true even if we do not possess a name for the object we can distinguish from other objects, such as when we come across an object for the first time, or when we want to say something but do not find the right word.

When we use a certain word or inflect it in a certain way, we have the conscious experience of its meaning, that is, we know that it differs from the other words or from the same word but inflected in a different way precisely because it means something different from them: if we substitute it with another word, or if we inflect it differently, we will express a different idea or concept. It is the conscious experience of the meaning of a given word that makes us differentiate it from the meanings of other words, or that make us distinguish the objects which the word refers to from other objects. If we consider, for instance, the plural inflection of nouns, we can give a first rough description of the conscious experience it produces by saying that the plural form, as opposed to the singular form, implies for us a *multiplicity* of objects, actions or events: when we say "apples" we refer to more than one apple. This is not however the sole conscious experience we have when using the plural form. Actually, if we compare the word "apples" with "fruits", we will clearly notice that the plural introduces a certain kind of *equivalence* or uniformity between the various objects: whereas "apples" might simply give the idea that there is more than one apple, "fruits" unequivocally shows not only that there is more than one fruit, but also that it is possible to group under one common category objects of different kinds: from this point of view, apples, pears, bananas, and so on, despite their apparent diversity, are all equal, and share something in common. Obviously, by making further comparisons, we might distinguish some additional characteristics, and give a more precise and comprehensive account of the elementary conscious experiences of the plural form.

After identifying the elementary conscious experiences that invariably characterize the meanings of words, Attentional Semantics tries to describe these conscious experiences in terms of the attentional operations that are responsible for their production. For this purpose, Attentional Semantics must take into account the set of basic operations that attention can perform. Attention can for example:

- be oriented (this operation can in turn be divided in three elementary operations: engaging on a target, disengaging from it, and then shifting to a new target) (Posner, 1980, 1994b; Posner and Cohen, 1984);
- be focused at variable levels of size, being set either widely across a display of objects or narrowly to the size of a single object (Jonides, 1983);
- be focused at variable levels of intensity (La Berge, 1983);
- be stopped (Logan, 1983, 1985; Umiltà, 1988, 1994);
- be sustained or maintained for variable, though limited, amounts of time (La Berge, 1995);
- combine and integrate the features or properties of objects (Treisman and Gelade, 1980; Treisman, 1982). It is precisely this function that allows subjects to experience colored shapes as opposed to pure shapeless colors or pure colorless shapes[5].

On the basis of these elemental operations, more complex ones can be performed (even thanks to the working of some other organs such as working memory):

- attention can be addressed to an object or feature A, and then suspended momentarily from it, but in such a way as to keep or maintain it, as it were, in the background for a certain time, while simultaneously operating on a new object or feature B. This allows several kinds of operations to be performed, such as comparing A and B, referring A to B, constructing A using B as a model, evaluating A on the basis of B, and so on.
- each single attentional operation can be combined with other attentional operations in various ways, forming an orderly, albeit complex, sequence of attentional operations (the complexity of the sequence can vary both in terms of the quantity and the type of operations involved);
- a sequence of attentional operations can be integrated into a new single item to be stored in memory, a phenomenon known in psychology as *chunking* (G. A. Miller, 1956).

Considering, for example, the case of the plural inflection of nouns, a first approximate account in attentional terms of the conscious experiences that we have identified as characterizing it, that is, the experiences of *multiplicity* and *equivalence*, could be the following one. The conscious experience of multiplicity results from having repeatedly focused our attention, and from having each time thus obtained - whether in the form of a perception, a recollection, a mental image, or something else – an object that *differs* from the others in some aspect: the place it occupies, the time in which it occurs, its shape, etc. The conscious experience of equivalence (as well as that of difference implicit in the experience of multiplicity) relies instead on the possibility to:

[5] This list does not pretend to be exhaustive: it presents only some of the possible operations attention can perform. A very structured and useful classification, specifically designed for linguistic and semantic analysis, has been developed by Oakley (2004, 2009 and this volume). His *greater attention system* consists of three distinct but interdependent systems: the *signal system*, the *selection system*, and the *interpersonal system*. These three systems are comprised of eight processes of attention: the signal system consists of *alerting* and *orienting*; the selection systemconsists of *detecting*, *sustaining*, and *controlling*; and the interpersonal system consists of *sharing*, *harmonizing*, and *directing*.

- attentionally construct an object, say *a* (whether it is a perception, a mental image or something else);
- use *a* as a reference (by placing it in working memory) for the construction of another object;
- try to construct the latter object by means of repeating the attentional operations used to construct *a*. If the construction succeeds, then two objects (the reference object *a*, and the new object constructed on the basis of the reference object) can be said to be *equal*, otherwise they are considered as *different*.

It should be noted that the apparent contradiction between experiencing *difference*, implicit in multiplicity, and experiencing *equivalence* disappears when we consider that the latter experience concerns the object that is pluralized, while the former concerns something that is *associated* with the object, such as its spatial or temporal localization, or some of its features.

As we will see more extensively later, some of these attentional operations can be performed only thanks to the working of some other organs, such as memory and a comparison system. However, what is important to notice and realize at this level of analysis is that it is thanks to the various and different kinds of attentional operations we can perform that we can have a various and composite range of conscious experiences: consequently, we can characterize this variability and difference of conscious experiences primarily in terms of a corresponding variability and difference of attentional operations.

5. THE ANTECEDENT OF ATTENTIONAL SEMANTICS

The main hypothesis of Attentional Semantics that the function of words and language is to pilot a human being's attention, is not new and has its main antecedent in Silvio Ceccato's (Ceccato, 1969, 1972, 1987, 1988, 1990; Ceccato and Zonta 1980; Ceccato and Oliva, 1988) work. Here I will firstly summarize his main ideas and then discuss what I consider to be the main drawbacks of Ceccato's work.

5.1. Silvio Ceccato's Work

Ceccato's initial interests were mainly devoted to philosophy: in his first works (1964, 1966) he carried out an extensive and articulated criticism of the philosophical tradition by unmasking the main negative aspect of the philosopher's practice: the "philosophical mistake". The philosophical mistake consists in believing that things, whether they are physical objects, abstract ideas, perceptions, emotions, operations, or anything else, exist in themselves, independently of the mental activity performed by the person who experiences them. According to Ceccato, this belief led philosophers to completely overlook the importance of the mind in constructing and shaping things as we see, perceive, remember, conceive, and value them. Despite being primarily interested in matters that concern the mind, its activity and products (thought, ideas, concepts, values, etc.), philosophers - with some notable exceptions like Kant, Berkley and Hugo Dingler, whose works nevertheless do not

seem to be completely free from the philosophical mistake - are completely unaware of the importance of the mind. Consequently, philosophical theories are inadequate to explain all those matters, issues, phenomena, facts and events that are generated, elaborated and affected by the mind, or in some other way related to it.

In his subsequent studies, Ceccato tried to analyze and explain how the mind works, its role in perception and observation, how it produces thoughts, ideas, meanings, and emotions, and how it generates attitudes: in brief, how it contributes to constitute all the things we see, touch, feel, perceive, conceive, think about, remember, imagine, name, etc. and that characterize human life.

After his first attempts to develop a model of the mind, Ceccato reached the conclusion that the building block of mental life is the "attentional state", which he symbolized with an "S". Ceccato, despite admitting that attention can be focused for variable amounts of time, conceived of and above all used the attentional state as something that had essentially a digital nature, that is, as an "on-off" or "all-or-nothing" phenomenon.

In his view, attention can be either focused on sense organs or on itself. When attention is focused on sense-organs, we get what he called "presentiated things" (Italian: "presenziati"), that is, what is reffered to by words such as "red", "yellow", "cold", "hot", "pain" and "pleasure". "Presentiated things" are the basis for the construction of all physical and psychological things (Italian: "osservati"), such as "horse", "sun", "book", "jealousy", and "envy".

When attention is applied to itself, we get pure mental constructs, that is, constructs that do not identify any physical or psychological thing. By variously combining the attentional states with the aid of memory, we obtain various mental constructs. Ceccato called such mental constructs "mental categories": examples are prepositions, conjunctions, interrogative-indefinite-relative pronouns and adjectives, demonstrative adjective and pronouns, adverbs of place, time and manner, pronouns and adjectives of quantity, negation, numerals, "grammatical" verbs like "to be", "to be", "to have", "can", "must", etc., most morphemes indicating cases, number, tenses, moods, forms etc. (see Benedetti, 2009, 2010, 2011). The combination of pure mental categories and physical or psychological constructs produces what Ceccato called "mixed constructs" (Italian: "costrutti misti"), such as "fruit" and "trumpet".

Ceccato investigated many experiential fields, such as perception, observation, thought, language and attitudes, basing his analyses mainly but not only on the attentional state. No doubt, the field where he directed most of his analytical efforts was language. Certainly, this was principally due to the fact that, compared to other phenomena, language provides the most complex, complete, articulated, and available manifestations of the activity of the mind. However, in my opinion, a relevant part in determining Ceccato's choice of language as his major field of study was played by the prevailing influence exerted, first, by neo-positivism and, then, by analytical philosophy on the cultural environment of his time.

Ceccato set up a clear and well-defined research program based on the assumption that the meanings of words can and must be conceived of and analyzed in terms of the various combinations of one single element, the attentional state. For example, he hypothesized that the combination of two attentional states, S+S produces the mental category expressed by the Italian word "cosa" ("thing"); the combination of an attentional state with the mental category "cosa", S+(S+S), produces the mental category expressed by the Italian word "oggetto" ("object"); the combination of "cosa" ("thing") with an attentional state, (S+S)+S, produces

the mental category expressed by the Italian word "soggetto" ("subject"); and so on. This method is reminiscent of Mendeleev's way of classifying chemical elements: while the number of the basic elements is very limited – here, there is only one basic element: the attentional state "S" - their combination yields a theoretically infinite number of outcomes.

Ceccato performed his analyses mainly on the basis of his personal experience, using introspection as his main research tool. He considered his analyses as provisional hypotheses that must and can be subsequently tested and verified by means of empirical methods, such as neurosciences.

5.2. The Drawbacks of Ceccato's Proposal

Despite this well-defined research program, Ceccato did not always respect, and adhere to, it. According to Benedetti's research (2001), the majority of Ceccato's analyses (120 out of about 300) are expressed using common words, that is, without resorting either to the concept, or the more technical symbology of the attentional state. This fact, along with Ceccato's own recurring dissatisfaction with, and revision of, the combinatorial structure of his analytical system, and with his open admission in his last work (1996) that analytical work cannot be carried out only in terms of attentional states, clearly shows the inadequacy of Ceccato's choice of articulating his theory of mind and analyses of mental activities exclusively on such a restricted notion of attention or "attentional state" as it was conceived of by him.

In my opinion, most of the problems and difficulties raised by Ceccato's proposal derive from the fact that when approaching the study of mind he did not *fully and thoroughly* take into consideration and investigate its main aspect and characteristic: consciousness. If he had carefully considered consciousness, he would have been led to analyze how it forms, the mechanisms that make it appear, the importance it has for the emergence of the sentient subject and of the objects surrounding it, and its various manifestations and dimensions. Taking consciousness into due consideration would have implied for him: to reflect on and account for the role of unconscious mechanisms in generating, sustaining and shaping conscious phenomena (perceptions, meanings, memories, emotions, etc.); to consider the importance of the continuous interplay between consciousness and the unconscious for a subject to emerge as an entity differentiated from the objects that somehow have a relationship with it; to consider meanings and the process of meaning formation as a necessary step for, and a natural by-product of, the emergence of the subject; to explain phenomena like the stream of consciousness, thought and rhythm, and account for their propulsive, driving and pushing forward aspect in terms of the interplay between consciousness and the unconscious; to account for the qualitative and quantitative aspects of sensation and perception. By neglecting to consider consciousness in its whole dimension, he left the unconscious out of his analysis almost completely; he identified the mind only with its conscious products; he did not give any account of the qualitative and quantitative aspects of consciousness; he disregarded most of the ways in which attention works; he failed to give a systematic and exhaustive description of the meanings of words in attentional terms that could plausibly account for the conscious experience we have of such meanings.

Let us consider, for example, the problem of conscious perception. Ceccato states that when we focus our attention on sense-organs, we get what he calls "presentiated things"

(Italian "presenziati"), that is, we have those conscious experience that are referred to by words such as "red", "yellow", "soft", "hard", and so on. Though this approach suggests which road to take in order to analyze conscious perceptions, it neither fully clarifies how such perceptions occur, nor accounts for their qualitative and quantitative character.

Ceccato's proposal provides only a generic and incomplete description of the operation of "focusing", without explaining how it is possible to integrate at a specific level (the attentional, mental one) elements (sensory signals) that by definition are extraneous to that level and that, on the contrary, belong to another one (the naturalistic, physical one). Therefore, his analyses surreptitiously introduce spurious elements (the physical, sensory signal) that have little to do with the level of analysis he chose (the mental one), and that, as such, appear consequently as unanalyzed and unanalyzable *prius* or, using Laganà's definition, "extra-semantic postulations" (Laganà, 1992, p. 38). As Laganà rightly observes, the analysis of meanings as it is carried out according to Ceccato's principles is (I translate into English):

> forced to incorporate into itself unanalyzable elements that inevitably reappear when any observable construct is being formed, thus endangering the principle according to which all meanings can be reduced to mental operations (Laganà, 1992, p. 38).

The introduction of these spurious, unanalyzable elements is consequent to an inadequate and deficient analysis of how "presentiated things" are constructed. Ceccato, though having correctly stated that the "presentiated things" are obtained by applying attention to the sense-organs, did not however sufficiently investigate how this may come about. In fact, he completely neglected to analyze and explain how it is possible "to apply" attention to the various sense-organs, how and where a physical element (the physical, sensory signal) interacts and combines with a mental one (the attentional state), what effect this combination has on mental activity, and so on. In other words, he did not address questions such as: When attention is applied to a sense-organ, is the former affected by the latter? If so, how is it affected? What kind of influence does the sense-organ have on attention? If, on the contrary, we suppose that attention is not affected by the sense-organ, how can we explain the specific conscious, mental experience we have when applying our attention to a sense-organ, given the fact that attention is the sole element responsible for the mental, conscious presence of whatever we can be conscious of? How could we explain the qualitative difference between the conscious experience of a sensation and the conscious experience of a pure thought by resorting to the sole variable of attention? More in general, how does attention produce conscious experience?

If he had properly thought about how it is possible to practically and feasibly realize an organism that applies its attention to its sense-organs, and that consequently has certain conscious experiences, sensations and perceptions, he would have realized that his restricted notion of attention as a phenomenon that is characterized almost exclusively by the fact of having a digital nature and of being applicable to something is neither sufficient nor adequate. Indeed, the application of attention to the sense-organs produces conscious sensations and feelings that are qualitatively distinct from those we experience when using it at a purely mental level, such as when we deal with words like "end", "plural", or "and". Moreover, when applied to sense-organs, attention may produce very different qualitative and quantitative sensations: let us think, for instance, of the difference between colors and sounds,

or between strong and week sensations. How is it possible then to explain the qualitative and quantitative differences between all these distinct instances of conscious experience by resorting only to Ceccato's restricted notion of attention? If that which gives rise to the mental, conscious presence or experience of something is only and always the same element, that is, attention or the "attentional state", the grounds for the qualitative and quantitative differences between the various instances of conscious experience must necessarily be found *also* in it and not only in something else (for example, the sense-organs). This implies, therefore, that attention or the "attentional state" must be considered not simply and only: a) as a phenomenon having a digital nature, but also as one characterized by various quantitative degrees and that can assume various forms and dimensions; and b) for the properties it has of being "applied" to something, but also for its function in producing conscious experiences having distinct qualities: a function that can certainly be performed only when attention is applied to something, but that the sole notion of "applying" is not sufficient to explain since some other notion is required, notably that of a variation in the state of the organism's attention induced by the very attentional activity performed by the organism (see Marchetti, 2010b).

By not considering consciousness in its whole dimension, and consequently by adopting his restricted, digital notion of attention as the basis of mental life, Ceccato also negatively prejudiced his project of methodically and fully analyzing the meanings of words in terms of the various possible combinations of the attentional state. According to Benedetti (2001), Ceccato's proposal raises many theoretical and technical problems:

- In Ceccato's system, the exponential growth of the number of possible combinations is not accompanied by a corresponding growth of the number of words: by combining more than 4 attentional states, the number of combinations that do not correspond to any Italian word increases dramatically, leaving too many combinations without a linguistic counterpart. This fact poses a serious doubt as to the usefulness of the proposal.
- The mathematical rigidity of the system of combinations entails a complete and exact classification covering all the possible meanings. Such a classification should be mirrored by a sort of universal language of thought, a kind of *mentalese*, shared by all human beings. What linguistic diversity shows, on the contrary, is that such a universal language of thought does not exist: some languages possess words that some other languages do not, and not always is it possible to exactly translate a word or sentence from one language to another. If a *mentalese* really existed, such problems would not occur.
- A system of analysis based on the combination of a set of basic elements works on a deductive principle. Deductive systems are risky: if even one of the basic elements or assumptions is wrong, the whole system can collapse. An inductive approach would seem to be more suitable.
- The very idea of the possibility of obtaining a system of meanings by combining few basic elements implies the idea of a set of combinations of increasing complexity: the higher the number of elements combined, the higher the complexity of the corresponding meanings. Such a system can ideally be partitioned into levels of combinations of increasing complexity: a first level of meanings formed by only one element, a second level of meanings formed by the combination of two elements, a

> third level of meanings formed by the combination of three elements, and so on. If we try to relate this hypothesis of a system of meanings of increasing complexity with children's language development, we face two alternatives: as soon as the neuronal correlates of the basic elements and of their combinations are sufficiently developed to be able to work, children can have: (1) immediate language development: they form all the possible combinations in a very short time; or (2) gradual language development: children form the combinations gradually, over the years, according to the level of complexity of the combinations. Children's language development, on the one hand, contrasts sharply with the first alternative: children need many years to learn a language, and, albeit with individual differences, seem to develop their vocabulary following a common kind of order (for instance, words pertaining to specialized vocabularies are learnt later than common words). On the other hand, it does not reflect the levels of combinations of increasing complexity inherent in Ceccato's system. Children do not learn to say first "thing", then "I" and "it", then "beginning", "end", "individual", etc., that is, they do not follow the levels of Ceccato's system: which, although not making the second alternative (gradual language development) implausible, certainly makes Ceccato's analyses highly implausible.

According to Benedetti (2001, 2005, 2006, 2011) and to me (2006, 2010b), these problems can partly be solved by adopting a wider and more representative set of basic operations. Benedetti (2005), for example, identifies nine basic operations, some of which are not attentional ones: 1) attentional focalisation; 2) attentional movement; 3) evaluation of attentional movement; 4) change of intensity of attentional focalisation; 5) maintenance of attentional focalisation for variable amounts of time; 6) attentional discarding; 7) memory; 8) representation; and 9) comparison. This set of basic operations is not exhaustive, determined once and for all, but is open: it can always be expanded, reviewed and improved.

Benedetti, even though his criticism of Ceccato does not originate from the same considerations on consciousness I have made here, but mainly from methodological and technical observations about Ceccato's system, reaches my same conclusions: only by adopting an "analogical" conception of attention - which, unlike the "digital" one adopted by Ceccato, accounts for the quantitative, qualitative and dimensional variability of its states - can we adequately and accurately analyze and describe those special products of our mind that are the meanings of words.

I think that one can immediately and easily see the advantage of adopting a wider set of basic attentional operations simply by comparing the disarming and appealing simplicity of the analyses made by Benedetti with Ceccato's. While the former explains the meaning of very basic and primitive words, such as "to be", or "point" by resorting to few essential attentional operations, the latter has to resort to a longer series of operations. Even if only from the point of view of the pure phylogenetic formation of meanings and mental categories, this certainly makes Ceccato's analyses unconvincing as opposed to Benedetti's.

Let us consider for example the analysis of the word "point" (Italian, "punto"). While Ceccato (Ceccato and Zonta, 1980) describes the meaning of "point" as resulting from the combination of the categories of "place" (Italian, "posto") and "singular" (it should be noted that in Ceccato's system the category of "place" results from the combination of the categories of "space" and "singular"; the category of "space" results from the combination of

the categories of "thing" and "plural"; the category of "thing" results from the combination of two attentional states; the category of "plural" results from the combination of an initial category of "thing", an attentional state and a final category of "thing"; the category of "singular" results from the combination of initial attentional state, the category of "thing" and a final attentional state), Benedetti explains the meaning of "point" as (I translate into English):

> a narrowing down of the focus of attention on its object or field, so that attention is prevented from making any further movement, and yet remains focused on them (Benedetti, 1999, p. 176).

6. The Importance of Non-Attentional Operations for Attentional Semantics

Benedetti's work (Benedetti, 2005, 2006, 2009, 2011) hints at another fundamental aspect of research on mind that Ceccato unjustifiably and inexplicably underestimated and overlooked: the importance of non-attentional operations. In fact, Benedetti proposes representation, memory and comparison as basic operations. These operations, which in Benedetti's view are non-attentional, can nonetheless help or support attention in performing some specific activity, or can be the outcome of some previously performed attentional operation. Let us consider the importance of such kinds of operations for Attentional Semantics.

6.1. Mental Activity Consists of Conscious and Unconscious Operations

According to Ceccato, mental activity is characterized by the fact that its products coincide with the activity itself, in the sense that they last and are present only as long as the activity itself takes place. Let us consider, for instance, the thought of a burning tree: the image of the burning tree (that is, the product of your mental activity) lasts only as long as you think about it, and fades away as soon as you stop thinking about it (that is, when you stop performing that specific mental activity). Compared to mental activity, other kinds of activities, such as for instance physical or psychological ones, are characterized on the contrary by the fact that their products outlive the activity itself, and remain quite visible even after the activity is over: when we burn a piece of wood, we can see the product of the physical activity (the ashes) quite clearly even after it has ended.

Ceccato's definition certainly captures one of the most distinctive aspects of mental activity. However it unavoidably: a) recognizes only a given kind of mental products, excluding many other products of equal importance; and b) confines mental activity only to, and identifies it only with, *conscious* mental activity, excluding *unconscious* mental activity altogether (incidentally, it should be noted that these limitations make Ceccato encounter severe problems when analyzing not only the meanings of words, but also the structure of thought and rhythm: see Marchetti, 1997).

As to a), it can be noted that conscious mental activity produces not only mental products that fade away as soon as it stops, but also mental products that do not fade away at all when it stops. All the mental abilities and things you learn, such as for example the language you speak or your ability to make calculations, are undoubtedly the products of your conscious attending to what your parents, teachers, etc. told you when they taught you to speak and make calculations: these products certainly faded away from your *consciousness* after you stopped attending to your parents and teachers, but they did not fade away from your *mind*.

As to b), it can be observed that (at least part of) the activity we perform unconsciously possesses all the qualities of what can be defined as mental, except obviously the quality of being conscious. Let us consider this point more extensively.

Unconscious mental products and processes constitute what Baars (1988) calls the "context", that is, the complex and articulated system of rules and representations that always constraints conscious contents without itself being conscious, and without which there could hardly be conscious contents at all: to a certain extent, but consistently and substantially, it influences, determines and sustains our conscious life, whether by automatically or semi-automatically processing stimuli, performing or contributing to perform acquired skills and procedures, or creatively finding new solutions to new problems.

Obviously, some could claim that these unconscious products and processes are not at all mental, but merely physical: this seems to be the thesis embraced, for instance, by Searle when he says: "that is all that is going on inside the brain: neurophysiological processes and consciousness. On my account, talk of the unconscious mind is simply talk of the causal capacities of neurophysiology to cause conscious states and conscious behavior" (Searle 1992, p. 168).

Undoubtedly, unconscious products and processes differ from conscious ones: for example, they lack some properties of the latter, the most important one being that we do not know that they are occurring. In this view, one may legitimately claim that they are not mental phenomena. However, they also possess properties that contribute to distinguish them altogether from purely *physical* products and processes, and that make it reasonable enough to assimilate them to *mental* ones: properties such as those that: 1) allow one, after having learnt the relevant rules, to automatically apply these rules even in *new unexpected* contexts and situations, and perform *new and very complex* operations, or that: 2) allow one to *creatively* find the solution to *new* problems.

As to the former kind of properties (1), think for example of all those cases in which, despite facing a new situation, never experienced before, you are able to automatically, but sophistically, decode and react to it, without having any conscious awareness of the rules by which you do so. Velmans illustrates this situation very well: "Consider how one silently reads the following sentence: 'The forest ranger did not permit us to enter the reserve without a permit'. Note that on its first occurrence, the word 'permit' was (silently) pronounced with the stress on the second syllable (per*mit*), whereas on its second occurrence the stress was on the first syllable (*per*mit)" (Velmans, 1991, p. 657). As Velmans argues, "the syntactic and semantic analysis required to determine the appropriate meaning of the word 'permit' must have taken place prior to the allocation of the stress pattern; and this in turn, must have taken place prior to the phonemic image entering awareness". While reading, one is not conscious at all of the complex and sophisticated processes that allow one (even when a similar combination of words is encountered for the first time) to correctly interpret the sentence: they just happen, as a consequence of having previously learned to read.

As to the latter kind of properties (2), think of all those cases in which unconscious processes help us perform cognitive, imaginative and decision-making functions in a much more creative and flexible way than conscious processes themselves. Sometimes we face a difficult problem and are not able to find an immediate solution to it: the best thing we can do in that case is to literally "sleep on it", as the saying goes, that is, let our unconsciousdo the job that our conscious side cannot accomplish. In fact, most of the times, the solution to our problems comes automatically thanks to the working of our unconscious, whether it occurs during sleep or in other relaxed occasions[6].

All this makes it quite unrealistic to think of unconscious products and processes as purely physical and to believe that they can be described and predicted solely by an *a priori* knowledge of neuronal processes. As Libet observes (Libet, 2004, p. 100): "It seems simpler, more productive, and more in tune with clinical experience to regard unconscious processes as 'mental functions', phenomena that are related to the conscious mental functions but lack the added phenomenon of awareness".

This way of regarding unconscious processes and products as mental phenomena can be expressed in a definition of mental activity which, despite being broader and less specific than Ceccato's, is able nonetheless to account in a sensible and comprehensive way for a fundamental difference between the mental and the physical domain. According to this definition, *mental activity is that activity that allows an agent provided with a mind to act on and deal with the same object or event in different ways, and to act on and deal with different objects and events in the same way.* Here I use the verb "to act" and "to deal" in their most general sense, meaning not only "to perform purely physical kinds of actions", but also partially-physical and non-physical ones, such as thinking about, conceiving of and imagining. In this sense, it is thanks to mental activity that we can work on, perform activities on, see, perceive, think about, conceive of and imagine the same physical object or event in several, different ways, and work on, perform activities on, see, perceive, think about, conceive of, and imagine different physical objects or events in the same way. If we look at a wood, for instance, we can not only say that it is a "wood" but also "trees" or "a set of trees", or also "an area of land, smaller than a forest, covered with growing trees". Conversely, for different kinds of trees – an oak, a pine, an elm, etc. – we can say that they are all "trees". In this sense, mental activity is completely independent of and distinguished from the physical domain.

Using Pylyshyn's notion of *cognitive penetrability* (1984), we could say that mental activity comprises all the processes that are cognitively penetrable, that is, that can be altered in a semantically regular way, by changing for example the subject's goals, needs or beliefs. An example of a cognitively penetrable process is perception: the way something is perceived can vary radically even if the physical stimulus remains the same, and can be the same even if the physical stimulus changes. According to Pylyshyn, cognitively penetrable processes do not belong to the physical domain, nor to that of the functional mechanisms, but to the

[6] For experimental evidence of the merits of unconscious thought in creativity, see for example Dijksterhuis & Meurs (2005), Dijksterhuis & Nordgren (2006) and Zhong et al. (2008). According to Dijksterhuis & Nordgren (2006), there are various reasons for most of the merits of unconscious versus conscious thought: the former does not have the capacity limits characterizing the latter; during impression formation, people stereotype more when they think consciously than when they think unconsciously; consciousness generates thoughts or ideas in a very focused and convergent way, whereas the unconscious is more divergent. However, as Dijksterhuis & Nordgren (2006) correctly point out, all this does not imply that unconscious thought *always* performs better than conscious thought, but simply that it performs better under *certain* circumstances.

cognitive one: virtually no physical properties are necessary and sufficient for the occurrence of such a kind of processes. Consequently, the only proper way of describing them is by using the vocabulary of cognitive sciences, not the vocabulary of the physical or other natural sciences.

Unconscious processes also *are*, to a certain extent, cognitively penetrable. Indeed, they can be, and actually are, restructured and reorganized according to new beliefs, intentions and goals: they can be and are continuously learnt, modified and adapted to new contexts and needs. Clear evidence is given by psychological experiments where the visual field is transformed in a dramatic way: Gregory (1966), for instance, reports experiments where subjects were fitted with prism spectacles that turned the visual image upside down. At first, the subjects saw the world upside down. However, after wearing these spectacles continuously for about a week, subjects began to be able to behave as if the image were normal.

6.2. A Classification of Conscious Experiences Elicited and Produced by the Joint Activity of the Organ of Attention and Other Organs

Mental activity seems therefore to be better and more comprehensively understood when defined in terms that capture not only its conscious side but also its unconscious one. In this view, if Attentional Semantics wants to give an exhaustive and complete account of the operations that produce the meaning of a certain word, it has to rely not only on the two different levels or steps of analysis that we have already described (that is, firstly, the identification of the elementary conscious experiences that invariably the use of the word brings about, and secondly, the description of the attentional operations that produce such conscious experiences). It must also rely on a number of unconscious and non-conscious operations, and on the respective organs, that directly or indirectly serve either as the support that makes it possible for the attentional operations (and, consequently, for conscious experiences) to take place, be completed, and occur in a certain way, or as the necessary complement that makes it possible to execute and implement the activities that are determined and triggered by conscious experiences.

Attentional Semantics proposes a classification of such unconscious operations, and of the relevant organs. The classification is based on the kind of conscious experience produced by the specific relationship existing between the organ of attention (and the activitiy it performs) and the other organs. The classification also includes all those physical operations (which I will call from now on, “non-conscious”) and their relevant organs that in some way interact with the organ of attention. So far, I have identified four fundamental and specific kinds of conscious experiences, each of which is produced by the specific way the organ of attention or the products of its activity affect, or are affected by, the other organs:

1. conscious experiences that are determined by the direct application of attention to the other organs;
2. conscious experiences that are determined by the direct or indirect influence on the organ of attention of some other organs and the physical substrate of the body, whether or not attention is applied to them;

3. conscious experiences resulting from the operations, performed by the other organs, on the products of the activity of the organ of attention;
4. conscious experiences resulting from activities that are triggered, organized and controlled by earlier conscious mental acts.

Let us now analyze in some detail these four kinds of conscious experience, and describe the organs and operations that make them possible.

6.2.1. Conscious Experiences Determined by the Application of Attention to Other Organs

The first kind of conscious experience is, no doubt, the most common one and is exemplified by most of the physical sensations and perceptions we can have (tactile, auditory, visual, etc). They can be either stimulated by a real external stimulus that we passively undergo or actively search and expect, or elicited and evoked by retrieving the information stored in our memory. We produce them by focusing our attention either on our sense-organs and proprioceptive system, or on our memory system: what we obtain are respectively real sensations and perceptions, and imagined or remembered sensations and perceptions.

The organs necessary for attention to produce this first kind of conscious experience are therefore the sense-organs, the proprioceptive system and memory. It is the activity done by these organs that supplies the organ of attention with the material that allows us to have physical sensations, perceive and feel physical things, imagine, recollect, evoke and represent physical objects, events and situations, but also to have hallucinations. Yet, these conscious experiences could not take place without the active participation of attention. In fact, what mainly characterizes them is the fact that they last only as long as we focus our attention on our sense-organs and proprioceptive system, or on our memory system: as soon as we withdraw our attention from these organs, these conscious experiences disappear.

It is important to underline that (at least part of) the sense-organs and proprioceptive system does not only supply what we could define raw, unstructured sensations, such as colors, sounds, smells, and the like, but also, up to a certain degree, structured perceptions. For example, Pylyshyn (1999) lists evidence concerning visual perception that clearly confirms that our visual sense organ provides us with structured perceptions. No doubt, the more striking evidence is that optical illusions are not destroyed by demonstrating their falsity: even after you have had a good look, for instance, at the *Ames room*, it still looks as though the person on one side is much bigger than the person on the other side. Therefore, our perceptual system, when we apply our attention to it, supplies more than raw sensations: it supplies us with partly structured perceptions.

Another important source of evidence is represented by the experiments on visual search. A vast amount of research undisputedly shows that at the first stage of vision, which, strangely indeed, psychologists label as "preattentive" or "vision before attention", some features pop-out and guide the following, subsequent stages of vision (Wolfe, 1994)[7]. The features that certainly have this property are: colors, orientation, motion, size, curvature,

[7] I say "strangely indeed" because this first stage of vision actually involves some kind or amount of attention. In visual search experiments subjects are requested to look for one target item in a display containing a number of distracting items. Therefore, they apply their attention to their visual system, even if for a short period. In my opinion, then, it would be better to speak of "preliminary attention" rather than of "preattentive" or "vision before attention".

various cues of depth, and several aspects of form. "Preattentive" processing of more complex properties like object shape, letters or faces seems to be efficient only if stimuli are overlearned (Wolfe 1998, 2000). Further evidence comes from the asymmetry of many basic feature searches: in a display, it is easier to find a moving stimulus among stationary distractors than to find a stationary target among moving distractors; it is easier to find the presence of something than to find its absence; it is easier to find a deviation from a canonical stimulus than it is to find a canonical stimulus among deviants. Using Wolfe's words (Wolfe, 1998): "preattentive processes divide the scene into 'things' and the preattentive basic features describe the 'stuff' out of which perceptual 'things' are made". All this clearly testifies to the complex role played by our perceptual system in supplying structured perceptions.

A very important kind of conscious experience connected to the proprioceptive and the vestibular systems, is that of space. When attention is applied and locked to the proprioceptive and the vestibular systems, and its activity is consequently piloted by them, *shifts or movements of attention* occur[8]. As highlighted by Carstensen (2007, 2011 and this volume) and by Scheider and Kuhn (2011), conscious spatial experience is primarily determined by such shifts or movements of attention (on the importance of bodily movements in general for the experience of space, see Berthoz, 2000 and Morris, 2004).

Attentional movements or shifts, even though necessary for the construction of the conscious experience of space, are not sufficient, however (Marchetti, 2009b). The conscious experience of space also requires that working memory assemblies and integrates the single perceptions entailed by movements of attention by keeping them present in an *incremental* way. It is this kind of assembling and integrating activity of working memory that allows for the construction of a "sequence" or "succession" of perceptions, which is the basis for the formation of two-dimensional constructs, such as "path", "line" and "distance"[9].

The need for working memory (in addition to attentional movements) in the construction of the conscious experience of space is evident when comparing the different conscious experiences of "movement" and "line" (or "path") we have when performing the same act. For example, move your index finger slowly. Now, look at the tip of the finger while the finger moves, and consider it as a "moving" object. Next, repeat the movement and consider the "path" or "line" drawn by the tip of the finger. You will notice that in the former case you will simply follow the tip of the finger, maybe anticipating its direction, but without keeping track of the positions previously occupied by it; on the contrary, in the latter case you will follow the tip of the finger by constantly keeping track of the positions it occupied, moment after moment, since it started moving.

6.2.2. Conscious Experiences Determined by the Influence on the Organ of Attention of Other Organs and the Physical Substrate of the Body

These conscious experiences arise because of the influence that, in general, the physical substrate of the body and, more specifically, the activity of some other organs have on the

[8] According to the premotor theory of attention put forward by Rizzolatti et al. (1987), spatial attention derives from the activation of the same frontal-parietal circuits that, in other conditions, determine motor behavior toward specific spatial locations.

[9] The need for the assembly and integration of the single perceptions entailed by movements of attention is due to the periodic, pulse-like nature of attention (Bush and VanRullen, 2010; Marchetti, 2014; Van Rullen et al., 2007; Wyble et al., 2011).

organ of attention (even though attention is not applied to them). We can distinguish here between two different kinds of experiences according to which kind of influence is exerted on the organ of attention. The first is elicited when an organ or the physical substrate of the body affects, pervasively and unselectively, the organ of attention, thus indistinctively altering or modulating all its operations; the second, when an organ sends circumscribed and selective instructions to the organ of attention on the operations it has to perform.

Typical examples of conscious experiences elicited by the first kind of influence are physiological states such as pain, pleasure, thirst, hunger and tiredness, and psychological states such as emotions, moods and impulses. Usually, their occurrence is accompanied by, or is a sign of, a temporarily general transformation in the working mode of our brain and body: all our brain processes and physical activities result as either speeded up, slowed down or altered in some other way. As a consequence, we cannot behave as if such conscious experiences were not occurring. They share, in common with the conscious experiences analyzed in the preceding section (those determined by the application of attention to the other organs), the character of *immediacy* and *intuitiveness*, that is, using Ducasse's (1944, p. 134) words, the fact that "however much we may learn *about* them, yet we do not know *them* unless we ourselves have felt their intrinsic quality". They have this character because of the pervasiveness of the influence of the physical substrate of the body and the activity of the other organs on the organ of attention: indeed, they affect and alter, directly or indirectly, its way of working in a global and indistinct manner for periods of time that may even be relatively long. As a consequence, our perceptions, thoughts and sensations, in a word, all our conscious activities, assume a distinct character that is specific to each kind of physiological or psychological state. When, for example, we feel "enthusiastic", all our movements, actions and thoughts seem to be driven by a force that comes from within us but that we cannot control, a force that pushes us to perform them and makes them easy to perform. This kind of influence on the organ of attention therefore gives a distinct form to all the conscious experiences we can have: thoughts, perceptions, images, memories, etc.

The second kind of influence affects not so much the organ of attention as the operations it performs. While the first kind of influence affects indirectly, yet pervasively, the operations of the organ of attention, the second kind pilots them directly, yet selectively. The first kind of influence is exerted on the organ of attention, and has a physical character; the second, on the operations of the organ of attention, and has a symbolic and procedural character. The first kind of influence modulates the global working of the organ of attention, whatever the operations it has to perform; on the contrary, the second kind specifies precisely what operations the organ of attention has to perform. While the first kind of influence gives a distinct form to all the conscious experiences we can have, irrespectively of whether they are thoughts, perceptions, images, memories, or something else, the second gives origin to specific thoughts, perceptions, images, memories, and so on. The second kind of influence can be brought about by all the automatisms, schemas, frames or unconscious procedures that we have acquired and learnt during our life, and that help us perform complex activities such as speaking, driving, playing games, doing specific work, achieving goals, and so on. This kind of influence is also exerted by all those mental or psychological elements that are not innate, but subjectively or culturally acquired, determined, and usually structured and organized in fields or networks, such as concepts, memories, representations, motivations, expectations, interests and aspirations.

Let us now make some additional considerations about the first kind of experience, which is induced on the organ of attention by the pervasive and unselective influence of the physical substrate of the body and the activity of the other organs.

Due to the close interconnection of all the organs of our body, practically any of these can directly and indirectly affect the organ of attention, even though certain organs seem to have been selected through evolution as a specialized means of modulating brain activities in general: an example is given by the organs that secrete hormones, neurotransmitters and neuromodulators.

A specific kind of conscious (and unconscious and non-conscious) experiences are those elicited by, or somehow linked to, the consumption of the energy level of the organ of attention. The consumption may be induced by various causes, such as stress, physical activity, lack of food, mental activity, etc., and produces some important phenomena such as sleep and time sensations.

Everyday we experience feeling physically and mentally exhausted, not being able to do any kind of activity any longer, and the consequent necessity to rest and sleep. Sleep is the principal means our organism has of recovering lost energy. Since dreamless sleep is characterized by the fact that, while some vital functions of our organism continue to be performed, we cannot exert any control over our attention, and we have no conscious activity or experience whatsoever, one can infer that one of the most important kinds of energy that has to be restored is that necessary for the organ of attention to work. According to La Berge, "the major 'computational' goal of resting sleep appears to be the blocking of sensory information from reaching the cortex and the prevention of information processing within and between cortical areas" (La Berge 1995, p. 185). The brain would achieve this goal through a dramatic shift of activity of the thalamocortical circuitry, which is one of the main organs responsible for attentional activity, from a regular-spiking mode to a burst-firing mode.

A very special kind of conscious activity we have during sleep is dreaming. Dreaming is the product of the combination of two different kinds of conscious experience: those determined by the direct application of attention to our memory system, and those elicited by the influence exerted on the organ of attention by the other organs and the physical substrate. Indeed, dreams are made of sensory experiences: we see, hear, smell, touch, etc., which makes us feel active, participate directly in our experience; but dreams are also made of a part that does not depend on our will: they proceed independently of our decisions, they go on even if you do not want them to.

An important conscious experience connected with the consumption of energy of the organ of attention is that of time. The conscious experience of time is elicited by the continuous and incremental application of a portion of our attention to the conscious product of the activity performed by means of another portion of our attention: this requires the support of some other organs such as working memory (Marchetti, 2009a, 2014). In this sense, the classification of the sensation of time proves to be quite problematic, because it could also be classified under the next category, that is, as a conscious experience resulting from the operations performed by the other organs on the products of the activity performed by the organ of attention.

On the basis of the conscious experiences determined by the direct application of attention to the other organs, and by the direct or indirect influence on the organ of attention of the other organs and the physical substrate of the body, it is possible to build the forms of conscious experiences that will be analyzed in the following two sections. These latter forms

are more elaborated than the former, and their formation requires the intervention of self-consciousness.

6.2.3. Conscious Experiences Resulting from Operations, Performed by Other Organs, on the Products of the Activity of the Organ of Attention

This kind of conscious experience arises when the products of the activity performed by the organ of attention - that is, other conscious experiences - are combined, used to form other mental constructs, or further worked out thanks to the activity performed by one or more other organs. We all commonly experience, for instance, the possibility of comparing things: we can see and say that a given person is "taller" than another, or that a given food is "saltier" than another. This possibility has even been grammatically formalized in our languages by means of the comparative forms. We do not know how it works: we simply look at things, or consider them, and find that we are able to say: "A is more interesting than B", or "A is more beautiful than B". We are conscious of the starting situation ("A" and "B") and of the final situation ("A is more interesting than B"), but we are not aware of the mechanisms that allow us to get from the former to the latter. We can therefore only formulate some hypothesizes about what these mechanisms are and what kind of operations they perform. One can assume, for example, that in order to perform a comparison there must be at least a memory system that stores the conscious information concerning the term of comparison ("B"), and a mechanism that measures the thing to be compared ("A") against the term of comparison. The important thing to know however is that, whatever these non-conscious mechanisms are, they are nevertheless necessary to make a comparison between A and B, and that attention alone is not sufficient: without these non-conscious mechanisms we will never be conscious of the differences between A and B.

Many kinds of operations can be performed on the products of the activity of the organ of attention, and consequently many kinds of conscious results can be obtained. We can perform some quite abstract operations, such as: refer a thing, object or event, say A, to another, say B; evaluate A on the basis of B; integrate a sequence of attentional operations, say A, B, into a new single item, say C, a phenomenon known in psychology as *chunking* (G. A. Miller, 1956); abstract what is common to A and B, thus getting a new superordinate category, say α; add A to B; subtract A from B; multiply A by B; divide A by B. But we can also perform additional concrete, perceptible operations, such as: turn a pure mental construct, such as a meaning, into a mental image or a perceptible representation; elicit ideas, representation, emotions, desires, etc. from a given conscious experience by means of free association; imagine something that has not yet occurred, or mentally represent how a given situation could evolve, what form a certain object will assume (an experience that has been tested and analyzed by psychologists in various ways: see, for instance, the experiment on the mental rotation of a three-dimensional object reported by Shepard and Metzler, 1971); and so on. Undoubtedly, the production of such images or representations requires a mechanism that can combine and work out the perceptive material stored in memory. These kinds of representations or images must not be confused with the representations or images we get by simply focusing our attention on our memory system. While the representations we get by focusing our attention on our memory system *reproduce* or *re-present* in a simplified way something we have already experienced, the representations we get by elaborating and further working out the perceptive material stored in our memory system *produce* something new,

allowing us to anticipate future events and even what we might never have seen before: a difference that is well-known to psychologists (see, for instance, Denis, 1991).

All the operations that are performed on the products of the activity of the organ of attention by one or more other organs are identified and designated by the words "to think", "thinking" and "thought". Not all authors share this opinion however. For Ceccato and Zonta (1980) these words refer only and specifically to that kind of activity, or to the results of such a kind of activity, by means of which we mentally connect things – whether they are meanings, images, ideas, thoughts or feelings - relating one thing or group of things to another. Ceccato and Zonta conceive thought as being a correlational or combinatorial activity that allows us to relate or connect a given mental construct A with a mental construct B via a certain kind of relation C. Undoubtedly, in most of the cases, when we think we correlate things to each other, and we do this for many purposes: to measure the distance between things, to assess their mutual size or quality, to infer one from the other, to establish a causal relationship between them, to combine them, to separate them, etc. Many kinds of relationships can then be established between things: causal ("A is due to B", "Because of A, B lost his job"), spatial ("B stayed in front of A"), temporal ("A arrived before B"), logical ("If A, then B"), physical, psychological, aesthetical, and so on. Considering that correlational thought play a predominant and import role in our everyday life, and that the manifold diversity and variety of relationships that can be set between things is reducible to a general, basic form of activity - the correlational one -, it is easily understandable why one can be led to suppose that thought has this very specific form.

However, in my opinion Ceccato and Zonta's definition of thought and thinking as a purely combinatorial or correlational activity seems to be too limited: it does not cover all the various and different instances of thought experience. This is due to several reasons.

Firstly, we use the words "thoughts" and "to think" to indicate some other kind of mental activity that can hardly be conceived of as a combinatorial or correlational one. Sometimes the verb "to think" is synonymous with "calling to mind", "remembering" or "directing one's attention to something" as in: "He thought of his father"; sometimes it is synonymous with "occupying one's mind with something" as in: "I can't stop thinking about her". In all these there is no correlational activity at all, or there is not necessarily correlational activity: we call to mind a thing, direct our attention toward a thing, have in mind and cannot free ourselves of a thing, but do not (necessarily) correlate that thing to, or combine it with, something else. What our attention is doing is moving toward a thing, or trying to escape from it, but not relating it to something else[10].

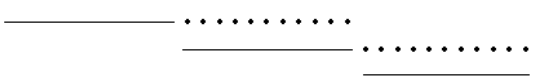
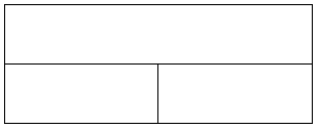
Secondly, it does not account for some instances of visuo-spatial thought. When we think, for example, about a flower as it opens, an image that is usually shown in naturalistic documentaries, or how clouds change their shape, we are not relating things to each other: we are simply applying a certain transformational rule to the object of our thought (the flower, the cloud). We do not relate the flower (or the cloud) at time T_1 to the flower (or the cloud) at time T_2. We do not segment our experience into parts that we combine by means of a

[10] As I stated at the beginning of the chapter, by applying our attention we consciously experience how other entities affect us and how we affect other entities, and therefore become aware of our limits and boundaries. In this sense, the use of attention always implies a relational activity. However, this very general relational activity is not what is meant by Ceccato and Zonta's (1980) definition of "correlation" and "correlational activity".

conscious relation; on the contrary, our experience acquires a sense of uninterrupted continuity.

Thirdly, although it describes how two things can be combined, it does not account for the possible result of the combination. When we add 2 and 3, we get 5. The correlational conception of thought describes how it is possible to relate a certain thing to another thing, but it does not show either that a given specific relation can produce a certain result, or how that given specific relation produces that result. It describes how 2 can be combined with 3, but it does not show either that this combination makes 5, or how the combination makes 5. The correlational conception of thought specifies what position the mental constructs occupy in the correlation and the sequence in which they occur. It does not consider the propulsive, driving and pushing forward aspect of thought, that is, the fact that a correlation of things, but even one single thing, can produce, cause, recall, evoke, and summon up another thing. While it provides a description of the way the various mental elements follow one another in the correlation, it does not provide a description of how the combination of these various elements produces, or can produce, a certain effect, consequence, outcome, etc.[11]

Furthermore, Ceccato and Zonta's account of the correlational activity of thought raises two difficulties. Firstly, their hypothesis (which derived most probably from the belief that all instances of thought can be reduced to the general, basic form of correlation) of the existence of a specific organ of thought having the specific function of correlating mental elements seems highly implausible. Ceccato and Zonta (1980, pp. 62-63) state that (I translate into English):

> If we want to give an organ to thought, we can imagine it as a combiner of micro-units. The minimum combination is made up of three units and these always differ from each other because of the different moments they occupy while producing the flow of thought. In this way each one is characterized, even if by no other particularity, by this moment assigned to it by the combiner. Here are the three moments. The first thing is kept present as the second is added, which in turn is kept present as the third is added, which then takes the place of the preceding one. Here are the times represented in a diagram:
>
> 
>
> where the dotted line represents the maintaining of the unit in such a way that it is partly concurrent with the others. (...) But to make things clearer let's adopt what could be a less correct but more immediate, topological, diagram in which the unit present together with the other two occupies the upper box, and the other two the lower box, of half the length:
>
> 

[11] Barosso (2005) also highlights some other drawbacks of the correlational theory of thought proposed by Ceccato.

> A second particularity of this triadic combination is that the unit present with the other two, and therefore straddling them, is always made up of a relationship between the two as a result of attention (…) The following names have been adopted for the three units which make up a correlation – that is, the minimum unit of thought: *correlator* for the unit straddling the other two; 1st *correlatum* for the first unit present; 2nd *correlatum* for the second unit present.

Undoubtedly, Ceccato and Zonta supply here a general description of the way correlational thought unfolds and develops in time which, in so far as it concerns the serial order in which the various mental elements follow one another, seems to be quite plausible. However, there are cases in which this description does not hold. Sackurand & Dehaene (2009) report some experiments in which participants were required to add (or subtract) two to a stimulus number (either two, four, six or eight), and then compare the result with five. They found evidence for an approximately sequential processing, but with an important qualification: the second operation (comparison) appears to start before completion of the first operation (addition/subtraction), in that initially it takes as input the stimulus number rather than the output of the first operation. As Sackur and Dehaene observe: "The second operation, which should wait until some information about the result of the arithmetic operation is available, actually starts ahead of time. (...) Therefore, seriality of the composition is defeated by a specific form of crosstalk. There seems to be a partially parallel execution of the two operations" (*ibid.*, p. 207)

Moreover, Ceccato and Zonta's proposal of the existence of a specific "organ of thought" is also quite questionable. Why should we resort to such an additional, specifically dedicated organ as the "organ of thought" to account for a function that can be also carried out thanks to the joint and coordinated action of some other organs that were originally designed to perform other, more basic functions? Why should nature have developed an extra, specific organ to perform a certain activity when that same activity could be performed equally well by the already existing organs? One should remember in these cases the dictum: *Natura non facit saltus.* As I have shown in my analyses (Marchetti 1993, 1994), in order to produce such "correlating elements" (Italian: "correlatori") as the conjunction "and", the "noun-adjective correlation" and "noun-verb correlation", you do not need a specific "organ of thought": you can produce these by means of more basic, primitive, multi-function organs, such as memory and a measurement or comparison system. Therefore, rather than proposing that an organ of thought is dedicated to a specific function, as Ceccato and Zonta did, it seems more sensible to opt for a solution of a system or set of different and distinct organs, each one devoted to performing a generic function, that can independently, when necessary, be used to originate and produce different kinds of "correlating elements", operators, and the like.

Secondly, Ceccato and Zonta's account of the thought process in terms of the overlapping of mental elements does not provide an adequate explanation of the phenomenon. They do not clearly specify whether (i) this overlapping implies that the two mental elements are both consciously present, or (ii) that only one is conscious and the other is unconscious. In either case, however, their account is not satisfactory. Indeed,

(i) in the former case, the overlapping of simultaneous conscious elements conflicts with evidence from both what one can subjectively, personally experience and what laboratory research shows: it is not possible to be conscious of two different scenes,

however complex they may be, or simultaneously think about two or more different things or have, or keep in mind two or more ideas, concepts, or meanings. Moreover, as shown by the PRP (Psychological Refractory Period) effect, central, post-perceptual stages of mental processing are subject to a single-channel bottleneck. When people try to concurrently select and produce two independent speeded responses (task 1 and task 2), central processing limitations arise: the decision-related stages of task 2 cannot commence until the corresponding stages in task 1 have been completed. The planning of one response delays the planning of another, even when the person attempts to produce both as fast as possible. This queuing arises when tasks involve post-perceptual processing such as the planning of actions, perceptual comparison, mental rotation, and memory retrieval. As Pashler observes: "It seems probable, therefore, that many operations that comprise thinking are limited to taking place one at a time" (Pashler, 1998, p. 404) (below some threshold of processing demand, many *perceptual* elements can, on the contrary, be processed in parallel without evident capacity limits).

(ii) in the latter case, the fact that there are unconscious mental elements or operations that occur at the same time as the conscious ones, despite being highly plausible from a psychological point of view, does not represent *per se* an *explanation* of how they can interact, connect or relate, but only a likely, and to be ascertained, *description* of the phenomenon: indeed, this co-occurrence may be a simple and accessory consequence of a more basic process. Different and various unconscious mental operations can take place in our brain simultaneously, and they can occur at the same time as the conscious ones, but this does not necessarily imply a causal or actual relationship or link between them. Phenomena can co-occur without being, for this only reason, correlated.

Libet (2004) also stresses the importance of the overlapping of mental elements, but for another reason: it will avoid breaks in the stream of consciousness, and more precisely, in the stream of thoughts - the feeling of continuity in sensory experiences being assured by what he calls the mechanism of "automatic subjective referral" (Libet, 2004, p. 113). Apart from the implausibility - which has been revealed by the PRP effect (Pashler, 1998) - of the simultaneous occurrence of several different conscious non-sensory experiences and more in general postperceptual events, Libet's hypothesis seems untenable for another reason. If the feeling of continuity we experience in our stream of consciousness was to be determined only by the overlapping in time of conscious events, it would be impossible to explain why the gaps created by dreamless sleep, anesthesia or some other kind of interruption are not experienced directly as such, that is, as gaps of consciousness, but indirectly, as a conscious experience of having lost consciousness. It is only by inference that we know that we have been unconscious, or by being told of this by someone else. No one can be conscious of being unconscious. The feeling of continuity is assured even when there is an actual temporary interruption, due to either sleep, anesthesia or some other reason, in our conscious life, that is, when it is absolutely impossible for an overlap of conscious events to occur.

As I have tried to show (Marchetti, 2010), our subjective feeling of a smooth flow in a series of thoughts, and more in general of all the other kinds of mental elements, does not depend so much on the overlapping of such mental elements. It depends on a more complex and continuous interplay between "the schema of self" and the "perceptual system", which

yields an uninterrupted sequence of single units of conscious perception secured by the fact that the previous units play a direct, causal role in the production of the following ones.

Apart from the specific difficulties raised by the description of thought in terms of an overlapping of mental elements, the definition of thought as a purely correlational activity is, in any case, too restrictive. Correlational thought is certainly an important kind of thought, probably the most important, and can certainly be described in a very general way, but it is just one kind of thought. By defining thought only as a correlational activity, Ceccato and Zonta seem to have made the same mistake they attribute to other authors (Ceccato and Zonta, 1980, p. 68): that of confusing a specific kind of thought with the general structure of thought, which is tantamount to defining music through, or as, one of its particular species, such as a sonata or a fugue.

In my view, correlational thought is a particular species of a more general class of conscious experiences: a class identified by, and composed of, the conscious experiences that arise when the product of the activity performed by the organ of attention (that is, an earlier conscious experience) is worked out by some other organ. We could represent this more general form of thought as follows:

$$op \rightarrow \mathbf{C} \Rightarrow \mathbf{C_1}$$

where C_1 represents the conscious experience that arises as a consequence (=>) of the operation (*op*) unconsciously performed (→) on an earlier conscious experience C. It is important to note that while the operation on C is performed by an unconscious mechanism (we do not know what kind of operations our mind performs when we add 2 and 3: the only thing we are aware of is that we get 5), the instruction to perform it may be either consciously given or unconsciously occasioned (we can deliberately decide to add 2 and 3; but a certain idea or sensation can come to our mind because of free association, without any deliberate input).

This way of representing thought accounts for and covers all the instances in which:

a) we perform any kind of operation on a conscious experience. When we "think of" someone, in the sense of directing our attention toward someone, we perform a certain operation *op* (direct our attention toward) on (→) someone (C); as a consequence (=>) we will have the image of that someone (C_1) in our mind. Likewise, when we "think about" a flower as it opens, we apply a certain transformational rule *op* (open) to (→) a flower (C); as a consequence (=>) we will imagine a flower opening (C_1);
b) we produce a conscious experience from an earlier one. When we evoke a sensation by means of free association with an image, we produce (=>) a given sensation (C_1) by operating on (→) an image (C) applying a certain association rule (*op*). When after seeing some dark clouds, we think that it will rain soon, we produce (=>) the idea that it will rain soon (C_1) by performing some kind of inferential operation (*op*) on (→) the perceived dark clouds (C). When adding 2 and 3 we get 5, we perform a certain operation *op* (add 3) on (→) 2 (C), having 5 (C_1) as a result (=>);
c) we relate things to each other. If, for instance, we want to compare someone (John) with someone else (his wife) to see who is taller, we perform a certain operation *op* (compare against John's wife) on (→) John (C) that will give as a result (=>) "taller"

(C_1): which will be expressed by a sentence like: "John is taller than his wife". If we want to consider or analyze the consequences of smoking tobacco, we perform a certain operation *op* (analyze the consequences of smoking) on (→) tobacco (C) that will give as a result (=>) "cancer" (C_1): which will be expressed by a sentence like: "Smoking tobacco causes cancer" or "Smoking means cancer". If we want to describe who is with John, we perform a certain operation *op* (describe who is with) on (→) John (C) that will give as a result (=>) "Mary" (C_1): which will be expressed by a sentence "John is with Mary" or "John and Mary".

Obviously, the new conscious experience $\mathbf{C_1}$ (for instance "Cancer", in "Smoking tobacco causes cancer") can in turn be further operated on:

$$op \rightarrow C_1 \Rightarrow C_2$$

giving rise to a new conscious experience $\mathbf{C_2}$ ("Stop smoking"), which can be operated on in turn. This opens the way to the possibility of forming long and articulated thoughts, and developing our thoughts along infinite, different lines, or towards infinite, different directions and dimensions. Most probably, just because of the relevance this possibility has for the cultural and scientific development of human society, human beings contrived and developed in their history dedicated linguistic and symbolic tools designating specific ways of operating on conscious experiences, producing new conscious experiences from earlier ones, and relating conscious experiences to each other. Conjunctions, prepositions, the subject-verb correlation, the noun-adjective correlation, mathematical and logical operators and the like have precisely these functions.

In this section we have analyzed at some length the operations that can be performed on the products of the activity of the organ of attention: these operations are generally designated by the words "to think" and "thought". We have seen that attention alone is not sufficient to perform such operations. Some other organs are needed, such as memory, a comparison system, and a representational system: they perform those unconscious operations on the products of the attentional activity that allow us to produce new conscious experiences from earlier ones, and relate conscious experiences to each other: in a word, to think.

6.2.4. Conscious Experiences Resulting from Activities that Are Triggered, Organized and Controlled by Earlier Conscious Mental Acts

This kind of conscious experience arises as a consequence of previous conscious mental states such as decisions, volitions, desires, intentions, plans, interests, motivations, aspirations, necessities, possibilities, and so on (from now on, for sake of brevity, I will call them "intentional states"): that is, mental states by which we purposefully deliberate to do things, move, work, think about things, imagine, perceive, etc. Even though this fourth kind of conscious experience may in some way resemble the first and the third kinds of conscious experiences described above, it actually differs from them. Indeed, while the first kind shows how we can consciously experience perceptions, images and memories, and the third kind how we can consciously experience thoughts and elaborate representations, this fourth kind shows how we can consciously *decide, will, intend, plan, etc.* to consciously perceive, represent, remember, and think. Moreover, it also encompasses all those cases that are not comprised by the other two kinds of conscious experiences, that is, all the occurrences in

which we put into action plans, ideas or intentions that do not have as their primary goal that of eliciting sensations, images and memories, or of further mentally working out previously produced mental constructs, but something else: for instance, performing physical actions such as walking, sitting, moving hands, arms, etc.

Apart from the conscious experiences explicitly triggered by an intentional act, which can be classified under the three classes we have previously seen, intentional states give rise to two additional kinds of conscious experiences. These two kinds are a sort of by-product of the act performed intentionally: they are not intentionally and explicitly produced, but nonetheless they accompany almost every intentional act:

1. The first kind is represented by all those conscious experiences - physical sensations, emotions, feelings, thoughts, ideas, etc. – that unavoidably accompany, follow on, and are strictly relevant to, the specific activity triggered by the intentional state. If we decide to stand up and walk, for instance, we will have not only the experience of standing up and walking, but also some other accessory, unwanted and unexpected experiences: we will see things from a different perspective, we will feel more tired than before, or perhaps we will have a temporary sense of dizziness.
2. The second kind is represented by those conscious experiences that still more indirectly, yet in a more profound and fundamental way than the second, qualify the activity triggered by the intentional state. In fact, these conscious experiences make us aware of the fact that, by means of our conscious activity, we can govern and exert a voluntary control over our own actions, affect the course of our own actions, set our own aims and objectives, and choose what to do next: in a word, become self-conscious. The recurring and frequent experience that a given intentional state, for instance the intention to stand up and walk, has (or has not) produced the desired effect or course of actions, makes us aware of the fact that "if we want to stand up and walk, we can" or that "we are able to stand up and walk". Usually, this kind of self-awareness is expressed by means of the auxiliary verbs "may", "can", "must", "need", "shall", and "will", or by means of verbs such as "to want", "to have to", "to be able", "to choose", and "to intend". These conscious experiences can then be considered as a kind of *meta-conscious experiences*.

These two kinds of conscious experiences, despite being prompted by a previous operating of the organ of attention, cannot arise and take place without the involvement of some other different organ. Without, for instance, the musculoskeletal system, we could never perform those physical actions we want or have to do, and therefore we could never experience the causal link between our decision to perform a given action and the performance of that very action. Likewise, without the "schema of self" (Marchetti, 2010) we could never attain self-consciousness.

It is important to note, however, that the involvement of organs other than the organ of attention, such as the "schema of self", while being necessary for the production of conscious experiences typically associated with self-consciousness - that is, those that are usually expressed by means of verbs such as "may", "can", "must", "need", "shall", "will", "to want", "to have to", "to be able", "to choose", and "to intend" – is not sufficient. Indeed, the conscious experience of volition differs from one of duty, or possibility, despite the fact that both share the necessity, in order to occur, to involve organs other than the organ of attention.

When we say: "I want to work", we express a conscious experience that is quite different from what we express when we say: "I have to work", or "I can work". What is it that makes them differ? What is it that characterizes a conscious experience of volition as such? A conscious experience of volition is built on the same structure on which a conscious experience of duty, or of any other intentional state is based: a certain intentional state causes a certain action. What differs between these various conscious experiences is the different stress that each lays on the intentional state prompting the action and the action it prompts. These differences in stress can only be determined by the activity of the organ of attention: they cannot be ascribed to any other organ.

Let's analyze some of these conscious experiences more in detail, trying to identify what implications they have for our attention: how does each of them pilot our attention? What does each of them draw our attention to? Let's start with a "neutral" situation, where no intentional state is implied, for instance: "I open my hand". Now compare this situation with one where our action is guided or prompted by an intentional state, such as: "I can open my hand". We immediately feel a difference. Let's try to describe this difference in attentional terms: where does our attention go? What does our attention do? The use of "can" implies a specific stress on the action prompted by the intentional state: it underlines the fact that we have no problem in opening our hand, if we desire to do that. Now let's try with a different kind of intentional state: "I want to open my hand". The attention brought here is not so much on the action prompted by the intentional state, as on the intentional state itself: the verb "want" specifies that we have no problem in mentally triggering or activating our intentional state because the act of triggering or activating it depends completely on us (but it does not specify whether the action can be as easily prompted: indeed, one thing is to want to do something, quite another to be able to do what one wants to). Also the sentence: "I must open my hand" focuses our attention primarily on the intentional state: it does not state anything about our actual capacity to perform the action. However, unlike "to want", "must" underlines that the intentional state, and its activation, depends not so much on us as on someone or something else.

CONCLUSION

The classification of the conscious experiences produced by the joint activity of the organ of attention (and the activity it performs) and the other organs, which I have sketched in the previous sections, allows us to identify four main kinds of unconscious and non-conscious operations:

1. those performed by the sense organs, the propriocetive system and memory that elicit most of the physical sensations and perceptions we have (tactile, visual, auditory, olfactory, gustative, proprioceptive);
2.
    a) those performed by the interoceptive system, the internal milieu and viscera, nociceptors, and all those substances (such as hormones, neurotransmitters, neuromodulators) that elicit physiological states such as pain, pleasure, thirst,

hunger and tiredness, and psychological states such as emotions, moods, and impulses.

b) those represented by all the automatisms, schemas, frames and unconscious processes that we have acquired and learnt during our life and that help us perform complex activities such as speaking, driving and playing games;

3. those performed by organs such as memory, comparison systems and representational systems that allow us to combine our conscious experiences in various ways and to relate conscious experiences to each other: simply put, to think;
4. those performed by organs such as the schema of self that allow us to intentionally plan and perform actions and activities, and to have those conscious experiences that are associated with self-consciousness: that is, those that make us aware of the fact that, by means of our conscious activity, we can govern and exert a voluntary control over our own actions, affect the course of our own actions, set our own aims and objectives, and choose what to do next.

The identification of these unconscious and non-conscious operations is essential for an exhaustive analysis and description of the elementary attentional operations that compose the meanings of words, and the way these attentional operations are combined. Without them it would be practically impossible to account for the different ways attentional operations take place, can be combined and related, give rise to other conscious states, can be modulated and controlled by earlier conscious states. They represent the necessary complement and counterpart of attentional operations in the construction of most of, if not all, meanings (and more generally of all conscious experiences).

This classification helps us classify words in relation to the kind of unconscious and non-conscious operations we have to resort to when analyzing their meanings. By using such a classification, we can classify words according to whether they refer to conscious experiences of:

1. exteroceptive and proprioceptive sensations, such as colors, sounds, tastes, smells and movements; sensations related to space; physical objects, beings, events and activities;
2.
   a) interoceptive sensations, such as thirst, hunger, tiredness and sexual desire; sensations of pain, pleasure and time; innate psychological states and activities, such as emotions, feelings, moods;
   b) culturally acquired psychological states and activities, such as motivations, expectations, interests and aspirations; complex activities which, in order to be performed, require learnt schemas, frames, and automatisms;
3. thought activity and the products of such activity, such as conjunctions, prepositions, relative pronouns, the name-adjective correlation, the subject-verb correlation, logical and mathematical operators, articles, singular and plural forms, indefinite adjectives and pronouns, abstract nouns, verbs referring to abstract actions, etc., that is, most of what Ceccato (1969) has defined as “mental categories” (see also Benedetti 2001, 2005, 2009); or:

4. meta-mental activities, usually identified by verbs such as “may”, “can”, “must”, “need”, “shall”, and “will”, “to want”, “to have to”, “to be able”, “to chose”, “to plan”, and “to intend”.

This list is not exhaustive – many words cannot be exactly classified in this list, because they are the combination of different kinds of unconscious and non-conscious operations – and should only be considered as a first approximate attempt at classifying words according to the kind of unconscious and non-conscious operations that are involved. I think it represents however a good basis for future research work and analyses on the meanings of words.

Table 1. A classification of the possible interactions between the organ of attention (and the activity it performs) and the other organs; the relevant non-attentional operations; and of the words referring to the conscious experiences resulting from such interactions

Possible interactions between the organ of attention (and the activity it performs) and the other organs	Types of non-attentional operations supporting the production of conscious experiences	Classification of words based on the type of conscious experience they refer to, resulting from the interaction between the organ of attention and the other organs
Direct application of attention to the other organs	Operations performed by the sense organs, the propriocetive system and memory that elicit most of the physical sensations and perceptions we have (tactile, visual, auditory, olfactory, gustative, proprioceptive)	Words referring to exteroceptive and proprioceptive sensations, such as colors, sounds, tastes, smells and movements; sensations related to space; physical objects, beings, events and activities
Direct or indirect influence on the organ of attention of the other organs and the physical substrate of the body, independently of whether or not attention is applied to them	a) Operations performed by the interoceptive system, the internal milieu and viscera, nociceptors, and all those substances (such as hormones, neurotransmitters, neuromodulators) that elicit physiological states such as pain, pleasure, thirst, hunger and tiredness, and psychological states such as emotions, moods and impulses. b) Operations represented by all the automatisms, schemas, frames and unconscious processes that we have acquired and learnt during our life and that help us perform complex activities such as speaking, driving and playing games	a) Words referring to interoceptive sensations, such as thirst, hunger, tiredness, and sexual desire; sensations of pain, pleasure and time; innate psychological states and activities, such as emotions, feelings and moods; b) Words referring to culturally acquired psychological states and activities, such as motivations, expectations, interests and aspirations; complex activities that, to be performed, require learnt schemas, frames and automatisms
Operations, performed by other organs, on the products of the activity of the organ of attention	Operations performed by organs such as memory, comparison systems and representational systems that allow us to combine our conscious experiences in various ways and to relate conscious experiences to each other	Words referring to thought activity and the products of such activity, such as conjunctions, t prepositions, relative pronouns, he name-adjective correlation, the subject-verb correlation, logical and mathematical operators, articles, singular and plural forms, indefinite adjectives and pronouns, abstract nouns, verbs referring to abstract actions
Activities triggered, organized and controlled by earlier conscious mental acts	Operations performed by organs such as the schema of self that allow us to intentionally plan and perform actions and activities, and to have those conscious experiences that are associated with self-consciousness	Words referring to meta-mental activities, such as the verbs: “may”, “can”, “must”, “need”, “shall”, and “will”, “to want”, “to have to”, “to be able”, “to chose”, “to plan”, and “to intend”

Table 1 summarizes the classification of the possible interactions between the organ of attention (and the activity it performs) and the other organs, of the relevant non-attentional operations, and of the words referring to the conscious experiences resulting from such interactions.

REFERENCES

Alvarez, G. A. (2011). Representing multiple objects as an ensemble enhances visual cognition. *Trends in Cognitive Sciences*, *15*, 122–131.

Baars, B. J. (1988). *A Cognitive Theory of Consciousness*. Cambridge: Cambridge University Press.

Bachman, T. (2011). Attention as a process of selection, perception as a process of representation, and phenomenal experience as the resulting process of perception being modulated by a dedicated consciousness mechanism. *Frontiers in Psychology*, *2*, 1-7. doi: 10.3389/fpsyg.2011.00387.

Barosso, G. (2005). Il costrutto di pensiero. http://www.giampaolo-barosso.it/file_pdf/costr-pens.pdf

Bartolomeo, P. (2008). Varieties of attention and of consciousness: evidence from neuropsychology *Psyche*, *14*, 1-33.

Baumeister, R. F. & Masicampo, E. J. (2010). Conscious Thought Is for Facilitating Social and Cultural Interactions: How Mental Simulations Serve the Animal-Culture Interface. *Psychological Review*, *117 (3)*, 945-971.

Benedetti, G. (1999). "La categoria di *spazio*". In AA.VV., *Studi in memoria di Silvio Ceccato*. Roma: Società Stampa Sportiva.

Benedetti, G. (2001). *Semantica operativa. La semantica in termini di operazioni mentali. Parte prima. Principi generali, metodologia e tecnica di analisi*. Retrievable from: www.mind-consciousness-languagecom

Benedetti, G. (2005). Basic mental operations which make up mental categories. Available from: www.mind-consciousness

Benedetti, G. (2006). Operational Noology as a new methodology for the study of thought and language: theoretical aspects and possible practical applications. *Cognitive processing, 7, 217-243.*

Benedetti, G. (2009). The meaning of the basic elements of language in terms of cognitive operations: Operational Semantics. *Advanced Studies in Biology, Vol. 1, no. 5-8,* 255-305.

Benedetti, G. (2010). "A semantics of the fundamental structural elements of language, based on cognitive functions: Operational Semantics." In: G. Salvati, & V. Rabuano (Eds.), *Cognitive Psychology Perspectives*. Hauppauge, New York: Nova Science Publishers, pp. 1-61.

Benedetti, G. (2011). *An enigma in language - The meaning of the fundamental linguistic elements. A possible explanation in terms of cognitive functions: Operational Semantics*. Hauppauge, New York: Nova Science Publishers.

Berthoz, A. (2000). *The brain's sense of movement*. Harvard University Press.

Bush, N. A. & VanRullen, R. (2010). Spontaneous EEG oscillations reveal periodic sampling of visual attention. *Proceedings of the National Academy of Sciences of the United States of America, 107 (37*), 16048-16053.

Carstensen, K.-U. (2007). Spatio-temporal Ontologies and Attention. *Spatial Cognition & Computation 7 (1),* 13-32.

Carstensen, K.-U. (2011). Toward Cognitivist Ontologies. *Cognitive Processing, 12 (4),* 379-393.

Ceccato, S. (1964). *Un tecnico tra I filosofi. Come filosofare.* Padova: Marsilio.

Ceccato, S. (1966). *Un tecnico tra I filosofi. Come non filosofare.* Padova: Marsilio.

Ceccato, S. (1969) (ed.). *Corso di linguistica operativa.* Milano: Longanesi.

Ceccato, S. (1972). *La mente vista da un cibernetico*. Torino: ERI.

Ceccato, S. (1987). *La fabbrica del bello.* Milano: Rizzoli.

Ceccato, S. (1988). *Il perfetto filosofo*. Roma-Bari: Laterza.

Ceccato, S. (1990). *Lezioni di linguistica applicata*. Milan: Clup.

Ceccato, S. (1996). *C'era una volta la filosofia*. Milano: Spirali

Ceccato, S. and Zonta, B. (1980). *Linguaggio consapevolezza pensiero*. Milano: Feltrinelli.

Ceccato, S. and Oliva, C. (1988). *Il linguista inverosimile*. Mursia. Milano.

Chun, M. M., Golomb, J. D. & Turk-Browne, N. B. (2011). A Taxonomy of External and Internal Attention. *Annual Review of Psychology, 62,* 73-101

Cisek, P. (1999). Beyond the computer metaphor: behavior as interaction. *Journal of Consciousness Studies, 6,* 125-142.

De Brigard, F. & Prinz, J. (2010). Attention and consciousness. *Wiley Interdisciplinary Reviews: Cognitive Scecnce, 1,* 51–59.

Demeyere, N. & Humphreys, G. (2007). Distributed and focused attention: Neuropsychological evidence for separate attentional mechanisms when counting and estimating. *Journal of Experimental Psychology: Human Perception and Performance, 33,* 1076-1088.

Denis, M. (1991). *Image & Cognition.* New York: Harvester-Wheatsheaf.

Dijksterhuis, A. & Meurs, T. (2005). Where creativity resides: The generative power of unconscious thought. *Consciousness and Cognition, 15,* 135-146.

Dijksterhuis, A. & Nordgren, L. F. (2006). A theory of unconscious thought. *Perspectives on Psychological Science, 1,* 95-109.

Ducasse, C. J. (1994). *Art, the Critics and You.* New York: Oscar Piest.

Edelman, G. M. (1989). *The Remembered Present: a Biological Theory of Consciousness*. New York: Basic Books.

Fuchs, T. (2011). The Brain - A Mediating Organ. *Journal of Consciousness Studies, 18(7-8),* 196-221.

Gambarara, D. (1996). (Ed.). *Pensiero e linguaggio. Introduzione alle ricerche contemporanee*. Roma: La Nuova Italia Scientifica.

Gregory, R. L. (1966). *Eye and brain. The psychology of seeing.* New York: McGraw-Hill.

Iwasaki, S. (1993). Spatial attention and two modes of visual consciousness. *Cognition, 49,* 211-233.

Jonides, J. (1983). Further toward a model of the mind's eye's movement. *Bulletin of the Psychonomic Society, 21,* 247-250.

Koch, C. & Tsuchiya, N. (2006). Attention and consciousness: two distinct brain processes. *Trends in Cognitive Sciences, 11,* 16-22.

Koivisto, M., Kainulainen, P. & Revonsuo, A. (2009). The relationship between awareness and attention: evidence from ERP responses. *Neuropsychologia 47*, 2891–2899.

Kouider, S., de Gardelle, V., Sackur, J. & Dupoux, E. (2010). How rich is consciousness? The partial awareness hypothesis. *Trends in Cognitive Sciences 14 (7)*, 301-307.

La Berge, D. (1983). The spatial extent of attention to letters and words. *Journal of Experimental Psychology: Human Perception and Performance*, *9*, 371-379.

La Berge, D. (1995). *Attentional Processing. The Brain's Art of Mindfulness.* Cambridge, MA: Harvard University Press.

Laganà, A. (1992). *Percorsi della filosofia*. Roma: Gangemi.

Lamme, V. A. F. (2003). Why visual attention and awareness are different. *Trends in Cognitive Sciences*, *7*, 12-18.

Lavie, N. (1995). Perceptual load as a necessary condition for selective attention. *Journal of Experimental Psychology: Human Perception and Performance*, *21*, 451-468.

Libet, B. (2004). *Mind Time. The Temporal Factor in Consciousness*. Cambridge, Mass.: Harvard Univ. Press.

Logan, G. D. (1983). On the ability to inhibit simple thoughts and actions: I. Stop-signal studies of decision and memory*Journal of Experimental Psychology: Learning, Memory and Cognition*. *11*, 675-691.

Logan, G. D. (1985). On the ability to inhibit simple thoughts and actions: II. Stop-signal studies of repetition priming. *Journal of Experimental Psychology: Learning, Memory and Cognition*. *9*, 585-606.

Mack, A. & Rock, I. (1998). *Inattentional Blindness.* Cambridge: MIT Press.

Marcel, A. J. (1983). Conscious and unconscious perception: Experiments on visual masking and word recognition. *Cognitive Psychology*, *15*, 197-237.

Marchetti, G. (1993). *The Mechanics of the Mind*. Roma: Espansione.

Marchetti, G. (1994). Analisi della congiunzione "e". *Working papers della società di cultura Metodologico-operativa*, *50*, 1-14.

Marchetti, G. (1997). *La macchina estetica. Il percorso operativo nella costruzione dell'atteggiamento estetico.* Milano: Franco Angeli.

Marchetti, G. (2001). A theory of consciousness. www.mind-consciousness-language.com

Marchetti, G. (2006). A presentation of Attentional Semantics. *Cognitive Processing*, *7*, 163-194.

Marchetti, G. (2009a). Studies on time: a proposal on how to get out of circularity. *Cognitive Processing*, *Vol. 10, No. 1*, 7-40.

Marchetti, G. (2009b). Commentary on David Morris' "The sense of Space". http://www.mind-consciousness

Marchetti, G. (2010a). "A New perspective on Human Consciousness." In: G. Salvati and V. Rabuano (Eds.), *Cognitive Psychology Perspectives*. Hauppauge, New York: Nova Science Publishers, 63-115.

Marchetti, G. (2010b). *Consciousness, Attention and Meaning*. Hauppauge, New York: Nova Science Publishers.

Marchetti, G. (2012a). Against the view that consciousness and attention are fully dissociable. *Frontiers in Psychology*, *3*, 1-14. doi: 10.3389/fpsyg.2012.00036.

Marchetti, G. (2012b). "How consciousness builds the subject through relating". In: R. J. Jenkins and W. E. Sullivan (Eds.), *Philosophy of Mind*. Nova Science Publishers, Inc., 37-69.

Marchetti, G. (2014). Attention and working memory: two basic mechanisms for constructing temporal experiences. *Frontiers in Psychology*, *Vol. 5*, *Nr 880*, 1-15.

Maturana, H. R. (1995). "Biology of Self-Consciousness". In: G. Trautteur (Ed.), *Consciousness: Distinction and Reflection* (145-175). Napoli: Bibliopolis, 145-175.

Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological Review*, *63*, 81-97.

Morris, D. (2004). *The Sense of Space*. Albany, NY: SUNY.

Nakayama, K. & Mackeben, M. (1989). Sustained and transient components of focal visual attention. *Vision Research*, *29*, 1631-1647.

Oakley, T. (2004). *Elements of Attention: A new Approach to meaning Construction in the Human Sciences.* Retrievable from: www.mind-consciousness

Oakley, T. (2009). *From attention to meaning: Explorations is semiotics, linguistics, and rhetoric*. European Semiotics Series, Volume 8. Bern: Peter Lang Verlag.

Pashler, H. E. (1998). *The psychology of attention*. Cambridge, Massachusetts: The MIT Press.

Perlovsky, L. I. (2006). Towards physics of the mind: Concepts, emotions, consciousness, and symbols. *Physics of Life Reviews*, *3*, 23-55.

Posner, M. I. (1980). Orienting of Attention. *Quarterly Journal of Experimental Psychology, 32*, 3-25.

Posner, M. I. (1994a). Attention: the mechanisms of consciousness. *Proceedings of the National Academy of Sciences of the United States of America*, *91*, 7398–7403

Posner, M. I. (1994b). "Attention in cognitive neuroscience: An overview." In: M. S. Gazzaniga (Ed.), *The Cognitive Neurosciences*. Cambridge, MA: MIT Press.

Posner, M. I. & Cohen, Y. (1984). "Components of performance." In: H. Bouma and D. Bowhuis (Eds.), *Attention and Performance*. Hillsdale, NJ: Erlbaum.

Pylyshyn, Z. W. (1984). *Computation and Cognition.Toward a Foundation for Cognitive Science.* Cambridge: the MIT Press.

Pylyshyn, Z. W. (1999). Is vision continuous with cognition? The case for cognitive impenetrability of visual perception. *Behavioral and Brain Sciences*, *22*, 341-423.

Rizzolatti, G., Riggio, L., Dascola, I. & Umiltà C. (1987). Reorienting attention across the horizontal and vertical meridians: evidence in favor of a premotor theory of attention. *Neuropsychologia*, *25*, 31-40.

Scheider, S. & Kuhn, W. (2011). Finite relativist geometry grounded in perceptual operations. *Spatial Information Theory*, *6899*, 304-327.

Searle, J. R. (1992). *The Rediscovery of the Mind*. Cambridge: the MIT Press.

Shepard, R. N. & Metzel, J. (1971). Mental rotation of three-dimensional objects. *Science*, *171*,701-793.

Srinivasan, N. (2008). Interdependence of attention and consciousness. *Progress in Brain* Research, 168, 65-75.

Talmy, L. (2007). "Foreword". In: M. Gonzales-Marquez, I. Mittelberg, S. Coulson & M. J. Spivey (Eds.), *Methods in Cognitive Linguistics*. Amsterdam/Philadelphia: John Benjamins Publishing Co, xi-xxi.

Treisman, A. (1982). Perceptual Grouping and Attention in Visual Search for Features and for Objects. *Journal of experimental Psychology: Human Perception and Performance*, *2*, 194-214.

Treisman, A. (2006). How the deployment of attention determines what we see. *Visual Cognition*, *14*, 411–443.

Treisman, A. & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive Psychology*, *12*, 97.

Tsuchiya, N., and van Boxtel, J. J. (2013). Introduction to research topic: attention and consciousness in different senses. *Frontiers in Psychology*, *4:249.* doi: 10.3389/fpsyg.2013.00249.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychology*, *26*, 1–12.

Umiltà, C. (1988). "The control operations of consciousness". In: A. J. Marcel and E. Bisiach (Eds.), *Consciousness in Contemporary Science*. Oxford: Oxford University Press, 334-356.

Umiltà C. (1994). "Attenzione e coscienza." In: P. Legrenzi (Ed.), *Manuale di psicologia generale*. Bologna: Il Mulino.

Van Boxtel, J. J., Tsuchiya, N. & Kock, C. (2010). Consciousness and attention: on sufficiency and necessity. *Frontiers in Psychology*, *1*, 1–13. doi:10.3389/ fpsyg.2010.00217.

Vandekerckhove, M. & Panksepp, J. (2009). The flow of anoetic to noetic and autonoetic consciousness: A vision of unknowing (anoetic) and knowing (noetic) consciousness in the remembrance of things past and imagined futures. *Consciousness and Cognition*, *18*, 1018-1028.

VanRullen, R., Carlson, T. & Cavanagh, P. (2007). The blinking spotlight of attention. *Proceedings of the National Academy of Sciences of the United States of America*, *104*, 19204-19209.

Velmans, M. (1991). Is human information processing conscious? *Behavioral and Brain Sciences*, *14*, 651-726.

Wolfe, J. M. (1994). Guided search 2.0 a revised model of visual search. *Psychonomic bulletin & review*, *1(2)*, 202-238.

Wolfe, J. M. (1998). "Visual search". In: H. E. Pashler (Ed.), *Attention*. London: University College London Press.

Wolfe, J. M. (2000). "Visual attention". In: K. K. De Valois (Ed.), *Seing*. San Diego: Academic Press.

Wyble, B., Potter, M. C., Bowman, H. & Nieuwenstein, M. (2011). Attentional episodes in visual perception. *Journal of Experimental Psychology: General*,*140 (3)*, 488.

Zlatev, J. (2002). Meaning = Life (+ Culture): An outline of a unified biocultural theory of meaning *Evolution of communication*, *4 (2)*, 253-296.

Zhong, C. B., Dijksterhuis, A. & Galinsky, A. D. (2008). The merits of unconscious thought in creativity. *Psychological Science*, *19(9)*, 912-918.

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Chapter 3

ATTENTIONAL SEMANTICS AND READING

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ABSTRACT

In his book *Consciousness, Attention and Meaning*, Marchetti (2010) proposes that attention works as a process of piloting semantic interpretation, considering the conscious role of users on experiencing meaning. Thus, by extending the author's approach, understanding texts may be seen as a guidance provided by a process of selective attention which discriminates certain terms in such a significant way that leads to some specific interpretation. In this paper, we want to point out the importance of the author's proposal in highlighting attentional operations, as a process that leads to experiencing conscious meaning and, moreover, its extension as a reading operator. More specifically, we will set a challenge to attentional semantics: how to justify conscious experiencing of meaning for indirect uses of the lexicon? In our viewpoint, two basic operations are required in this task: the *migration of words*, namely, the need to carry certain words to other semantic domains, and the *meaning dissemination*, the possibility that the migrated words, in part or in a whole, might be 'contaminated' by the semantic nature of the new domain. Therefore, our hypothesis is to show, from the importance of attentional process for semantics, how it might apply to explain indirect use of the lexicon, since we can use the lexicon of carnival and soccer to address issues of politics, economics, etc. In order to support this hypothesis, we will explore examples and a text in Portuguese language.

1. INTRODUCTION

In the section *Attentional Semantics* (Marchetti 2010), the author suggests, as a hypothesis, that words have the power to lead attention in the semantic interpretation process, from users' conscious management of grasping word meaning. Marchetti attempts to validate his assumption by making use of a series of arguments in order to justify what he proposes as

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Attentional Semantics, i.e., a suggested approach to meaning production processes, which attempts to emphasize the attentional set of operations that the subject performs while consciously experiencing the relations that words express in the full spectrum of interactions held by the subject in his or her socio-biophysical niche. The plan in which attentional semantics is suggested highlights two key aspects to better understanding it: firstly, to identify the essential, elementary conscious experiences of the relations (between us and other entities, between us and ourselves, and between the other entities themselves) that invariably accompany, characterize, and are prompted by the use of the word being analyzed; secondly, to describe these conscious experiences in terms of the attentional operations that are responsible for their production.

The first aspect stresses the nature of experiencing what is required from users, i.e., the need for a conscious domain of what our interactions in the environment represent, where we exercise different experiences in interlocutive terms (with other subjects or ourselves) as well as interactional terms (with world objects), according to the author. The second aspect addresses the key role of attentional operations in our conscious experiences. What links these two aspects is the value that we assign to words as instruments that are capable of managing meaning production processes.

We will not, in this introductory stage, describe the author's formulation in detail - that is done, in a more synthetic way, in Marchetti (2003) and, in more detail, in Marchetti (2010)[1]. We rely on the practicality of his proposal in order to justify it as an essential reading tool, added by two skills that subjects resort to as they manage, according to certain textual typologies, their conscious reading experience, i.e., *sign migration* and *meaning transfer*, concepts that will be ellaborated further along this chapter.

However, as issues regarding linguistic meaning process often reveal themselves as subjected to theoretical turbulence – one has more doubts than certainties - it is important to stress that the author relies on three key concepts in his theory that seem to enrich meaning analysis: attention, conciousness, and experiencing. The first is used by the author to describe the very term semantics and from it he draws the implications to linguistic meaning process, led by the functionality that words have in bringing our attention to meaning. The author uses the second concept to specify the conscious nature of our experiential processes, as they are managed effectively by appropriating words, driven by attentional processes. The third concept ratifies the experienced level of significance in interactive processes, a dimension that has been often emphasized through embodiment. Thus, attention, conciousness, and experiencing, each in its own functionality, contribute decisively to a new perspective on the study of meaning. Marchetti observes the overlap between the fundamental terms he discusses - meaning, awareness, and attention - at various times in his formulation, as follows:

> After identifying the elementary conscious experiences that invariably characterize the meanings of words, Attentional Semantics tries to describe these conscious experiences in terms of the attentional operations that are responsible for their production (Marchetti, 2010, p. 75).

[1] See, in particular, the discussion developed in the section Meaning (2010, p. 59-77).

The terms mentioned by the author, together with the immediate correlations resulting from them - meaning (→ words), conciousness (→ experiences), and attention (→ operations) - should be thought of in the light of Attentional Semantics, not as merely isolated concepts but as an integration network that defines the linguistic meaning process as a whole. With such interconnections, the author embodies his semantic approach, which goes beyond the fragmented content of semantic theories in modern linguistics and allows to focus on the work performed by the subject from the moment he or she hears or sees words in various forms of interactions, shared in the social- biophysical environment[2].

From this brief review, we open our discussion by describing our main goal, that is, to assess the importance held by words as commands, leading the reader's attention to the possible reading paths a text can offer. In particular, we will draw attention to textual patterns whose prime lexical orientation needs to be complemented by other mechanisms involved in meaning production.

2. LEXICAL READING ROUTES

Attentional processes, when catalyzed for the reading activity, seem to reflect something quite natural to readers for two major reasons involved in our practices. The first relates to our inattention on certain moments of reading a text: we miss key clues to basic text meaning, which ultimately impose some reinterpretation of the paragraph, the section on which we were unaware. The second refers to the fact that our attention is not evenly focused on all the lexical units of a text. Some units stand out as the reading develops and get to require greater care from readers along the following steps. Attention, perhaps by physical body limitations, becomes a necessarily selective process that chooses certain things and dismisses others. We are not able to keep an eye on everything that surrounds us. Thus, we will take into consideration this second dimension, implicated in attentional processes, as we assess some of the general aspects related to reading activity and, in particular, the alleged adjustments that need to be made in relation to the words firstly focused on by attention.

This review, therefore, is not aimed at discussing the key role of Attentional Semantics for reading: we take its importance for fact. Among the different patterns we experience when reading a text, there is not a single one that underestimates the strength that attention may have in leading us on the path of certain preferred words. However, the words that make up a text (or a path drawn by attention from a few words) may not be *in natura* the only device employed by the subject when reading a text. The attentional focus required by various text formats may demand additional attention movements, or changes on attentional focus itself along the reading process. All these considerations concerning text reading are implicit in the operations described by Marchetti.

It is possible that all production/perception of direction is controlled by a set of relatively selected words with the aim of producing some kind of meaning effect, bearing in mind the text/reader production conditions. Thus, the meaning of a text dealing with economy, for example, should be initially controlled by a set of terms that report something about the economy world: *development, growth, inflation, public deficit, low/high interest rates,*

[2] Marchetti reminds us that the concept of meaning, implied in his approach, is very similar to that proposed by Zlatev (2002, p. 258).

production, expenses, exchange, currency, (un)employment, among many others. None of these elements implies economy by itself - nor is itself economy. However they can be integrated by a cognitive network to express economy: for example, the growth of a country can integrate a network of terms that includes *low inflation, low interest rates, increasing production, reducing unemployment, public deficit control*, etc. This is valid for our social activities in general: simple or complex the social objects we interact with on a daily basis, they are somehow organized, structured through a network of terms available in the language systems.

What makes us move along this process is the attention commanded by words. It allows us to focus on certain reading paths that can set standards to represent specific theme scripts. Reading, as a complex activity of meaning production, relies on attentional operations, to a great extent as a criterion of cognitive economy, led by representative words of certain interpretive paths. Although the weight given to words as drivers of attentional operations is being assumed by this statement, it is important to note that such a position does not entail any form of meaning transparency to words. Having this scope in mind, we introduce below the concepts of sign migration and meaning dissemination.

3. SIGN MIGRATION AND MEANING DISSEMINATION

Studying the lexicon of a language has an acknowledgeable importance because of the multiple factors that are bound to it. We could aim to show certain ways in which cultures are organized - highlighting certain objects and, consequently, the extent and expertise of terms, as well as the ways of life in a given community - the various professional specializations and their specific vocabulary. Similarly, to what was done by Marchetti, we could ascribe to words the function of leading attention. Many other factors fall into this recognition, but among them we need to highlight the word relevance regarding reading comprehension processes and their effectiveness for school reading. What should be highlighted on the study of the lexicon in order to achieve some of these purposes?

No exploratory inquiry of the lexicon may be conceived without prioritizing its structural dimension which results only in matrices that semantic approaches of modern linguistics relied on in order to describe meanings. However, it also represents conscious mental patterns of its processing. Addressing the structural organization of the lexicon is a way to advance towards specific references of its operation, either while processing facts of the experienced world, or as a field of conceptual networks built with words. Although current lexical analysis attempts to account for only a very small fraction of units of a lexicon, we know these analyses have been decisive to the understanding of meaning facts. No semantic theory has neglected the lexical question. Most of semantic aproach still refer to lexical organization and functioning as a challenge to be overcome.

Alongside with the set of factors that we typically relate to structural assessment of the lexicon - determining universal and idiosyncratic features, hierarchy and formal arrangement of features, relations of interdependence, etc. - there are those of functional orientation which may be called lexical movements[3]. These are modes that streamline the process of linguistic

[3] We believe that the way through which Marchetti refers to the lexicon would be closer to a functional dimension for the operational content he ascribes to words: that of leading attention.

comprehension, enabling the arrangements designed within the system to be restructured in texts and discourses. Such mobility may be attributed to the lexicon. Once it contributes to the conversion of language in speech, it is materialized in two basic concepts: sign migration and meaning dissemination.

3.1. Sign Migration

The comments on the function of lexical items within a linguistic system may be evaluated with two objectives: (a) an assessment that determines how a lexical unit may operate as an instrument of appointment, description, predication, and explanation of facts inside lexical fields of the system; (b) an assessment that may include the same categories of (a), but also highlights the consequences arising from transpositioning lexical items from a given lexical field to another, or in forming a semantic field circunscribed to a text, as it will be seen ahead. In the case of (b), the object of the present discussion, it is important to consider two aspects: one that indicates the migration of signs in language/speech, and another that indicates meaning dissemination. What may be understood from these two concepts?

Migration may be understood here as the possibility of transposing signs from a lexical field to (an)other and may result in new conditions of meaning and reference. This motion undergone by signs in languages, essential to their operation, may help keep part of the original meaning in many dimensions since the conditions of meaning must be less fuzzy than the conditions for reference. However, the distinction between both perspectives is not always clear-cut, since the former is seen as a prerequisite for the latter. In addition, reference may require its own format, in the case of a new object, to become effective in a new system. So, when the term *virus* migrates from biology to computer – what is possibly a very symmetrical process – some adjustments in its meaningful process must occur in order to adapt to new conditions in such a way that represents distinct objects in both fields but without changing many aspects of the first meaning.[4] As to the ability to refer, since it is another object and due to the new environment in which the term will operate, *virus* may adjust its content in order to refer.

Migration, thus conceived, enjoys fundamental status in the creation of texts and discourses. It eases the lexical selection process in the construction of non-natural meanings, as it transposes hitherto unprecedented components to a lexical field. Let us evaluate the following sentence, as an illustrative example:

(1) No exterior, você usa orações coordenadas ou desesperadas?[5]
(When abroad, which do you use: coordinate or desperate clauses?)

Regarding the meaning perception of this phrase, we may state that our attention is led by four lexical items, accounting for the whole meaning process towards a (supposedly) conscious experiencing of the facts in the interaction, i.e., *abroad*, *clauses*, *coordinate*,

[4] A key advantage to be associated with migration refers to the fact that migration adjusts itself to the the possibility of covering new meanings, without the need to create a new sign. The transposed sign is the same, given the necessary meaning adjustments to its new way of referring.

[5] Posted on a billboard by an English language school from Belo Horizonte, Brazil.

desperate. Among these words, *clauses*[6] is highlighted by applying, commonly, to two different referential conditions, as showed in Figure 1.

Figure 1 shows the poliysemic potential of the Portuguese word *oração* (meaning both "clause" and "prayer") in the system dimension. When located outside a specific context, the term *orações* can lead our attention to experiencing two referential situations – linguistic and religious. As we compare and contrast both possibilities in the given example, we may note that Referential Situation #1 prevails, for it attracts the other lexical elements that were mentioned to its field. Such prevalence over the other elements in the sentence brings no surprise: three of the highlighted words may be interpreted in a semantic field of language, considering *abroad* (a country where another language is spoken), *clauses* (a linguistic form), and *coordinate* (a type of linguistic structure). Although *desperate* does not belong to the field of linguistic concepts, it has migrated to it, integrating it with a specific type of interpretation, that is, a disjointed, deformed linguistic structure. The process of transposing a lexical item from a lexical field to a semantic field[7], is what we call *sign migration*, a phenomenon bound to circumstances of textual/discursive use of language.

No fact involved in this process seems to contradict Marchetti's hypothesis on Attentional Semantics: the purpose ascribed to words (of leading attention) continues to be prevalent. In such circumstance, however, there is increased attention on *desperate*, as a need to ratify a new way of experiencing that justifies a proper interpretation of the text. Because migration is a phenomenon associated with adjusting the meaning bound to discursive conditions, part of the original meaning is usually maintained, as it may be seen in the following section.

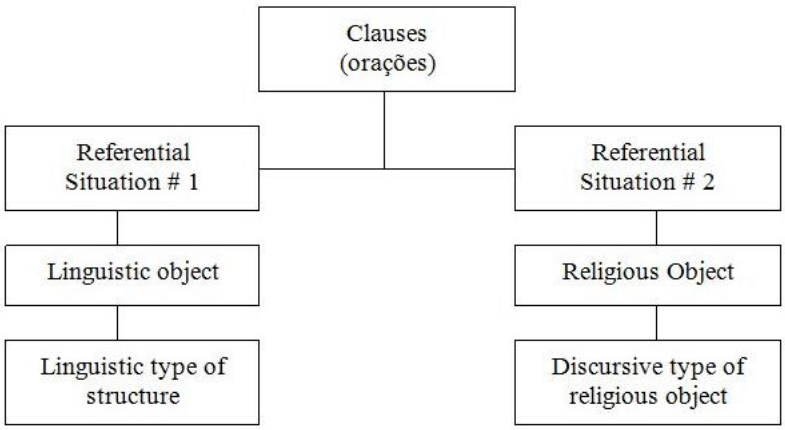

Figure 1.

[6] Translator's note: The English word 'clause' does not contain, symmetrically, the same polysemic correlation of the word *orações* in Portuguese. Thus, this translation aims at ensuring text readability, rather than reproducing the meaning effects that the Portuguese term provides.

[7] It is important to stress a difference to be made between lexical field and semantic field: the former is a structural organization pattern of lexical items in a language, whereas the latter is a contingent form of semantic organization that needs to be validated by textual/discursive use. Migration has this contingency effect of allowing lexical units to restructure according to specific uses.

3.2. Meaning Dissemination

As it has been mentioned previously, the meaning dissemination phenomenon cannot be seen independently from that of migration: there can only be dissemination if we consider the signs that migrated from different lexical fields to be reinterpreted in some semantic field. Based on this assumption we may infer, more precisely, that dissemination refers to the fact that, in order to integrate a semantic field, the transposed sign undergoes some adjustment in its meaning, which is determined locally by the dominant meaning from the field that housed the sign. A sign that has gone through this process does not only have its meaning adjusted, as it has just been described, it may also bring to the destination field other elements with the meaning already determined by it. We could use the example of virus migration to the computer field, to show not only suffered adjustments depending on the objects of that field , but also the import of many other signs that now operate in the field of computer technology, such as infection, eradication, antivirus, inoculation, vaccination, quarantine, etc.[8]

It may be seen, in the above-mentioned example (1), that meaning dissemination resulted from the overlap of the field of linguistic objects on religious practices, although a general meaning of this field has not been entirely deleted. Let us analyze the following sentence, in order to determine what sense is disseminated in this particular case:

(2) Se o carro beber, não dirija (Ford Corolla).
(If the car drinks, do not drive.)

The sentence analyzed in Figure 2 is an advertisement of the car shown in brackets (Ford Corolla). The construction of its meaning refers to an intertext concerning government campaigns - *If you drink, do not drive* - warning about the incompatibility between alcohol consumption and driving. What is being disseminated by the comercial, based on the reference intertext?[9]

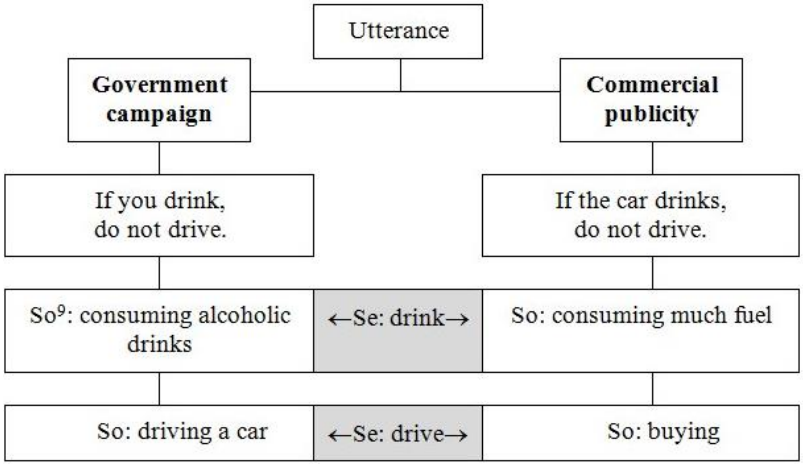

Figure 2.

[8] In many cases, migration is likely to have the role of setting lexical items in other lexical fields, where the migrated item is granted polysemic value in addition to its contingency content of textual use.
[9] *So* is *signifié* and *Se* is *signifiant* according to Saussure.

Let us use the statement in brackets as a trace of the sentence utterance. In fact, Corolla determines the occurrence of *car* as the subject of the original sentence and in so doing it disassembles the alocutive content that the phrase held in its original form - *If you drink*: oriented to any citizen; the alocutive value, however, remains in the second sentence – *do not drive*. Combining these facts changes the meaning of the verb *drink* in the campaign - So: drinking alcohol – changes to So: consuming much fuel. In fact, the two alocutive forms in the campaign - *If you drink, do not drive* - implied that the actions of drinking, as well as driving, are subject to the user decision. However, the change in the enunciative content of the first sentence in the advertisement - from alocutive to delocutive - dismantles the possibility of the user's act by imposing the manufacturer's vision and preserving the user decision only in the second sentence, that remains alocutive. Thus, *driving* remains a user decision, but *drinking* is a technical car specification.

In summary, as we take all this information into account, we can conclude that not only *drinking*[10] has its meaning changed, *driving* also represents *buying* in the commercial. It is not the purpose of the commercial to warn the user against *driving* a car that consumes much fuel, but especially *not to buy* a car in such conditions - a decision up to the user. Integrated in this new semantic field – car commercial - this aspect of meaning contaminates the verb *drive*. We may otherwise state that the dissemination of the field over the verb represents a possible metonymic dimension to *buying*, which is based on a causal relationship - if (buying) then (driving). The sentence, therefore, conveys meaning dissemination, guided by Corolla's use in a commercial[11], with a change of the basic meaning of *driving*.

As it may be noted, the two movements operate in a complementary way: while the first - *migration* - justifies the material transposition of elements from a field to another, the second - *dissemination* - enhances the effects that such transposition may have on local formulations, in terms of meaning. The interdependence between *migration* and *dissemination* does not ensure, however, to which extent we should conceive *dissemination* as a difusor of other issues of meaning or other conditions for referentiation. As we probably know, no sign is imported from a lexical field into a semantic field when it comes to proper use, if it is to assume a very important role in the meaning production process. The central idea it represents should be contained in the various details of the objects at stake: the concept of grammar would not be imported into any field if the object into consideration were not involved in connections that allowed to show, at least, some dimensions to which the ideas of organization, control, and forecasting may be applied, through rules.

Summing up, the potential for sign migration and the consequent meaning transfer that it assimilates in the new discursive environment where it currently functions may be linked to the nature of the facts that it can represent in a discursive event, the possibilities of its application, and the user intention to extract something unforeseen from it. None of these aspects seems indifferent to what is essentially proposed by Marchetti: seen as instruments, words command our attention, aiming at experiencing meaning production[12] consciously. Among our attentional operations, migration and transfer should occupy an important place, as they have relevant impact on the production of meaning effects. The pattern that often

[10] This change of meaning in *drinking* is already enshrined in the language and it is part of the polysemic matrix of this verb, so it is no longer a case of migration that interests us in this approach.

[11] It is possible that the use of the original text, evoking ethanol, may also be related to some degree of competition in the car industry concerning the nature of the fuel in use.

[12] See Mari (2008, pp. 99-120).

justifies migration seems to be structured in simple logical inferences, from public domain, involving various patterns of linguistic processing.

Sign migration and meaning dissemination processes are movements that integrate the very nature of lexicon and allow continuous adjustments in the potential significance of lexical items of a system. The diffuse and malleable content of the lexicon enables the existence of many meaning production processes that rely on the ressignification of lexical items. For example, the origin of many metaphors could be explained in terms of this mobility of the lexicon. Thus, a metaphorical instance such as "Life is a ball" allows the ball to be redefined to mean facts of life, regardless of having positive content (dominating the ball - dominar a bola-, softening the ball -amaciar a bola- ...), or negative content (dropping the ball - pisar na bola- ; carrying the ball - levar bola nas costas –...). The metaphorization of all these expressions results from the sign migration of ball from the field of sports facts to facts of life. Such sign transposition enables its ressignification to spread into many expressions and to be incorporated into the sign, whether by those already culturally consecrated metaphors or by those that might be performed in specific texts. So the fact that we cannot impose metaphorical limits for a lexical item is due to the fact we cannot impose any limit on sign migration and meaning dissemination.

It may be finally stated that *migration* and *dissemination*, even though a clearer specification of the scope is still needed, are sign movements in language and common phenomena in any activities involving discursive practices: after all, at first, we can say anything with any word, given the adjusted enunciative conditions for such. This entire process, involving both movements, can be justified on grounds of diversifying the details attached to them, by means of operations such as *metaphor* and *metonymy*, which are widely used in social discourse.

4. TEXTUAL ANALYSIS

In this section, we will analyse, as some kind of more structured reading exercise, the text "Botânica" (Botany)[13], by Brazilian author Luis Fernando Verissimo (See Appendix), showing how we can avail ourselves to the concepts discussed here in order to justify its reading. The aim of this analysis is to highlight some of the aspects proposed by Marchetti in terms of their application to reading and to what extent we need to use the concepts of sign migration and meaning dissemination to understand some kind of texts. In other words, we can say that the reading production process of a text takes place in different degrees of tension between the reader and the words arranged on its surface. So the challenges of signifying a text are not resolved within a single standard, but in a complex network of procedures, resources, and concepts we make use of. A text may contain places of less tension - for more linear readings - but also places of greater tension - for readings that intersect different codes and meaning levels. Neither dimension is indifferent to attentional processes, but the places of greatest tension certainly compel readers to refine these processes, or to implement more detailed processes for reading.

[13] We will not present a very detailed analysis of the various aspects of the text that could be explored within the reading schemes that we propose later. The aim of this analysis is to show an integrated view of the two processes we are discussing in particular.

Thus, we may interpret Marchetti's hypothesis with a validity that extends throughout the whole lexicon of languages: any use of words in a text implies attentional operations that make us consciously experience meaning. However, we do not make use, with the same attentional intensity, of the meaning of all the words in a text, and all the possible reading paths that may be designed by them as, by natural limit and contingent, we opted for a meaning effect to be achieved and have left aside so many potential others (some whose existence we may not be aware of).

At first, nothing in terms of text vocabulary can be dismissed into your reading, but any reading designs a meaning path and abandons many others and, in so doing, selects lexical units to any extent - articles, prepositions, nouns, adjectives, verbs, adverbs – to change them into a greater attentional effort, consciously extracting the meaning effects that the path in question can provide. The construction of the irony effect in a text, for example, leads to more intense attentional operations on certain words, for we need them so as to consciously draw or construct a compatible experience with this effect. Throughout this process, we have seen reading as a conscious experience of the reader's interaction with the text, and we have likewise identified such experience as the effect of meaning that can be built during reading. For the text in question, we will consider three reading paths:

FIRST PATH: from its title – 'Botânica' (Botany) - we can assume a first reading path, one that naturally leads us to signifying objects in the plant world. This possibility can be confirmed throughout the text by naming certain objects - *greenhouse, orchid species, plants, leaves, fruit, vine, stem, branch, bush* ... - or by the nature of predications - *twisted, arrive spontaneously, pointed leaves, not grown, do not grow anywhere, new leaves have just sprouted*... It is not, however, a standard interpretation, since a large part of the terms does not refer directly to the objects in that field. So *facetiae, joke, witticism, mockery, pleasantry, crack, satire, jest,* etc. suggest types of humor narratives that, in terms of textual construction, have migrated to the generic field of plant names and assimilated the general meaning of this field. The dissemination process, reinforced by the nature of predication - *mockery: plants with pointed leaves*; *satire:* the vine that creeps along the *stem* – have contaminated the whole meaning of these terms. Thus, the effect created by the interpretation process, when it comes to the METAPHORIZATION OF PLANT SPECIES and its resemblance to types of humor, requires that our attention is guided by such words to the conscious perception of what the reader experiences as meaning effect.

SECOND PATH: We might as well reverse the hypothesis of the first path and justify a meaning effect that suggested the METAPHORIZATION OF TYPES OF HUMOR by predication for vegetables. This path requires some reversal in the attentional process: in the first path, the attentional process was controlled by the words that represent the field of botany: now the words that represent the field of humor should lead the attention (certainly a more adjusted hypothesis to the enunciative conditions of the author, a humorist). We may start by the metaphorization of *botany* and consider how diverse humor narrative types can be and how they often differ in detail. This metaphorization relates directly to *greenhouse*: the humorist cultivates its forms inside it, until they are suitable for planting in the social environment – *derision: only we humorists should be given the license to cultivate them*. In this passage, the predications for vegetables migrate to the field of humor and this field provides them with a specificity of meaning that disseminates through all types. Thus, the joke is conceived (un)consciously, and this very content of meaning is present in the

predications attributed to it: *come spontaneously, cannot be grown and neither require special care*. The same may be observed regarding the types of irony that the author takes into consideration: *fine irony: the kind of fur that seems to cover everything; heavy irony: awkward bush*. In this interpretation path, the types of humor lead the reader's attention; the reader's cognitive effort must overcome the challenge of reconciling the content of the types of humor with predications that are proposed in an attempt to qualify them. If this is the conscious reader experience about the processes of creating humor, then this reading path seems to assimilate such possibility.

THIRD PATH: The two paths have described different levels of acceptability: the first one is, in our view, a less likely reading hypothesis; the second resonates as a more plausible hypothesis, bearing in mind the author's enunciative conditions[14]. These two paths are just as relevant to determine the third interpretation path: the METAPHORIZATION OF POLITICAL LIFE, by naming types of humor and predications for vegetables. Under the same qualifications ascribed to jokes, the author creates a series of compounds that resemble, at the same time, the (morphosyntactic) format of plant names and the (semantic) content of anecdotal facts of political life. Thus, *political-blunders, newton's-gaffes, rural-indebtedness* - seem to evoke a pattern of plant names, as well as political events, and both are qualified by a devastating effect - *endemic species that proliferate in Brazil*. The attention command in these expressions may not be initially defined by the content of any of the previous two paths, since such terms do not exist in Portuguese and can only assume some meaning within the text[15]. The presumed neutrality regarding the two paths offers the possibility of compositional reading to each of the expressions and terms. In this reading, terms such as *ministers*, *Newton* (a military commander of clumsy actions) and *indebtedness* seem to lead the reader's attention to the political sphere addressed by the chronicle, compelling the reader to consciously experience the meaning effect that will be produced in this path: one mocking critique of Brazil's political wounds. The two dimensions emphasized in the previous paths - designations of humor narratives and predications for vegetables - are graspable in this new path with another value, the political one. We highlight just a few excerpts that may ratify this new interpretation perspective – *derision: highly injurious to all types of life: vegetable, animal, social, and national; derision: spread throughout Brazil, become widespread and today they are out of control.*

Finally, if we conceive this path as one that should 'restrain' our interpretation of the text, this is due to the fact that some social value has been ascribed to it[16] - a critical position on political life - which can only reflect the reader's point of view on the types of life that we experience.

Moreover, our limitation to see a type of life reflected in this text may be a consequence of the limits of the instruments we used in order to validate and justify the wide range of significance that, given the current circumstances, we attempt to experience consciously. Although we may rely on this instrumental limit, we cannot, as in Barthes's words (1980, p. 14) "equate the limited text to limit-text".

[14] Having in mind the enunciative conditions of the text: the author is a humorist who metaphorizes types of humor by qualifying the behavior of plants. He is not a botanicist who metaphorizes types of plants by describing types of humor.

[15] Despite the fact that, in the text, the terms represent a mixture of the two dominant fields (vegetables and humor), their meaning can only be filled by the circumstances of textual interpretation.

[16] The other paths certainly contained seminal values that were essential to the construction of this final value.

CONCLUSION

As we compare and contrast these three paths, it is important to emphasize, from the meaning point of view, the content of these three reading hypotheses (certainly not the only ones), constructed from the meaning data revealed by the words in the text and their role in leading our attention as we scroll the text by one of these paths. Each route strengthens our understanding of a part of the text meaning, and each route strengthens the meaning inferences we come across in every reading movement. As a matter of fact, the meaning effects enabled by the reading of a text are not limited to our interpretation of it. On the other hand, our ability to see new effects is restricted by the tools we actually use.

In our view, Attentional Semantics shows a path for expanding and consolidating the instruments we avail ourselves to in the reading process. If it is true that words lead our attention to consciously construct the meaning effect we intend to extract from a text, in a discursive practice, then they probably do not do it with the same intensity for all those words along a reading path: we trigger different attentional processes when a word elicits a metaphor, an irony, or when it entices us to resignify it through other procedures such as those discussed here.

Once it substantiates the significance of general principles such as attention, consciousness, and experiencing, Attentional Semantics is likely to signal a different path to meaning issues that need to be taken from more global parameters, at least to circumstances beyond lexical description and recognition of meaning atomization - often relevant to understanding many meaning facts. The process of reading a text is not indifferent to anything that may be described on the meaning units that comprise its structure, but it does require something more than a collection of semes, of features that make up lexical items. It requires something that leads the meaning structuring process of a text towards a global dimension, where it finds itself inserted in, perhaps as a conscious experience of interlocution that may be experienced by the reader/text relation.

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APPENDIX

Botânica
Luís Fernando Veríssimo
In: Revista Veja, 09/09/87

- humorista lidera um grupo num giro pela sua estufa, enquanto lá fora a tempestade rufa.
- Estas são facécias – aponta, mostrando uma espécie de orquídea contorcida.
- E ali?
- Chistes.
- Há chistes por toda a parte.
- Sim, os chistes brotam espontaneamente, não são cultivados nem requerem cuidados especiais. São como bobagens-de-ministro, ordens-do-dia, outras-do-newton e moratórias-do-campo, espécies endêmicas que proliferam no Brasil.
- Como as piadas.
- Sim, se bem que a piada não nasce em qualquer lugar, só em terminadas condições.
- Estas plantas de folhas pontudas...
- Zombarias.
- E estas pequeninhas, de várias cores? São graciosas.
- Não, são gracejos. Graciosas são aquelas ali. E este fruto amarelo, estão vendo?
- que é?
- Graçola.
- Dá suco?
- Não. Não dá nada. É como lorota, só tem aparência.
- que é isto neste vaso?
- Isto é uma pilhéria. E estes são remoques. E ali estão as piadas.
- Aquelas não são troças?
- Não, são motes. E, atrás, motes miniaturizados, motetes. E ali, claro, um motejo.
- E essa espécie de penugem que parece cobrir tudo...
- É a ironia. Aqui, a ironia fina. Aquele arbusto desajeitado é a ironia pesada.
- Estas são troças.
- Acertou.
- Também parecem estar cobertas por uma leve... É a mofa. Ah, e aquela trepadeira que se enrosca no tronco, subindo com ele e quase o escondendo: é uma sátira.
- Sátira mordaz?
- Bem, tem a mordaz e a leve, também chamada sutil. Esta é a leve.
- E esta a... Epa!
- Quase pegou seu dedo, não é? Esta é perigosa. É o escárnio.
- Mas é horrível!
- Feio, não é? Cuidado! Não cheguem perto.
- Pensei que o escárnio fosse proibido.
- Na verdade só nós, humoristas, devíamos ter licença para cultivá-lo, em condições controladas. O escárnio é uma variedade de sarcasmo que por sua vez é uma degenerescência da ironia pesada, mas hoje é considerado uma categoria à parte e altamente pernicioso a toda vida vegetal, animal, social e nacional. Nós o cultivamos separado das outras plantas, mas humoristas inconscientes não tomam este cuidado e o resultado é que o escárnio se espalhou pelo Brasil, se generalizou e hoje está fora do controle. É o que dá não regulamentarem a profissão.
- Esse som...
- Ele está rindo de nós. Mas vamos adiante. Aqui temos o belo ramo de chufas.
- E ali? São dichotes?
- Quase acertou. São ditérios. Ah, e aqui está ela.
- que é?
- Uma anedota em formação. Vejam, as folhas recém estão se abrindo e...

Botany[17]
Luis Fernando Verissimo

- The humorist leads a group on a tour of his greenhouse, while a storm roars outside.
- These are facetiae – he points, showing a kind of twisted orchid.
- What are those over there?
- Jokes.
- There are jokes everywhere.
- Right, jokes come spontaneously, they are cannot be grown and neither require special care. Just like political-blunders, daily-orders, newton's-gaffes, and rural-indebtedness, endemic species that proliferate in Brazil.
- Like jokes.
- Kind of, for jokes do not grow anywhere, only in finished conditions.
- These plants with pointed leaves ...
- Mockery.
- How about these little ones, of various colors? How pleasant!
- They are pleasantries. Those down there really please me. And this lurking fruit, can you see it?
- What is it?
- Lark.
- Is it juicy?
- Not at all. It's more like a crack. It's not as juicy as it's cracked up to be.
- What's in this vase?
- This is a jest. And these are mocks. And there are the jokes.
- Those are not scorns?
- They are windups. And the ones behind them seem to be wheezing something out. And there, of course, is witticism.
- How about that kind of fur that seems to cover everything?
- Oh, it's verbal irony. And here is dramatic
- That's derision. Oh, and the vine that creeps along the stem, rising with it and almost hiding it: it is a satire.
- Biting satire?
- Well, there is the snappy and the light kind, also called subtle. This is the light kind.
- Is this the ... Ouch!
- It almost hit your finger, didn't it? This one is dangerous, it's a caustic remark.
- But it's horrible!
- Ugly, isn't it? Watch out! Don't get too close.
- I thought it was forbidden to grow caustic remarks.
- Actually, only we, humorists, should be given the license to cultivate them under controlled conditions. Caustic remarks are a variety of sarcasm, which in turn is a degeneracy of heavy-handed irony, but today they are considered a separate category and highly injurious to all types of life – vegetable, animal, social, and national. We grow them separately from other plants, but unconscious humorists aren't careful enough and, as a result, caustic remarks have spread throughout Brazil, become widespread and today they are out of control. That's what you get for not regulating the profession.
- What's that sound?
- They're laughing at us. But hey, let's move on. Here we have a beautiful bouquet of gags.
- And there? Is that a prank?
- Close call. It's a punch line. Oh, and here it is...
- What is it?
- An anecdote forming itself. You see, the new leaves have just sprouted, and...

[17] Translated by Denise Borille de Abreu - PhD student, Catholic University of Minas Gerais, Brazil.

irony. That awkward bush is irony of situation.

- These are spoofs...
- You hit the spot.
- They also seem to be covered by some light ...

REFERENCES

Barthes, R. (1980). *S/Z*. São Paulo: Martins Fontes, 14.

Marchetti, G. (2003). "Foundations of Attentional Semantics". Retrievable from http://www.mind-consciousness-language.com

Marchetti, G. (2010). *Consciousness, attention and meaning*. New York: Nova.

Mari, H. (2014). "Significado corpóreo: de movimentos etiológicos a ações intencionais". In: H. Mari and J. C. C. Silveira (Eds.), *Interfaces entre Cognição E Linguagem* (Unpublished Manuscript).

Mari, H. (2008). *Os lugares do sentido*. Campinas-S: Mercado de Letras.

Zlatev, J. (2002). Meaning = Life (+ Culture). An outline of a unified biocultural theory of meaning. *Evolution of Communication*,*4/2*, 253-296.

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Chapter 4

A COGNITIVIST ATTENTIONAL SEMANTICS OF LOCATIVE PREPOSITIONS

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ABSTRACT

This chapter presents an attentional approach to the semantics of locative prepositions like *in*, *on*, and *above* which typically denote spatial relations between objects in the world. Spatial relation expressions involving such prepositions are at the core of the linguistic inventory of natural languages. Interestingly, they are flexibly used, not only for the description of space, but also for the verbalization of non-spatial relationships. However, cross-linguistic data reveal that there is no overall unanimity in the linguistic description of spatial relations. These intra- and cross-linguistic phenomena pose a serious challenge to semantic approaches to locative prepositions which try to capture the meaning of these terms. In fact, it will be shown in this chapter that standard approaches fail to provide an explanatory account of the available data. As an alternative, a cognitivist attentional semantics of locative prepositions will be presented according to which spatial expressions designate *perspectivations* of space that are based on mental operations involved in how we *selectively attend* to our preconceptual perceptual representations of space. The development of this idea and the characteristics of this approach are described, and its treatment of the mentioned phenomena is discussed.

1. INTRODUCTION

The semantics of spatial expressions has received increasing interest in the last four decades or so and has inspired much research investigating the relation of language and space (P. Bloom et al., 1996). According to Zlatev (2007), there are two reasons for this interest in spatial meanings. The first is the central role (universality, primacy, immediacy) of space for human experience and for shaping conceptual structures (see also J. Mandler, this volume). Because of that, spatial expressions lend themselves to be used as "windows on the mind" in the search of conceptual universals or in the investigation of the relation of language and

spatial perception/cognition in general. The second is the "basic" nature of the spatial domain and the observation that spatial expressions often have non-spatial meanings, which demonstrates "the extent to which spatial metaphors and analogies dominate speech and thought" (G. A. Miller and Johnson-Laird, 1976, p. 375)[1].

While research on spatial semantics began as a linguistic task to specify the meaning of spatial expressions, researchers from related disciplines later joined that field and added their specific viewpoints and research methodologies, e.g., psycholinguistics (Clark, 1973), psychology (G. A. Miller and Johnson-Laird, 1976), Artificial Intelligence (Herskovits, 1986; Bateman et al., 2010), geography (Kuhn, 2005), computational linguistics (Kelleher and Costello, 2009), cognitive anthropology (Levinson, 2003), and neuroscience (Tranel and Kemmerer, 2004; Kemmerer, 2006).

In this spatial semantics research there has naturally been a come-and-go of favored phenomena, opinions, models, and methods (empirical, formal, experimental, computer-modelling). Attention-related phenomena, however, seem to have come to the fore only recently (perhaps culminating in Talmy, 2007, but see Carstensen, 1993). In this chapter, I will show that this is by no means warranted and that, in line with the general program of "attentional semantics" (Marchetti, 2006a), attention must rather be regarded as a phenomenon at the heart of the field, and as an essential link in the relation of language and space.

In this chapter, I will confine the discussion to the semantics of *locative expressions* (in short: locative semantics) which specify *where* an object is located (*on the table, under the towel* etc.) – as opposed to *directional expressions* specifiying, for example, the source, goal or path of a movement (*off the table, into the room, through the door* etc.). The locative expressions of interest here involve spatial prepositions that relate two entities: the *located object* (also called figure, trajector, or referent) and the *reference object* (also called ground, landmark, or relatum). They will be referred to as LO and RO, respectively. The class of locative prepositions can be subdivided, usually into two main groups: *topological* prepositions (*in, on, at*) and *projective* prepositions (*above, below, right of, in front of* etc.). Typically, projective prepositions are associated with *reference frames*, i.e. qualitative coordinate systems with respect to which a spatial relation can be characterized and which provide three axes: the VERTical (for above/below), the OBServer (for front/back), and the LATeral (for left/right) axis (Lang et al., 1991; Levinson, 1996). According to Levinson, three frames of reference must be distinguished: the *intrinsic* frame, where the axes are associated with RO (e.g., a cupboard having front, back, top, bottom, left, right), the *relative* frame, where the axes are determined by the observer (as in *behind/in front of the tree*), and the *absolute* frame, where relevant axes are provided by environmental features (as in *He lives downstream from here/south of the hill*). They are used to explain the fact that a given LO-RO configuration can sometimes be expressed by different (even apparently contradicting) prepositions.

Departing from the "observation that the portrayal of prepositional semantics in bilingual, but also monolingual dictionaries [...] is mostly inadequate (inaccurate, misleading and with mismatched examples)" (Brala, 2002, p. 1), research in spatial semantics faces two important

[1] This had led to the – highly questionable – assumption of "localism" where aspects of a language (e.g. temporal expressions or even grammatical case) are supposed to literally "derive from" spatial expressions (for an overview see Fortis, 2012).

problems. First, a spatial term usually has a vast number of different, but related senses which may range from strictly spatial to abstract ones as is shown in (1).

(1) a. helicopter over the house
b. veil over the face, clouds over the sun
c. John lives over the hill
d. the game is over
e. to have power over someone

The task is to characterize (and structure) these senses and separate them from the meaning description of other terms. Doing so, one sails between the Scylla of overgeneralization (where the proposed meaning description allows senses which are inacceptable to native speakers)[2] and the Charybdis of undergeneralization (simply listing different senses without abstraction of common aspects, and not capturing deviating but acceptable senses), cf. Haspelmath (2003, p. 239) for a similar use of this metaphor.

Second, languages differ in how their spatial terms refer to space. For topological expressions, this is shown in table 1 (after Bowerman, 1996, p. 394) in which the terms for the typical relation between object pairs are given.

With regard to projective prepositions, a similar cross-linguistic variation can be observed. A well-known example is the African language Haussa (Hill, 1982) in which a LO may be "in front of" a RO (say, a tree) in some situation while this would be described as "in back of" in English. Here, the direction of the OBServer axis is reversed but the left/right distinction corresponds to English usage. This is different in Tamil, where both horizontal directions are reversed.

These differences of establishing the relative reference frame are often described by how the coordinate system of the observer is imposed on RO: it is "mirrored" in English, "translated" in Hausa (also called "tandem principle"), and "rotated" in Tamil (Levinson, 1996). Depending on a semantic approach's ambition, the task is to explain why and how cross-linguistic differences appear and what this implies about the relation of language and cognition (and the question whether language affects thought, see Boroditzky, 2003).

In the following, I will first present some aspects of spatial semantics relevant for the present discussion, followed by a short description of the standard approaches in this field. This will lead to stating some misconceptions about locative semantics that I believe to exist in the literature. In the second part of this chapter, I will first retrace the development of the *Cognitivist Attentional Semantics* (abbreviated *CAS* in the following) approach to locative prepositions which is characterized by the assumption that selective attention plays a central role in the relation of language and space (see Carstensen, 2011, for a more general presentation of the Cognitivist approach). I will then elaborate on various aspects of attentional spatial relations. Based on these aspects, I will finally show how the semantics of locative prepositions can be given an explanatory specification and how some of the cross-linguistic phenomena can be explained.

[2] Here's a classical example: if you put a bowl over an object (say, an apple) on a table, then the object can be assumed to be objectively "in" the bowl. However, one would not say it is *in the bowl*, but *under the bowl*.

Table 1. Cross-linguistic variation in the linguistic classification of spatial relations

Situation	English	Finnish	Dutch	Spanish
cup-table	*on*	-LLA	*op*	*en*
apple-bowl	*in*	-SSA	*in*	*en*
handle-door	*on*	-SSA	*aan*	*en*

2. ASPECTS OF SPATIAL SEMANTICS

In general, the goal of spatial semantics is to arrive at a sufficiently adequate meaning description for a spatial term. If we take the J. J. Katz/Fodorian program for a semantic theory (J. J. Katz and Fodor, 1963) as the starting point of modern semantics, this corresponded to finding distinctive, potentially universal, semantic elements (semantic features called "semantic markers" and "distinguishers") associated with each term, e.g. '+VERTICAL' for *above* and '+HORIZONTAL' for *beside*. As D. Lewis (1970) pointed out, however, semantic markers are symbols (items of an artificial language he dubbed "markerese") which again require a semantic specification. Furthermore, Bierwisch could show in his work on the semantics of dimensional adjectives (Bierwisch, 1967, 1989) that it is impossible to devise a once-and-for-all semantic marker description for spatial terms (and linguistic terms in general) on *one* level. Therefore, a more flexible semantic description is needed that allows for underspecification and contextual variation (in the sense of semantic-level parameters being variable with respect to pertinent conceptual-level values in some context), and that ultimately connects to (models of) the world.[3] It was at this point, that spatial semantics split up and gradually evolved into the inhomogeneous multidisciplinary landscape of research it is today which can best be described by qualitative contrasts.

Explanatory/descriptive. As the tasks above are sufficiently complex, most approaches to spatial semantics are content with arriving at a coherent (classification) system of semantic description, e.g. as "linguistic ontologies" (Bateman et al., 2010) or as "sense networks" (e.g., Brugman, 1988; Lakoff, 1987; Tyler and Evans, 2004). For modern applications in corpus linguistics (e.g., for "sense tagging" in corpora), it may even only be relevant to classify spatial senses (as opposed to structuring the senses *for* a spatial term, see A. Müller, 2013). Most formal accounts of spatial semantics must be considered descriptive (e.g., Aurnague and Vieu, 1993; Zwarts and Winter, 2000). Other approaches, many of which are interested in psycholinguistic or (neuro)psychological data (e.g., G. A. Miller and Johnson-Laird, 1976; Carstensen and Simmons, 1991; Landau and Jackendoff, 1993; Kemmerer, 2010), strive to uncover the underlying, explanatory principles that determine the structure of spatial representations and their relation to language.

Cognitive/non-cognitive. Not all approaches to spatial semantics are concerned with aspects of cognition (they emphasize the relation to the world "out there"). It is at the core of the various branches of cognitive linguistics that cognition is central and that language as a

[3] Nowadays, talking of semantic markers/features/primes is sometimes regarded as justified if these elements are *grounded* in conceptual representations (Bierwisch, 2011).

cognitive phenomenon relates primarily and exclusively to cognitive representations of space (Jackendoff, 1983; Lakoff, 1987; Bierwisch and Lang, 1989; Carstensen, 2011).[4]

Within cognitive spatial research, however, it is important not to conflate or disrespect important distinctions, for example the one between lexical and conceptual knowledge (Kelter and Kaup, 2012), or between aspects of the mind in general and actual representation and processing (Sandra, 1998; Sandra and Rice, 1995). Therefore, the "window to the mind" metaphor should not be taken literally, but neither should the relation of spatial language and spatial representation be made a riddle just because of cross-linguistic differences (Holmes and Wolff, 2013), because the relation might be complex but not complicated. It is also helpful to remember that the system of spatial expressions in some language has evolved over time, and that a user of that language is not aware of the structure of this system. Likewise, the acquisition of word meaning by individuals evolves over time, and is even subject to qualitative shifts (see the "characteristic-to-defining shift" of Keil and Batterman, 1984).

Formal/non-formal. In formal disciplines, it is an established methodology to specify the semantics of a (formal) language by way of *models* where elements of that language are systematically mapped to objects in the model's domain (so-called model-theoretic semantics). This supposedly clear and rigorous approach was introduced by Richard Montague (see Partee, 1996) into linguistic semantics. Researchers in that tradition often start with set-theoretically or mereotopologically defined spatial regions (or with vectors) and then define spatial relations and linguistic semantics on that basis.

Non-formal approaches, on the other hand, often remain vague in their modelling and are therefore exposed to the above "markerese" criticism. However, the formal/non-formal distinction is not a divide between good and bad. Instead, formal spatial semantic approaches are only as good as their underlying ontological assumptions, and these may be wrong (for a more elaborated discussion on this point see Carstensen, 1995). Non-formal cognitive approaches rather establish the necessary link to the world via the postulation of "embodiment" of semantic/conceptual structure, that is, by grounding mental phenomena in the body's physiology.

Implicit/explicit. Olson and Bialystok (1983) observed that even small children have no problem to correctly categorize certain things as 'lollipop' although this involves spatial relations (a round thing attached at-the-end-of or at-the-tip-of a thin long stick) they have not yet available for thinking and speaking. This distinction of information being implicit in a representational format and being explicitly available for language is therefore important. Unfortunately, it is widely ignored in spatial semantics research, and a closer look reveals that what is modelled is only implicitly represented aspects of space.

Propositional/imagistic. Until late in the 1970s, it was quite usual to specify the meaning of prepositions by simple relational propositional descriptions, at least as a starting point. This is exemplified by the meaning descriptions for *in* and the two main senses of *on* in (2) taken from Herskovits (1986, p. 12) (see also chap. 6.1 of G. A. Miller and Johnson-Laird, 1976).

[4] Within cognitive approaches, cognitive linguistics in general and experimental (cognitive psychology, neuroscience) or modelling (artificial intelligence, computational linguistics) disciplines may have widely differing views on spatial semantics. There even are more or less subtle differences within cognitive linguistics between "Cognitive Semantics" (following the works of Langacker, 1987; Lakoff, 1987; Talmy, 2000), "Conceptual Semantics" (Jackendoff, 1983), the "Two-level Semantics" of Bierwisch and Lang (1989), and the "Cognitivist Semantics" of Carstensen (2011, 2013).

2. a. *in(LO,RO)* <-> *Located(LO, Interior(RO))*
   b. *on1(LO,RO)* <-> *Supports(RO,LO)* and *Contiguous(Surface(LO), Surface(RO))*
   c. *on2(LO,RO)* <-> *Contiguous(Boundary(LO),RO)*

Around that time, it was questioned whether propositions (or language-like meaning elements) are the only format to store information and/or to reason with, or whether mental images could be another, analogical, representational format (so-called "dual-coding theory", Paivio, 1983), which led to the "imagery debate" whether this is true (Finke, 1989; Kosslyn, 1994). This idea of "wholistic" descriptions was taken up by leading Cognitive linguists (for example, Lakoff, 1977) who combined it with the observation that the semantics of spatial terms is *schematic* (i.e., ignores details of LO and RO). As a result, they use so-called *image-schemas* as basic embodied elements of spatial semantics (in place of markers or features), see M. Johnson (1987).

Monosemy/polysemy. In linguistic semantics, there were two main reactions on the markerese criticism. According to the one (Bierwisch and Lang, 1989; Jackendoff, 1983; Lang and Maienborn, 2011), semantics must be viewed as a two-level phenomenon, with a semantic level consisting of context invariant and language specific, mainly monosemous, semantic forms acting as an interface to the conceptual level consisting of rich non-linguistic representations of the world. Here, the various specific senses of a term are not explicitly coded in the language system but derive from instantiations of abstract semantic forms in context-specific conceptual representations.

In contrast to that, the other main approach is characterized by the assumption that language stores all relevant senses of a term (at the same time rejecting the idea of an abstract "core" meaning) which are organized as image-schematic sense networks on one (conceptual) level (the classical example being the corresponding polysemy analyses of *over* in Cognitive Semantics, see Brugman, 1988, and Lakoff, 1987).

Meanwhile, this latter "radical polysemy" account has weaker variants, for example the "principled polysemy" approach proposed by Tyler and Evans (2003). They argue "that a significant problem with previous approaches is that they fail to distinguish between what is coded by a lexical expression and the information that must be derived from context, background knowledge of the world, and spatial relations in general" (Tyler and Evans, 2003, p. 97). As an alternative, they introduce abstract, primary meaning components (so-called *proto-scenes*) into spatial semantics, with which they factually converge with the two-level approach in that respect.

Spatial/geometrical/functional. It can be easily observed that spatial expressions do not exclusively have strictly-spatial meanings. For example, in *the North Star is to the right of the mountain peak* (an example from Herskovits, 1986) there cannot be an objective, spatial interpretation of being "to the right of". Similarly, a *bird sitting in a tree* is actually located outside, i.e. *between* parts of, the tree (if sitting on a twig). This is a general phenomenon deeply entrenched in spatial semantics (consider the non-verticality in *House on the beach* or in *He made it over the border*). It has led to the common belief that spatial expressions involve different kinds of mappings from objects to relevant parts or aspects (conceptualizations), or sense networks in which less spatial senses are systematically related to the prototypical spatial sense they ultimately derive from.

Some have also emphasized the role of functionality ('containment', 'support', 'contact') in spatial meanings (Vandeloise, 1991; Coventry et al., 1994; L. A. Carlson and van der Zee, 2005; see also the examples above).

3. APPROACHES TO LOCATIVE SEMANTICS

3.1. Region Approaches

As shown in (2a), the idea that a location relation between LO and a *region* of RO figures prominently in spatial semantics belongs to the early developments in spatial semantics. According to G. A. Miller and Johnson-Laird (1976), the concepts 'spatial relation' and 'region' are intimately connected: "In order to take account of spatial relations, the perceptual process must not only register place, but relations between places, which entails perception of a spatial region containing the place of the thing. [...] Thus, two things whose regions overlap can be seen in a spatial relation to each other" (G. A. Miller and Johnson-Laird, 1976, p. 59). G. A. Miller and Johnson-Laird also introduced the notion of 'region of interaction' as a confined "halo" around RO which is relevant for prepositions like *on* or *at*. This is shown in their semantic definition for *at* in (3), where "INCL" corresponds to the 'Located' relation, but emphasizes spatial inclusion (cf. G. A. Miller and Johnson-Laird, 1976, p. 390).

(3) AT(LO,RO) <-> LO is "at" RO if
(i) INCL(LO,REGION(RO))
(ii) not(INCL(RO, REGION(LO)))

In formal semantics, this notion of localization (being included in a certain spatial region) was taken up and generalized. According to the proposals of the German linguists Wunderlich (e.g., Wunderlich, 1982) and Bierwisch (e.g., Bierwisch, 1988), the basic meaning component is a localization relation between the place of LO and some region of RO determined by the preposition, see (4).[5] This region-based account is spelled out in terms of set theory (where regions and places are modelled as spatial points, and spatial inclusion corresponds to subset relationship).

(4) 'Semantics of a locative preposition PREP relating LO and RO' <->
λRO λLO LOC(LO, PREP-REGION(RO))

I have repeatedly argued against the region-based approach of locative semantics (Carstensen, 1995, 2002, 2007). In general, it is only descriptive and does not explanatorily account for the (cross-linguistic) differences in prepositional meaning (e.g., between *under* and *below*, or between the prepositions in table 1) or for the existence of non-spatial senses. Most importantly, however, it cannot explain the specific cooccurrence patterns of distance phrases and prepositions (see (5), taken from Carstensen, 1992b): if distance adjectives

[5] Note that compositional semantics requires a specification of the prepositions' argument structure with lambda-bound variables. Usually, prepositions are regarded semantically as two-place functions which are first applied to RO, then to LO.

denote the measurement and gradation of the distance between LO and RO then it is neither clear how adjective and preposition semantically compose at all nor why there are cooccurrence restrictions, especially in contexts where one would expect no problems (see the inacceptable use of a measure phrase in (6)). As Zwarts and Winter affirmatively write, "[a] general compositional treatment of PP modifications is not forthcoming if locative prepositions are taken as relations between sets of points" (Zwarts and Winter, 2000, p. 173).

(5) a. *weit/*nahe hinter*[6] far/*near behind b. **weit/nahe an/bei* *far/near by c. **weit/*nahe in/zwischen* *far/*near in/between

(6) **I am standing 1m near/by the door*

3.2. Vector Space Approach

The vector space approach of Zwarts (1997) and Zwarts and Winter (2000) is an impressively detailed formal account of spatial semantics in general, and of locative expressions in particular. Instead of spatial points, the authors use vectors for the definition of some spatial term's semantics. They offer a solution to the compatibility/modification problem which can be sketched as follows. First, prepositions are assumed to denote sets of vectors from RO to LO, and so do other expressions (e.g., distance phrases). Second, prepositional vectors are subclassified according to whether they can be "stretched" (lengthened): for example, a stretched above-vector remains an above-vector. This property is quite obviously not given for the vector sets of *near*, *on*, or *at*. Third, measure phrases also denote stretchable vector sets. Fourth, compatibility can be modelled by intersecting the distance and location vector sets stated in a *modification condition*: prepositions can be modified by distance phrases if and only if the intersection yields non-empty sets.

I have some sympathy for this approach as it is close to the cognitivist attentional one (but see Carstensen, 2013, for a different treatment of the modification problem). However, like the region approach it is only descriptive: it *stipulates* that *near* denotes a non-stretchable vector set but it does not explain why. Correspondingly, while it is good to know that a spatial semantic theory can be formalized by using vectors, it would be even better to know where these vectors come from or how they are motivated on non-formal grounds. Besides that, like the region approach vector space semantics is RO-centered: the LO is always located *with respect* to RO (here, it is always the endpoint of the vector). Below I will show that this assumption is not warranted and will present an alternative view regarding centeredness.

3.3. Image-Schematic Approaches

In stark contrast to formal approaches, image-schematic approaches emphasize the importance of (certain aspects of) cognition for semantics. Examples are the figure-ground based distinction of trajector and landmark by Langacker, schematization by Talmy, image schemas by M. Johnson and prototypicality by Lakoff. Image schemas play a central role as they replace the discredited propositional semantic elements. They are typically conceived as

[6] The asterix "*" is used throughout the text to indicate linguistic unacceptability of the corresponding expression.

patterns of recurrent experience in the mind produced by neural processing in the brain, and as such they ground language in bodily experience. Based on image schema networks, Cognitive linguists often provide meticulous analyses of an expression's senses and their relationships (e.g., Lakoff, 1987; Brugman, 1988; Tyler and Evans, 2004).

However, the exact nature of image schemas is neither clear nor uncontroversial (Hampe and Grady, 2005), and criticism has addressed both the role of a single schema (Kreitzer, 1997) and the status of sense networks of image schemas (Sandra and Rice, 1995). As an example, consider figure 1[7] which represents the proto-scene for *in* (cf. figure 7.3 in Tyler and Evans, 2003, p. 183). According to the authors, this proto-scene involves both the spatial configuration (a characteristic relation of LO and RO) and the functional notion of 'containment' (see below for functional aspects in locative semantics). It is assumed that image schemas of other prepositional senses derive from this primary sense via image schema transformations. Now note that while figure 1 depicts an abstraction of cases where *in* is applicable, it does not give any explanatory account of IN-ness (for example, the figure could be taken to depict the meaning of *to be enclosed by*)! For less prototypical uses of *in,* e.g. *gap in the line* or *knot in the rope,* it therefore remains unclear why *in* is usable in these cases (as opposed to, for example, *on*) or, correspondingly, why some image schema transformation resulted in this linear sense. Furthermore, network models of meaning are forced to decide whether there are distinct sub-senses (image schemas) for gaps and knots being "in" their linear reference objects.

Another serious problem with image schematic approaches arises when semantic analyses (implicitly) involve metric aspects for the clarification of prepositional distinctions. For example, figure 2 depicts Tyler and Evans's overlay of the proto-scenes of *above*, *over*, *under* and *below* (cf. figure 5.7 in Tyler and Evans, 2003, p. 130). It is supposed to show that *above* and *below* express more distal, and *over* and *under* more proximal, spatial relations between RO and LO. However, either this is a bold hypothesis about relevant boundaries in our perception (which it isn't) or it is merely a imagistic description of typical metric differences of the contrasting prepositional relations. As for the latter option, it lacks the criteria for the metric differences and, correspondingly, an explanatory account of the prepositions' meanings.[8] Unfortunately, figure 2 or its metric criterion does not capture the fact that often both prepositions can be used (*There's a nice picture hanging above/over the mantel*, adapted from Tyler and Evans, 2003) or different ones in non-vertical contexts: *We found paintings *below/under the wallpaper* (both on the wall); *Let's amputate the leg above/*over the knee* (patient lying).

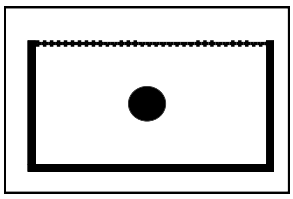

Figure 1. Proto-sense of "in" (after Tyler and Evans, 2003).

[7] Here, and in the following schematic depictions, the circle always represents the LO-referent.

[8] There is a German pair of prepositions (*an* vs. *bei*) whose elements only seem to differ with regard to the relative distance of LO and RO, and whose distinction would be similarly depicted by image schematic approaches. I will come back to this below.

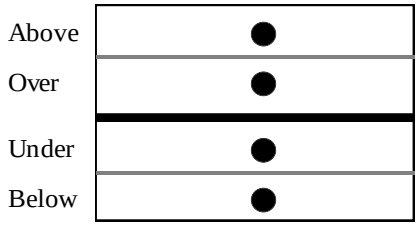

Figure 2. Proto-senses of vertical prepositions (after Tyler and Evans, 2003).

Summarizing, it seems premature to look for the neural correlates of image schemas in the brain (Rohrer, 2005) as long as they leave information implicit that should rather be explicit. Such a cautious attitude towards mental representation is adopted by Tyler and Evans (2003, p. 52): "it should be noted that our diagrams do not make any serious claim about the neurological or indeed psychological basis of such conceptual representations". However, if image schemas are not simply to be taken as depictions of the linguist's intuitive abstractions, there must be more to them. A corresponding suggestion is made by Grady: "the most useful way of understanding image schemas is to see them as mental representations of *fundamental units of sensory experience*" (Grady, 2005, p. 44, his emphasis). If attentional units belong to that (which is indeed shown below), then this view of image schematic approaches is compatible with the cognitivist attentional one proposed in this chapter.

3.4. Functional Approaches

Nowadays, there is almost general consensus that the semantics of locative expressions can hardly be characterized solely on the basis of spatial/geometric aspects (L. A. Carlson and van der Zee, 2005). Actually, the specification of locative semantics was complemented from early on (see G. A. Miller and Johnson-Laird, 1976, pp. 383f) by functional aspects like 'containment' (for *in*), 'support'/'contact' (for *on*), 'covering' (for *over/under*). Functional approaches emphasize these aspects and propose mixed models (e.g., Coventry and Garrod, 2005; L. A. Carlson and Kenny, 2006) or even postulate primacy of functional aspects (Vandeloise, 1991).

There seems to be abundant evidence that functional aspects are involved in the *use* of locative expressions. Typically, this is illustrated (e.g., Herskovits, 1986) with examples like the "apple under an inverted bowl" (**apple in bowl*, see above)[9], "wallpapers on the wall" (which can be described by *over/under* despite non-verticality), and "books on a table" (where some book on a pile is rather "above" the table). Psycholinguistic experiments show that both the type of LO and RO (and their typical functional interaction) as well as context factors (what happens to LO and RO) have an influence on the acceptability of certain locative expressions (Coventry et al., 1994). Furthermore, the "functional" prepositions *in*, *on* and *under* and their cross-linguistic equivalents have been found to be the first prepositions learned by children (J. Johnston and Slobin, 1979).

[9] Likewise, *apple in bowl* is inacceptable if the apple is only held into the bowl (on a line), but acceptable if it is spatially "outside" the bowl but on a pile of fruit contained by the bowl (Garrod et al., 1999).

However, there are at least three important objections that can be raised against an alleged *semantic* role of functional aspects (Carstensen, 2002; Langacker, 2009). First, functional aspects are only *partially* relevant for locative prepositions. There are some prepositions where such aspects are irrelevant (e.g., *above/below*). And even if they are, they are not *always* relevant. For example, a knot is *not contained* in a rope, a house that is described as *on the beach* is *not supported* by the beach, and a helicopter hovering over a city does *not cover* the city. To reflect these facts, polysemous approaches simply assume different senses of a preposition.

Second, functional aspects are much more complex than spatial relations. It is no wonder that they are expressed by verbs (*contain*, *support*, *cover*) because they involve complex conceptual conditions involving hypothetical situations: preventing moving away for 'containment', preventing falling down for 'support', preventing becoming seen for 'covering'. It is highly dubious to assume that aspects of a complex domain can be used to define aspects of a less complex domain. Therefore, any approach making parsimonious theoretical use of functional aspects in locative semantics is preferable to others that are profligate in this respect.

Third, functional aspects may rather influence/determine the *pragmatics of preposition use*, i.e. whether some prepositional choice is informative (enough) for the hearer. In general, there is no doubt that functional aspects are often involved in the understanding/production of locative prepositions. However, this observation has to be carefully kept apart from the question of whether functional aspects are necessarily involved in their semantics.

3.5. Attentional Approaches

Until the mid-1990's, hardly any connection between spatial semantics and attention can be found in the literature (but see Carstensen, 1993, 1995). At that time, the first computational models of (learning) spatial semantics were developed, beginning with the work documented in Regier (1995), who used a connectionist network to associate simple LO-RO image schemas with prepositions. Yet in this work, attentional mechanisms were implicit at best, which only changed with the sophisticated attentional computational model of Mozer and Sitton (1998) and implementations by Hogan et al. (1998) and Hogan and Diederich (2001). Meanwhile, Logan had shown the necessity of attentional shifts for the establishment of spatial relations (Logan, 1995) which led to the notion of spatial relations as vectors (or vector sums) from RO to LO in subsequent work of Regier and L. A. Carlson (2001). Logan introduced the construct *spatial template* as a psycholinguistic representation of a preposition's semantics. It consists of three regions of acceptability for a spatial relation term, given RO (i.e., it determines where the use of the term with regard to a LO is 'good', 'acceptable', or 'bad'). Research in this tradition investigates, for example, the influence of the form of RO (L. A. Carlson, Regier et al., 2006) or competing objects (Kelleher and Costello, 2009), and, increasingly, of context factors and functional aspects (Coventry et al., 2010).

Although these attentional approaches represent an important step forward toward an attentional account of preposition meaning, they address (too) low-level implementational and quantitative aspects of spatial semantics, rather than higher-level qualitative and explanatory criteria. For example, they try to model *which* relations count as 'above'-relations

but not *why* this is so. Accordingly, it is overlooked that spatial templates may be the result of categorizing spatial relations for a term (with categorization being a general cognitive process), and that the real question is which relevant attention-based conceptual or linguistic spatial relations exist and for what reason.[10]

In contrast to that, the work of Talmy (see Talmy, 2000) has always been characterized by the question which *qualitative* aspects of cognitive representation and processing are reflected in language. Over the years, he has increasingly made reference to "attention" and I applaud him for having collected a plethora of aspects which show its relevance in/for language. It can be argued, however, that he subsumes too many different phenomena (figure/ground, foregrounding/backgrounding, windowing, selection, focussing etc.) under this term.[11] With respect to locative semantics, his approach remains too unspecific as to the role of attention for spatial relations, and is furthermore still bound to image schematic approaches to language and space. In general, attention has not yet achieved the status of an explanatory construct in cognitive linguistics: in Evans' 2010 overview of the perceptual basis of spatial representation (Evans, 2010), it is hardly mentioned at all.

4. (MIS) CONCEPTIONS IN STANDARD LOCATIVE SEMANTICS

"One purpose of locative descriptions is to narrow down the domain of search for a referent" (G. A. Miller and Johnson-Laird, 1976, p. 384). This view has been eminently influential in spatial semantics and still characterizes the standard approaches to locative semantics according to which "the function of spatial language is to narrow the visual search for an object that the hearer is trying to locate" (Coventry et al., 2010). Langacker (2009) even notes that "terms like ['region',] 'search', 'find', and 'reference point' are not just metaphorical". As a defining criterion, however, such characterizations are not helpful, since locative expressions may only present more information about some LO ("this house is close to the beach") or simply serve as a differentiator between known options ("the one on the upper shelf or the one on the ground?"). Unfortunately, this view has deeply infiltrated spatial semantics and has led to some misconceptions in the semantics of locative expressions.

Misconception #1: Confusing "Purpose of" with "Meaning of" and Ignoring the Implicit/Explicit-Dichotomy

Consider the meaning of "rose" again. It should certainly not be characterized by "its function is not to confuse the object with an elephant ...", but by categorical criteria of what counts as a rose (with all its problems for semantics, see Lakoff, 1987). Accordingly, locative semantics should rather specify the conceptual aspects of how the implicit spatial relations a spatial preposition denotes are made explicit.

[10] Consider the task of categorizing other entities: do we have to assume templates for, e.g., *rose* that consist of good ("good roses"), acceptable ("acceptable, e.g., tulip-like roses") and bad ("bad roses like elephants, the universe etc.") example sets? There is something wrong with such a conception of categorization.

[11] A similar point is made in Marchetti (2006b).

Misconception #2: Hearer- and Understanding Orientation, and the Role of "Search Regions"

Spatial descriptions often originate in a hearer-side question "Where is X?" (the locative "quaestio", see Klein and Stutterheim, 2002), and there is certainly a pragmatic dimension of language in considering the hearer's needs and interests in communication (who is quite probably unsure about LO's location). However, the use of a locative expression is primarily speaker-based and generation-oriented. Assuming that the speaker has an answer to the quaestio (and a corresponding image or perception of the implicit relation), there is no "searching", "finding", "search region" etc. in his actual conceptual representation, and any model doing without these notions is preferable to the standard model.[12] Below, I will show that respecting the speaker's primacy leads to the clarification of some problems.

Misconception #3: RO-Centeredness

Closely related to the last point, it is not *necessary* to assume that the location of LO is specified *relative to* RO (as in region-, vector-based or image schematic approaches[13]). Consider again the speaker who *first* has to identify the LO and only then can notice a suitable RO. It might be (see the actual proposal below) that this suffices to characterize the implicit spatial relation.

Misconception #4: Image Schemas Are Non-Propositional, Wholistic, Schematic, and Static Descriptions

Image schemas once were "invented" as an alternative to propositional representations which were deemed unsuitable as abstract embodied representations required for abstract reasoning or metaphorization. Image schemas of locative expressions typically come as wholistic (both LO and RO are present), schematic and static depictions (despite assertions of Cognitive linguists that they also represent dynamic aspects, compare the force-dynamics of Talmy). However, this makes image schemas impossible figures: they depict wholistic static LO-RO constellations despite attention shifts between them. If they indeed depicted dynamic aspects, then they would lose their imagistic property. Hence they would rather resemble propositional representations, which they are not supposed to be by definition.

There is a related, more dramatic problem. According to Kosslyn (1994)'s model, visual images[14] are generated in the so-called visual buffer (on the basis of propositional specifications, by the way). He could show (Cave and Kosslyn, 1989) that the scale of a generated image depended on the type of the object (i.e., you do not imagine objects with regard to a global scale in which an elephant may "fill the screen" or an ant would be invisible). Now, image schematic approaches assume that the characterization of some preposition's semantics is *in* the image schema (due to schematicity, without any impact of LO- or RO-properties), which is inconsistent with Kosslyn's findings.

What if it is not even *necessary* to specify some relational aspects in image schemas (compare the problems of image schematic approaches above), or, equivalently, for search

[12] Correspondingly, if a speaker attends to a rose, he probably does not think of it as not being an elephant.

[13] The assumption of RO-centeredness is most clearly expressed by Langacker: "the conceptualizer traces the [...] mental path (from reference point to search domain to target) by way of apprehending the locative relationship" (Langacker, 2009, p. 25).

[14] Note that "image" is not restricted to vision (Tyler and Evans, 2003, p. 29), yet the argument applies in other modalities, too.

regions? Assume a preposition (let us call it *simploc*) whose semantic specification consists only of the following procedural description: 'imagine RO; then, add LO to the visuo-spatial representation'. Consider *car keys simploc key holder/iPad/bed*: instantiating the expression's meaning in the hearer's mind (despite its propositional specification) may suffice to locate the LO, especially when world knowledge about LO and RO and their typical spatial relationship is available (compare Spanish *en* here). Note that this crucially depends on non-schematicity and dynamicity of the constructed mental images, and on the other hand does not make reference to regions or similar constructs!

In Carstensen (2000, 2002), I have called this quite different conception of locative semantics the 'Localization as Mental Presentation' (LaMP)-view. Rather than *describing* implicit spatial relations by image schemas, this view is based on the mental operations (on elements in working memory) involved in "ceiving" (Talmy's blending of perceiving and conceiving) an explicit relation which, when categorized and expressed, are re-performed (*simulated*)[15] by the hearer and lead to an instantiation of the relation in her working memory. In the *CAS* approach below, this as yet underspecified view is spelled out in terms of attentional operations and other criteria of cognitive reference systems to specify the meaning of locative expressions.

Misconception #5: Distinguishing LO and RO Is the Only Relevant Asymmetry in Spatial Relations

Most approaches note the asymmetry between the LO as trajector and RO as landmark. For example, bicycles may be located with respect to a church, but a church not with respect to a bicycle. Much more important, however, is the possible asymmetry in *perspective*. If the construal of a spatial relation involves LO and RO, then this might be *from RO to LO or vice versa* (especially if attentional operations are involved). Therefore, establishing an explicit spatial relation with regard to an implicit spatial relation is a process which I have called *micro-perspectivation* (Carstensen, 2000). Due to RO-centeredness or wholistic image schematicity, this is mostly overlooked. Correspondingly, image-schemas usually depict only implicit spatial relations (as in figure 3a for the most generic case, see Langacker, 1987), while they should include one of the arrows in figure 3b signifying the order of attentional selection.

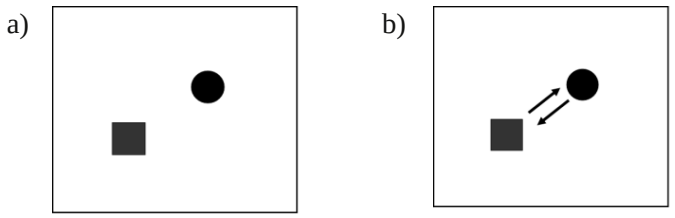

Figure 3. Implicit spatial relation (a) vs. explicit spatial relations (b).

[15] By reference to *simulation*, its dynamicity and its sensitivity to object aspects and contextual influences, the LaMP view is in some respect similar to the functional geometric framework of Coventry et al. (2010) who assume dynamic "perceptual simulations" as key parts in meaning construction (see also L. A. Carlson et al., 2006). There is also a correspondence to the notion of "representational state" as "re-presentation" in Spencer et al. (2010).

Misconception #6: The Concept 'Reference Frame'

At least in linguistics, the role of reference frames for spatial semantics as distinctive, three-dimensional, exhaustive qualitative coordinate systems is widely acknowledged. On closer view, however, speaking of holistic 'reference frames' seems to be inadequate. They are not distinctive, because the environmental vertical of the absolute reference frame figures again as the intrinsic vertical (of cupboards, towers etc.), and the viewer-centered observer axis of the relative reference system determines the intrinsic observer axis. Furthermore, the body-based and environmental-based verticals are typically conflated in the relative reference frame. Reference frames are not necessarily three-dimensional, as neither reference frame always provides all required axes and directions: in the absolute system, there might only be a gravitational vertical and a primary horizontal axis (e.g., *uphill*, *downriver*), but no left/right clue; in the relative system, even the vertical clue might be missing (compare *I hid the treasure in a hole in the wall, you'll find it right behind a pile of dead rats.*, ?*I hid the treasure in a hole in the ground, you'll find it left to a pile of dead rats*, ?*Seen from Beteigeuze, Orion is to the right of Cassiopeia.*); in the intrinsic system, not all object have (all) specified axes/directions (e.g., balls, towers, telescopes etc.). Non-exhaustivity of the proposed triplet of reference frames is shown by Bohnemeyer (2012) who proposes two further reference frames relevant in Mesoamerican languages: the *geomorphic* frame (for *The ball is downriver of the chair*) and the *landmark-based* frame (for *The ball is mountainward of the chair*). Finally, the failure of the concept 'reference frame' is most clearly exemplified by examples like *The obstacle in front of the rolling ball* which run counter to any "holistic" reference frame analysis. Correspondingly, a finer grained approach in terms of single axes seems to be more appropriate (Carstensen, 2007), which corresponds to the conclusion of L. A. Carlson and Van Deman (2008, p. 403) "that typical definitions of reference frames as sets of orthogonal axes may be somewhat misleading, to the extent that they suggest that these axes are all fully defined during the interpretation of a given spatial term."

Misconception #7: The (Mis)use of a Preposition Is Exclusively Determined by Semantic Conditions

The classic example showing the alleged problems in locative semantics is the apple-under-upside-down-bowl situation, which is used as an argument for functional semantic conditions ('containment' for in). This undervalues the pragmatic dimension of language[16], however, and the ability of the speaker to anticipate the understanding of his utterance by the hearer. As a matter of fact, psycholinguistic models of speaking (Levelt, 1989) assume an internal feedback loop with a conceptual "monitoring" component that prevents the generation of pragmatically inadequate utterances. Consequently, (non-)use of a preposition is determined in part non-semantically. Therefore, it may not be necessary to semantically exclude the apple under the bowl from being "in" the bowl.

Summarizing the first part of this chapter, all of the existing approaches fail, both individually and collectively, to provide a satisfactory, explanatory account of the semantics of locative prepositions. Some of the problems and misconceptions mentioned have led to the development of the cognitivist attention-based approach presented in the rest of this chapter.

[16] Consider indirect speech acts: The sentence *It's cold in here* may mean 'Close the window!' in some context, without having to change the semantics of the words involved.

5. THE COGNITIVIST ATTENTIONAL SEMANTICS (*CAS*) APPROACH TO LOCATIVE SEMANTICS

5.1. The Development of the *CAS* Approach

More than 20 years ago (in 1992), I started working on the semantics of locative and – especially in combination with – distance expressions. Although, "started" may be the wrong expression here: much of what I did before had to do with spatial semantics. In 1985, I had attended a lecture series of Ronald Langacker on his "Space Grammar",[17] and as a student of René Dirven, I had read the main works of cognitive linguistics (e.g., those of Lakoff and Talmy) of that time. Later, I had got acquainted with the German cognitive linguists (Manfred Bierwisch, Wolfgang Klein, Dieter Wunderlich) whose recent research also was mainly on language and space, but more close to the approach of Jackendoff (1983). Still as a student, I had worked in a project whose aim it was to formalize and implement the semantics of spatial expressions (mainly prepositions) within cognitive science (i.e., respecting evidence from cognitive psychology, Artificial Intelligence, Computational linguistics), although personally I had been mostly concerned with macrospace (route descriptions, Carstensen, 1992a) and the semantics of dimensional adjectives (Lang et al., 1991).[18] So I started off with some background, and even with a few already identified problems whose solution became my research goal. It turned out that these problems posed a severe challenge to the – then paradigmatic – region account.

The first problem concerned the distinction of the two German prepositions *an* and *bei* (roughly but wrongly, *on* and *by*)[19]. According to native speakers' intuitions, LO and RO are typically closer to each other when using *an*. However, it is not possible to capture this difference in terms of region extension and to specify the region boundary for *an* (see also the discussion of figure 2 above). Furthermore, usage data reveal that the prepositions show unexpected cooccurrence restrictions: with RO nouns like *Spitze [top], Rand [border, edge], Ecke [corner], Seite [side]* etc. use of *an* is obligatory and use of *bei* is unacceptable (even when indicating greater distance); in contrast to that, *bei* has to be used with city names, even if both cities are very close. These data suggested that it is not *quantitative* region extension itself that characterizes semantic differences, but that there had to be some *qualitative* distinctions yet to be discovered.

The second problem concerned the conception of a prepositional region as a search domain to find the LO. For *above* this would usually be a vertical upper region with regard to RO, for *hole in the vase* the material-part region of the vase, for *water in the vase* the non-material inner region. My question then was which region would be addressed in descriptions like *knot in the shoelace*. Examples like these show that postulating search regions as explanatory constructs simply begs the question: it shifts the problem from specifying the

[17] Langacker, R. (1985). Lecture series on Cognitive Grammar ('Overview'; 'Linguistic Semantics'; 'Nouns'; 'Verbs'; 'Grammatical Constructions'; 'A Usage-Based Model'; 'Subjectivity'; 'Abstract Motion'). University of Trier. March 25-27.

[18] It might be added that with my research on the generation of route descriptions I got used to the language generation view towards spatial phenomena, while most researchers in the field take the interpretative (language understanding) view.

[19] Note that *an* and *on* are not synonymous, see, for example *an der Ecke [*on/at the corner]*, and neither are *bei* and *by*.

semantics of a preposition to specifying a certain region, but with no (or negative) explanatory value.

The third problem originated from my interest in adjectives. If the semantic content of prepositions is about the placement of the LO in some region of the RO, then how do distance adjectives and prepositions semantically compose? One would expect the spatial extent between LO and RO to be measured by the distance adjective. There is no such extent available for semantic composition, however, and despite some proposals to repair this deficit (Carstensen, 1992b), reconsidering the region account seems to prove more effective (which is corroborated by the existence of vector-based approaches, see above).

The fourth problem had to do with compositionality, too. If distance adjectives are assumed to simply express a greater (*far*) or a shorter (*near*) distance, one would not expect restrictions as to which preposition can cooccur with such an adjective (except, perhaps, *in*, *between*, *around* or so). However, data like those in (7) show that this is exactly what can be observed. *weit* is compatible only with "distal" prepositions, and *nahe* only with "proximal" ones. These are *qualitative* constraints, i.e., even if the distance between LO and RO is very small (say, 1cm), **1cm (weit) bei der Tür [*1cm (far) by the door]* is not acceptable. Again, this is neither predicted nor explainable with the region account.

(7) a. weit/*nahe weg/über — b. * weit/nahe an/bei
far/*near away/above — *far/near near/at

At that time, I had the vague idea that attention must somehow be involved in the solution of these problems. Yet it was only when I stumbled across the title of a talk of George Sperling[20], that I somehow got on the right track. While his research in the rapid-detection paradigm of visual items was quite remote from my concerns, he nevertheless pointed to the fact that aspects of attention get *represented* and therefore constitute a representational dimension (as opposed to simple and vague ideas about differential attentional engagement to spatial locations). Other research corroborated this view of selective attention as an interface between vision (or other modalities) and conception, not only as a mechanism for selection but also as a mechanism that defines objecthood – which later led to my work on attention-based ontologies (Carstensen, 2011). Kahneman and Treisman, who called the corresponding representations *object files*, illustrated their relevance with the well-known example of the approaching Superman: "Onlookers in the movie can exclaim: It's a bird; it's a plane; it's superman!" (Kahneman and Treisman, 1992, p. 217). Although both visual properties and conceptual categorizations change, there is some reference object continuity (see also Pylyshyn's notion of FINST in Pylyshyn, 2009). An important corollary of that is the following: if attention changes between *different* objects, then there is a corresponding change on the level of attentional representations (i.e., between object files), separate from, and independent of, a shift of spatial attention.

It therefore turned out that conscious perception of the (spatial) relation between objects requires an attentional change. This observation is corroborated by the experiments of Logan (1995) who showed that spatial relations do not "pop out" (i.e., are not directly consciously available as a whole) but always involve attention shifts ("Computing relations requires

[20] "Selective attention to an item is stored as a feature of the item", see Sperling and Wurst (1991).

directing attention", Logan, 1995, p. 163).[21] It is also backed by neuropsychological results: patients with simultanagnosia (a subtype of Balint's syndrom) may not be able to perceive more than one object in a scene (and therefore not a spatial relation between two objects), although their visual systems are intact (Robertson, 2003). This is explained by the patients' disability to disengage attention. Attention (and its shift) can occur *spatially* (corresponding to a moving spotlight) or between *object-based* representations (Behrmann and Tipper, 1994; Mozer and Vecera, 2005). Therefore, it is evidently not only important *how an item is attended* (focused, defocused) but also *when* and on *which level of representation.*

When I became aware of the seriality in the perception of spatial relations, the alleged importance of the "what"/"where"-distinction was just under discussion (Landau and Jackendoff, 1993). Landau and Jackendoff asked why spatial prepositions make so little use of object shape (instead, they are quite schematic, as has been observed by many others). Based on neuroscientific evidence, they offered the explanation that this results from the neuronal bifurcation into an object/form identification ("what"-) system along a ventral pathway to the temporal lobe, and a spatial representation (or object location, hence "where"-) system along a dorsal pathway to the parietal lobe. Yet they themselves (as others later) noted that "what"-type information (e.g., a face) is defined by "where"-type information (e.g., where the nose is located with regard to mouth) so that this distinction is not helpful for the characterization of spatial relations. With attentional seriality as a separate level from pre-attentive visuo-spatial representation, however, this conflict dissolves. Olson and Bialystok (1983) already pointed to the fact that spatial relations are involved in both systems, but that they are *implicit* (or implicitly represented) in the "what"-system, but *explicit* (or explicitly represented) in the "where"-system. Kosslyn writes: "Although the ventral system cannot represent explicit spatial relations, it must be able to represent implicit spatial relations; [...] However, such spatial representations are embedded in the pattern itself; they cannot be used in any other context" (Kosslyn, 1994, p. 421). Combined, this leads to the hypothesis that the "where"-system has more to do with shifting attention than merely with representing space.

It therefore became clear to me that selective attention makes implicit spatial relations explicit by imposing an order in the visuo-spatial processing of the involved objects. According to Kosslyn, explicit relations are based on the movement of an "attentional window" across the "visual buffer" (the working memory corresponding to the "map of locations" in Treisman 1988), which combines several popular metaphors of attentional research (the moving spotlight, the zoom-lens, the attentional filter/channel). He describes how information about the displacement of this window, when associated with information from other sources (about head-, body-, and eye-positions), leads to the construction of spatial relations in different representational systems. He also notes that some tasks require fine-grained representations (e.g., actions like grasping something) while others do not (e.g., language). Based on his experiments he is able to identify subsystems that encode *coordinate spatial relations* (the former) from *categorical spatial relations* (the latter). His results indicate that even if the categorical spatial relation are not linguistic, it is these that language relates to ("language relies on categorical representations", Kosslyn 1994, p. 194).

[21] A similar proposal had been made earlier by Ballard: "The basic idea is that when *sequentially* fixating different objects, the change in fixation provides a direct encoding of the desired spatial relationship" (Ballard, 1987, p. 192).

But there still seemed to be a large gap between the semantics of prepositions and spatial/attentional representations (especially in psychological research, this gap is often further magnified). The psycholinguistic work of Tanenhaus et al. (1995) showed, however, that visual aspects (in that case, eye movements) and linguistic aspects (verbalization) are closely coupled in language production and understanding, which involves aspects of selection during the course of language processing, compare Slobin's "particular ways of thinking for speaking" (Slobin, 1996, p. 76). This led to the idea to regard spatial semantics as consisting of elements which directly match aspects of ongoing visuo-spatial processing of the speaker and which are then re-performed by the hearer, resulting in a mental presentation that suffices to locate LO (hence "Localization as Mental Presentation").

And yet, the work of Bowerman (1996) demonstrated that languages vary widely with regard to linguistic reference to space, and that there cannot be a hardwired connection between spatial and linguistic aspects. These observations, however, are reminiscent of the phenomena found in dimensional designation (the use of dimensional adjectives with regard to different objects). For example, the same dimensional extent of a pole can be said to be *long* if it is lying, and *high* if it is in upright position (standing), but not vice versa or both at the same time. Likewise, there are cross-linguistic differences in this domain: the English *wide* has two counterparts (*weit* and *breit*) in German, covering different senses of width. Such linguistic facts seem confusing on first sight, but can be straightforwardly modelled (Lang et al., 1991) if all relevant aspects of conceptual representation are uncovered and if conceptual and semantic representations are kept apart but are systematically related (with the semantic level containing only language-specific aspects). The task then was to find out how this scheme could be applied to the semantics of locative expressions.

5.2. Attention-based Spatial Relations

The core of the *CAS* analysis is the observation that attention serves as a selective mechanism in some representational domain (which is only one sense of understanding "attention", see W. A. Johnston and Dark, 1986), here, the spatial domain. In this sense, attention operates by enhancing processing of information at some place (space-based attention) or with regard to pre-attentively processed information (object-based attention) in some working memory (e.g., the visual buffer or map of locations in the visual domain) and gating this information to sites of further processing (selection-for-action, selection-for-recognition, selection-for-speaking etc.). Selective attention also leads to the establishment of so-called object-files which represent the ontological category of the attended item that may continue to exist although domain or conceptual features vary (Scholl, 2001). Therefore, attention is defining for the types of entities our conceptual knowledge is about (see Carstensen, 2011, on attentionally defined upper ontologies): for single phenomenal regions (or boundaries between such regions), attention is focused and leads to categorizing the attended aspects as *objects* (either *whole* objects or *parts/boundaries*); otherwise attention is distributed and leads to categorizing the attended aspects as *collections* or *masses*.

While orienting of selective attention may be influenced both by top-down (endogenous) or bottom-up (exogenous) factors (Posner, 1980), it is the *changes/shifts* of attentional engagement that are necessary and constitutive for explicit spatial relations. Note that only spatial shifts of attention may be straightforwardly represented as vectors; this is less clear for

object-based shifts or zoomin/zoomout-operations which can happen at the same position. Therefore, 'attention change/shift' is a more general notion than 'vector'.

The changes may occur in different cognitive reference systems which couple/associate information from different modalities/sites. For example, allocentric and gravitational information is coded in spatial reference systems, egocentric and vision-based information in visual reference systems. Both lead to abstract representations that may be dissociated from actual perception. This is shown by (hemi-)neglect phenomena as for instance the one reported by Allport: "The patient [...] failed to read the *terminal* (i.e., in canonical, alphabetic representation, the 'right') half of words, regardless of whether the word was presented visually in normal left-to-right orientation, or was mirror-reversed, or even if the words were orally spelled to the patient. Thus, hemineglect was manifested within what appears to be a word-centered, orthographic space, which is evidently *not* retinotopic." (Allport, 1993, p. 198, his emphasis).

Lang et al. (1991) showed that our conceptual representation of space can/must be described in terms of qualitative elements, and that the *axes* of reference systems play a prominent role, both for the determination of an object's possible dimensional designations (*long, wide, high* etc.) and for its position in space. Such conceptual representations, which categorize/couple information from different sources/sites, may also be quite remote from actual perception. For example, a picture has a fixed height and left/right axis, despite its actual position in space (e.g., in the waste bin).

As to the distinction of prepositional pairs ('above'/'below', 'in front of'/'behind', 'left'/'right'), this can be described as the congruency of the direction of the attentional shift with the direction of the axis (note that VERT and OBS are directed while LAT is not – which leads to observable problems with left-right assignments). According to that, 'above'-relations are congruent with the VERT direction and 'below'-relations are incongruent, both starting at the RO or its boundary.

Attention-based spatial relations can therefore be described as qualitative couplings of an attentional shift with regard to (some axis of) some reference system where the attended entities may be of different ontological types. Their establishment is an instance of categorical perception as it implies the rejection of other possible couplings. Such a coupling can be non-linguistic (conceptual categorization as in 'is a vertical relation') or language-based (linguistic categorization as in 'is an instance of the meaning of *at*'). The range of possible qualitative couplings corresponds to possible *micro-perspectives* of a given implicit relation and is therefore defining for the types of explicit relations that may exist (and may be expressed in language).

So far, explicit, attention-based spatial relations are underspecified with regard to the LO/RO distinction, yet they can be *sub-classified* accordingly. I have proposed in Carstensen (2002, 2007, 2013) to represent this distinction by a binary feature *reference polarity* (αrefpol): a spatial relation is +refpol if RO is the source of the shift (RO-centered), and –refpol if LO is the source of the shift (LO-centered). Reference polarity becomes relevant when considering localization from the viewpoint of language generation. In Carstensen (2002), I have discussed in detail that even RO-centered descriptions always start with LO-centered representations in the speaker's mind. The necessary steps involved are the following:

a) *Locating the LO*. Starting with the quaestio "Where is LO?", this requires first identifying LO in perception or imagination. The result is a focused LO in an appropriately scaled representation.
b) *Noticing a relevant RO*. In order to describe the place of LO, a suitable salient RO must be detected/selected. However this is achieved (it might involve transformations of the LO-centered image), this ends in an attention shift to RO. More precisely, it ends in a shift to a visuo-spatial referent associated with RO (for example one of its boundaries), i.e., a certain *conceptualization* of RO.
c) *Focussing the RO; Imposing reference frames*. If RO is used as a *reference point*, it has to become the center of the representation (which may involve necessary mental transformations, e.g. of scale and granularity, and results in focussing RO). After that, in standard terms, one of the set of possible reference frames is selected.
d) *Directing attention back to LO's referent*. This is what is supposed to be required for the computation of a specific explicit relation, as explicated above.

It is immediately clear that step a) already corresponds to a LO-centered representation. It should also be obvious that steps a) and b) represent the characteristics of a –refpol attention shift. Therefore, not only is RO-centeredness not necessary for coding an explicit spatial relation, but also is LO-centeredness sufficient for it! There are reasons why the cognitive system of the speaker might select the –refpol spatial relation (steps a) and b)) for speaking, rather than the +refpol spatial relation (including steps c) and d)). For example, the latter requires more resources, omission could therefore be due to time pressure or lack of information (e.g., for the establishment of reference frames/axes). Or, it might be that after focussing RO, LO is no longer "visible" (preventing step d)). Or finally, the –refpol spatial relation might be sufficient or at the right level of granularity in some context for the localization task. In any case, reference polarity is an important distinction when it comes to linguistic spatial relations (as RO can be one of *two* entities of the attention shift involved in an explicit spatial relation).

5.3. Cognitivist Attentional Locative Semantics

According to the *CAS* approach, locative semantics must be seen as a specification of which kind of attentional shift (as micro-perspective on an implicit relation between LO and RO) is expressed by a certain preposition. The meanings of prepositions then consist of propositional representations of attentional relations which are related to concepts like region of uncertainty, function, vector etc. but are not spelled out in terms of these. More specifically, the semantics of a locative preposition consists of qualitative criteria categorizing a micro-perspective that correspond to some of the "fundamental units of sensory experience" called for by Grady (2005). The question that now arises is: how do we know which perspectives are expressed by some preposition? Interestingly, part of the answer to this question has to do with distance adjectives and/or measure phrases. They can be used as a probe into which aspects of attentional relations are involved in the semantics of a preposition. In the following, this is discussed in detail.

Reference Polarity

Based on compatibility data (i.e., whether a combination of adjective and preposition is acceptable or not), Carstensen (2013) showed that adjectival pairs like *far/near*, which are usualy called *polar* (+/–), must actually be analysed semantically as measuring the corresponding *reference polar* perspectives of the preposition, with *far* being +polar (compare *far from/*to*) and *near/close* being –polar (compare *near/next/close to/*from*).[22] Vice versa, the reference polarity of some preposition may be indicated by the polarity of the adjective. Interestingly, the resulting subdistinction of prepositions roughly (but not fully) corresponds to the common distinction between topological (*near by*, **two meters/*far at, on*) and projective (2 meters/*far/*near over/above/behind/*...) prepositions.

Type of Attentional Shift

While *in* is usually classified as a topological preposition, it is different from *at, on, by* in that it can sometimes be modified by *deep* (as in *deep in the sea/jungle/forest/*...). This shows that *in* is a +refpol relation. According to the *CAS* approach, the difference to projective prepositions consists in the *type of attentional shift* expressed: While the latter designate shifts of displacement (orienting shifts), *in* (like *among* and *between*) designates *zooming in*. It may reasonably be assumed that *out of* designates a +refpol *zooming out* perspectivation.

Level of Attentional Shift (Object-Based vs. Space-Based)

The preposition *by* allows to emphasize proximity of LO to RO by using *near* or *close*. Perhaps with the exception of rare examples like *close at hand*, however, it is quite awkward/ unusual/inacceptable to do this with other –refpol prepositions (**close/near on/at*). If this observation is correct, it might be explained by whether a preposition involves spatial aspects (space-based attentional shifts and their distance) or not (merely object-based shifts). As to *at*, it has long been observed that its use seems to involve the typical functional LO-RO relationships. For example, being *at the desk/(the) school/the zoo* does not merely signify nearness/coincidence of LO and RO, but their typical interaction (sitting at the desk, working at/visiting the school/zoo). The *CAS* view does not require the preposition to have functional meaning aspects but simply states that if space-based information is selected for speaking then it is expressed as *by*, else as *at* or *on* (and typically, the actual spatial distance is irrelevant in functional senses). Accordingly, the level of the attentional shift is a semantic parameter with regard to which prepositions might differ. However, a preposition may be variable in this respect, giving rise to different contextual senses (*cavern deep in the ground* vs. **moon deep in the window*; *clouds high over the city* vs. *freckles all over his face*).

Conceptualization of RO (Type of RO-Referent)

While spatial extension of RO is usually disregarded when using *at* (even the linearity of the beach in *at the beach* or the planarity of the sea in *at sea*) – which is typically described as "RO is conceptualized as point" – spatial extension of RO's referent as a line or surface is a typical semantic condition of *on* (see (2), cf. also Herskovits, 1986). This contrast in the conceptualization of RO is most clearly exemplified in the German –refpol prepositions *an* and *bei*. As already explained above, their distinction cannot be pinpointed on the basis of

[22] As to measure phrases, it is a well-known fact that they are only compatible with +(reference)polar expressions (see for instance *10 meters (far) behind*, **10 meters close to*).

spatial distance criteria. The distinctive qualitative criteria called for, however, are easily specified in the *CAS* approach: *bei* involves an attentional shift to a referent of RO ontologically categorized as 'whole object', while the corresponding RO-referent of *an* must be categorized as 'boundary'. Difference in categorization results from LO-centeredness, as RO either "fits in" the mental presentation as a whole or not. The *CAS* analysis therefore not only treats some differences of prepositions as an epiphenomenon of the LaMP view, it also explains – without further stipulations – the lexical restrictions of possible ROs denoting boundaries where use of *an* is obligatory, e.g., *am Strand (on the beach* [linear sandy boundary of sea]*), an der Ecke (at the corner* [non-linear boundary where edges meet]*), an der Spitze (at the top/tip* [boundary point]).

Type of Reference System

Although reference frames are somehow related to cognitive *reference systems*, this relationship is seldom discussed (but see Levinson, 1996). While the importance of holistic reference frames is denied in *CAS* (for reasons presented above), reference systems are considered relevant, and it is assumed that categorization of an attention shift with regard to a reference system is an important parameter in locative semantics. The distinction of reference systems (for example, the visual and the spatial ones) reflects the fact that information about space is gathered in and stored with respect to different modalities irrespective of additional cross-, pluri- or amodal representations of space. This is most obvious in the case of vertical information, where our common concept of 'verticality' results both from sensing the axis of gravity through the vestibular system and from perceiving upright posture of objects as orthogonal to the ground/horizon. Typically, the prepositions *above*/*over*, and *below/under* are all related to the combined concept of verticality (see figure 2), which results in the problem of differentiating the preposition pairs, respectively. However, the critical examples presented above (*We found paintings *below/under the wallpaper*; *Let's amputate the leg above/*over the knee*) indicate qualitative rather than quantitative (distance) criteria of distinction.

The *CAS* approach therefore proposes to dissociate the spatial and visual aspects of verticality. According to that proposal, *above* and *below* designate attentional relations within *spatial* reference systems. This corresponds to observations that what is relevant for these prepositions is the *height* of LO with respect to RO in an oriented space (not just some vertical relation). For example, *Camp 6 is 1km above camp 5 on Mt. Everest* may mean that camp 6 is not 1km directly above, but in 5km distance from camp 5 (but the height difference of the camps is 1km). Apparently, the conceptualization of RO is restricted to 'whole-object' (contrast *The money is under the table* with *The money is below the table* where the money cannot be located between the table legs, but only be buried in the ground or located in the apartment downstairs). Reconsider also the fact that only *above/below* are usable with regard to intrinsic verticality/orientation which derives from typical alignment with the environmental vertical (see the amputation example).

In contrast to that, *over* and *under* are assumed to be associated with a *visual* reference system. In such oriented reference systems, verticality is not tied to gravitation but derives from orthogonality to some horizontal line/plane as abstracted from visual experience. While the neglect phenomena (see Allport's example above) demonstrate that oriented representations differing from actual environmental verticality really exist, exactly this variability is observed in the linguistic data (cp. *LO under the wallpaper, LO lives over the*

hill, the 'covering'- and 'on-the-other-side-of' senses of Tyler and Evans, 2003, pp. 78ff). Examples like *The money is under the table* show that extended parts/boundaries of RO may serve as horizontal clue for alignment with such a visual reference system. As to conceptual representations, the counterpart to intrinsic orientation in allocentric representations is *inherent* orientation (see Lang et al., 1991, where the terms *canonical orientation* and *inherent orientation* are used for the spatial/visual dichotomy, respectively). All writing-based objects (letters, books, newspapers, cards etc.) have inherent orientation.

According to this distinction of spatial/visual reference systems, if the contrast of *above/below* and *over/under* is depictable at all, then this should not be done in a single image schema as in figure 2, but in two separate ones. Correspondingly, figure 4a indicates *over/under* relations in a visual 2 1/2 d frame with an extended RO boundary collinear to a horizontal ground, and figure 4b shows the contrast of *above/below* in a 3d spatial reference system where horizontal ground and boundary of RO need not be salient (note the indication of vertical orientation in both schemas).

In English, linguistic vertical categorization is not so clear-cut. It seems that in *The sun is over/above the horizon* both prepositions can be used (even with a preference for *above*), although the sentence designates a visual (projected) relation. This is different in German, however, where the counterpart for *above* (*oberhalb*) is clearly out: *Die Sonne ist über/*oberhalb des Horizonts*. Interestingly, the visual/spatial-contrast appears with other relations, too. For example, a moon appearing in a window cannot be said to be **inside [German: *innerhalb] the window* (compare also **knot inside the shoelace*). Similarly, partial inclusion is compatible with *in* but not with *inside* (*the spear in/*inside his hand*). With respect to the observer axis, *The sun set behind the church* is acceptable whereas **the sun always sets in back of the church* (e.g., in a leaflet) is awkward, because there is no common spatial reference system for church and sun which – as is assumed here – is required for the use of *in back of*.

Categorization with Regard to Directions of Axes

In the *CAS* approach, the holistic, "molecular" use of reference frames is replaced by a modular, "atomistic" view according to which the semantics of projective prepositions can be specified in terms of +refpol attention shifts categorized with regard to directions of the VERT, OBS and LAT axis. This involves the following aspects.

First, RO (or an object RO is part of) may *provide* axes and directions via its object type (canonical/inherent VERT and OBS alignment, determining the sides, e.g. of cupboards, cars, valleys etc.). In this case, the pertinent side can be used directly as offset for some +refpol attention shift. Complementary (or alternatively), these axes may be *imposed* by contextual specification. For example, a tower has no intrinsic lateral assignments which therefore have to be determined by an actual observer/viewpoint. On the other hand, although a car has intrinsic sides, extrinsic contextual specification is nonetheless possible, leading to ambiguity of *LO in front of the car*. Note that if imposed, the LAT axis is always *secondary and orthogonal* to one of the primary axes (which might also be the MAXimal axis of a street that is incompatible with assigning OBS or VERT).

However, axis determination is systematically restricted and not arbitrary. If an object with canonical orientation is not aligned to the gravitational vertical (say, a tilted chair or tower), then selection of the intrinsic vertical axis for and acceptability of *above* depends on whether the speaker actually perceives the gravitational vertical or not (which might only be

the case in a confined perceptual scope or in outer space).[23] Correspondingly, an object to the right and near the top of an overturned chair is rather said to be *to the right of the chair*. The situation is slightly more complicated with relations between *parts of* objects with intrinsic axes. An example is the amputation situation with a lying patient. Here, amputation can both be said to be *above the knee* or *behind/left of/right of the knee* (depending on a corresponding viewpoint). With *inherent* orientation, this is different: the headline of an article in a newspaper on the table is always *above* the article, never *behind* (even if aligned with the actual observer axis).

Second, the directions of the imposed axes (or correspondingly, the sides of RO with regard to that axis) must be determined. For the VERT and OBS axis, this has to do with salience and/or relevance. Perhaps due to the fact that upward aspects are always more salient/relevant, there is no variation on the VERT axis so that *above* is always associated with the upward direction. As to the mirror/translation/rotation assignment of relative horizontal directions, they depend on relevance distinctions with regard to the OBS axis, with *in front of* (or corresponding lexemes in other languages) expressing relations categorized with regard to the relevant direction. In mirroring languages, the part of RO towards the viewer is typically judged relevant and inverts the OBS direction. In translation languages, OBS direction of the viewer is preserved (this is done in Hausa, but only if LO is visible, hence salient). The relative/extrinsic/deictic LATeral directions in English and Hausa can then simply be described as transferring the handedness of the viewer (i.e., determining left/right with regard to the viewer's OBS direction). The left/right distinction in "rotating languages" is correspondingly determined with regard to the *inverted* OBS direction. In general, LATeral distinctions "are the most difficult because nothing external to the person can anchor them; they can be defined for him only in terms of his own body" (G. A. Miller and Johnson-Laird, 1976, pp. 397f). Because of that, the asymmetry is artificial, hard to learn, and may be the reason that in some languages, the left/right distinction is not made at all ("familiar spatial notions like 'left' and 'right', and even sometimes 'front' and 'back', are missing from many, perhaps a third of all languages", Levinson, 2003, p. 35).

Further support for an axis-based approach towards projective prepositions' semantics is given by Wunderlich and Herweg (1990). They show that the front/back axis and their directions can be separately motivated (and without reference to viewer or viewpoint), similar to the above 'rolling ball'-example.

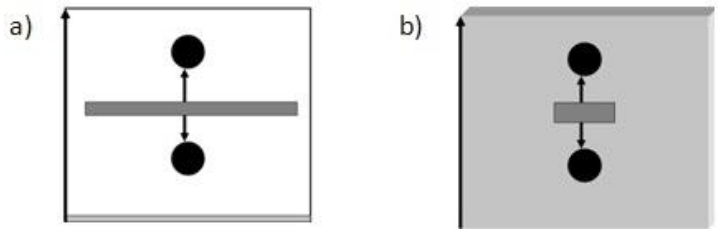

Figure 4. Visual (a) vs. spatial vertical senses (b).

[23] This has been shown in experiments by Carlson-Radvansky and Irwin (1993), and is discussed by Levelt (1996) whose *Principle of canonical orientation* refers to a restricting "perceptual frame of orientation" of LO. For experiments actually made in the Spacelab see Friederici and Levelt (1990).

Table 2. CAS parameters and values for selected English locative prepositions

Preposition	Reference polarity	Type of shift	Space-based shift	Type of RO-referent	Reference system	Reference axis	Congruence of direction
in	+	zoomin	ø	ø	visual	OBS	+
inside	+	zoomin	ø	boundary (preference)	spatial	–	
on	–	shift	–	extended boundary (preference)	visual	VERT	–
at	–	shift	–	non-extended	ø	–	
by	–	shift	ø	ø	ø	–	
over	+	shift	ø	extended boundary (preference)	visual	VERT	+
under	+	shift	ø	extended boundary (preference)	visual	VERT	–
above	+	shift	+	object (preference)	spatial	VERT	+
below	+	shift	+	object (preference)	spatial	VERT	–
in front of	+	shift	+	object	ø	OBS	+
behind	+	shift	+	object	visual	OBS	–
in back of	+	shift	+	object	spatial	OBS	–
right of	+	shift	+	ø	ø	LAT	+
left of	+	shift	+	ø	ø	LAT	–
beside	+	shift	+	boundary (preference)	ø	LAT	ø
away from	+	shift	+	object	ø	–	
off (of)	+	shift	+	boundary	ø	–	
among	+	zoomin	–	collection (of objects)	visual	–	

They argue that *LO is in front of RO* is also true in situations where a) LO is more accessible than RO within some container, b) LO is more accessible than RO with regard to a material boundary, c) movement of LO defines the front of RO d) both LO and RO move in configuration, and LO is the first in the direction of movement.

Finally, note that there are +refpol relations expressed by prepositions which have no axial association at all (least of all, association with a reference frame), especially *away from* (but also *off of*).

Table 2 summarizes the *CAS* proposal for a semantic classification of selected locative prepositions, showing the values of the semantic parameters introduced above. It is apparent that values are not always fixed, as a preposition may be underspecified in that respect (this is represented by 'ø'). '–' is the negative value, and a gray field represents non-definedness. Note that 'visual' as value of the 'reference system' parameter is compatible with the spatial system. Indeed, spatial senses might be the prototypical senses of a corresponding preposition (for example, *the clouds over the prairie*).

5.4. Cross-linguistic Aspects

Explaining why cross-linguistic differences like those exemplified in table 1 exist is clearly the second big challenge of spatial semantics. The *CAS* stance on that question can be pointedly put as saying "Why not?", justified by the observation (explicated in more detail in Carstensen, 2011) that there are no objectively given spatial relations "out there in the world" which languages could concordantly select. Instead, a given situation with its implicit spatial relations must be attentionally perspectivized to construct explicit spatial relations that may be selected for speaking.[24] As an extreme case, consider Siamese twins: even they might quarrel over whether a certain glass is half empty or half full. Compare this to speakers of different languages that may have evolved apart over hundreds and thousands of years.

Accordingly, research on cross-linguistic variation in locative semantics shows a wide spectrum of linguistic categorization in this domain. First, languages may differ in which *type of spatial information* is used. For example, Korean makes use of a 'tight fit'/'loose fit' distinction, crossing 'in'/'on' boundaries in English. Second, they may differ in which *further* information is lexically coded with the spatial term: in Tzeltal, the type of RO has to be specified (e.g., 'container with narrow opening') as well as conceptual aspects of the relation of LO and RO ('being hooked at', 'being inserted in' etc., Levinson et al., 2003). Third, they may differ in the *specificity* of information expressed (compare *away from*, Spanish *en*). Fourth, they may differentially *use* spatial information for communication (for example Guugu Yimithirr whose speakers predominantly use environmental information – in other words, the absolute reference frame –, see Levinson, 2003).

The *CAS* approach has nothing to add to this line of research (which is often still based heavily on functional notions). Rather, the question here is how to treat the incompatibilities of genealogically even quite close languages. For example, at first glance the English prepositions *at*, *on*, and *by* seem to correspond to the German prepositions *an*, *auf*, and *bei*, respectively. Yet a lexicon lookup shows that each preposition in the first group can in some context be a translation of every one of the other, while some expected synonymies fail to exist (consider for example a picture attached to a wall, which is expressed as **at/on the wall* in English but *an/*auf der Wand* in German).

The *CAS* answer to this question is based on a combination of fixed spatial semantics for a preposition, LaMP and so-called "as-if-conceptualizations" as explained in the following.

The entries in table 3 contrast the semantic specifications of these German and English –refpol prepositions. Observe that only *on* and *auf* have identical entries. *an* and *at* differ in RO conceptualization (cp. *an der Kante* [**at the edge*], *an der Seite/Decke* [**at the side/ceiling*]). *Bei* and *at* differ in the value for 'space-based shift' because it is possible to say *nahe bei* but not **close/*near at*. Furthermore, *bei* is restricted to whole-object conceptualization (**bei der Ecke/Spitze* [*at the corner/tip*]). *by*, on the other hand, may be space-based (*near by*) but is more general with regard to RO referent-type (e.g., *side by side* [*Seite an/*bei Seite*]).

[24] This is in accordance with the conclusion drawn in Slobin (1996): "The language or languages that we learn in childhood are not neutral coding systems of an objective reality. Rather, each one is a subjective orientation to the world of human experience, and this orientation *affects the ways in which we think while we are speaking*" (Slobin, 1996, p. 91, his emphasis).

Table 3. CAS parameters and values for contrastive prepositions

Preposition	Reference polarity	Type of shift	Space-based shift	Type of RO-referent	Reference system	Reference axis	Congruence of direction
an	–	shift	ø	boundary	ø	–	
auf	–	shift	–	extended boundary (preference)	visual	VERT	–
bei	–	shift	ø	whole object	ø	–	
at	–	shift	–	non-extended	ø	–	
on	–	shift	–	extended boundary (preference)	visual	VERT	–
by	–	shift	ø	ø	ø	–	

According to LaMP, the objective size of objects may influence the type of their referents in mental presentations (conceptualizations). For same-size objects (e.g., persons and doors), focusing one as LO may result in whole-object referents for RO (*He is at/*on the door*). For smaller objects (e.g., handles, pictures, spots), focusing them may leave only extended boundaries of RO in the mental presentation, disallowing use of *at*. In German, the same objective relations are expressed per default by *an* (similar to Dutch *aan*) which simply requires RO-referents to be boundaries. However, with even smaller LOs like spots on a wall, raindrops on a windowpane etc, *auf* can also be used. English has no such option, as *at* requires whole-object RO referents. This explains wider use of *on* in English.[25] Image-schematically, this difference is depicted in figure 5. In figure 5a, the RO must provide an extended boundary that may be collinear to (or may even coincide with) the ground of a visual reference system (which corresponds to 'close-up view'-perspectivations if LO is small). In figure 5b, the RO-referent signifies a part/boundary of RO.

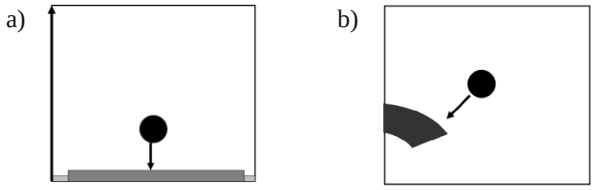

Figure 5. CAS proto-senses of "on/auf" (a) and "an" (b).

Now consider a ring attached to a finger. It is described as *on the finger* (German: *an*) although it is in fact "around" it. Or consider Russian, where holes in stockings or fissures in shirts are not described as "in", but as "on" their reference objects (Buschbeck-Wolf, 1995), similar to English *carving on the stone* or *crack on the wall* (Herskovits, 1986, p.143). In

[25] The insight that the number of linguistic terms in some field restricts the denotations of each term can be traced back to Ferdinand de Saussure, the founder of structural linguistics. Another famous example is the number of basic color terms in languages. See Lakoff (1987) for an overview of this topic, and on the difficulty of translation.

these cases, it is not always the "most objective" or "self-evident" attentional perspective that is selected for speaking, but a given visual scene is sometimes perspectivized/conceptualized "as if" it were a different one.[26] Different from other proposals, however, as-if vertical conceptualization is based on visuo-spatial and attentional aspects in *CAS*, not on abstract 'support'.

While the cognitive system provides the mechanisms for abstraction and categorization involved in imposing a visuo-spatial perspective on a spatial scene, it is *convention* that determines which micro-perspectives are lexicalized (for which LO-RO constellations) in a language, which in turn directly depends on the perspectives/viewpoints taken in the corresponding culture. Compare, for example, the intra-linguistic contrast of being *in* or *at the supermarket* (likewise, *at*/*on the beach*) or the cross-linguistic fact that people are *at the bus stop* and *at the post office* in English but *an der Bushaltestelle* and *auf der Post* in German (cf. Herskovits, 1986, for the discussion of these and other use types of locative prepositions). Note that the different prepositions for the person-door relation are a case in point, too.

In general, such linguistic categorizations can be assumed to be *motivated*: in English, objects transported can be said to travel *on the bus/boat/plane* (compare *in/*on the taxi*, German *in/*auf dem Bus*) regardless of their actual interior location, perhaps because of (originally) viewing these larger vehicles as transportation platforms. Similarly, using "over" in *the fence fell over* (the 'reflexive' sense, Tyler and Evans, 2003, pp. 103f) may be motivated by the similarity of the shape of the fence's top's path to movements *over the fence*; in German, the fences fall "um" ("around"), perhaps due to the quarter circle of the path. This points to the temporal dimension of cross-linguistic differences: depending on the state of a language *in time*, different options may exist for categorizing an implicit relation, which probably leads to differently shaped sense networks across languages. For example, English has a 'repetition' sense (*over and over*) *dependent on* the reflexive sense of *over* (cf. Tyler and Evans, 2003, p. 105). Coincidentally, having no reflexive sense, repetition is not expressed by *über [over]* in German. Finally, sometimes such diachronic developments in motivated conventional, not necessarily veridical, linguistic perspectivation lead to inconsistent descriptions: as graveyards are typically conceptualized as 2-dimensional surfaces, people have to be *buried on the graveyard*. If we didn't know better, this expression should actually be incomprehensible outside New Orleans or similar places.

6. DISCUSSION

In the previous sections, not all aspects have been sufficiently discussed. For example, it seems that it is not justified to fully ignore regions in spatial semantics. This is most obvious in French, where objects can be located systematically "in" some region with regard to RO (*en dedans/dessous/avant/arrière de*), but corresponding expressions also exist in other languages (like *in front of* or *in the interior of* in English), which probably has motivated the region view in the first place. However, often there exist also "simple" prepositions (e.g., *dans, sous, avant, arrière*) in the same language. These are evidently more "basic" and are not synonymous with their complex counterparts (cp. **knot in the interior of the shoelace*).

[26] Note that visual scenes have to be interpreted *in any case* by assigning figure and ground and by using depth clues etc. (e.g., for the distinction of a spot from a hole).

Note also that such a "region conceptualization" is not restricted to prepositions: for adjectives like *high* there are expressions like *in this height, breathing is difficult*. Similarly, use of nominalization occurs in the verbal domain, too, but again, there are differences in meaning (e.g., in a *small investigation*, no one **investigates small*). The *CAS* approach therefore places emphasis on the "primary" simple prepositions and regards the semantics and structure of complex prepositions (Roy and Svenonius, 2009) as a separate issue. Furthermore, a closer look at compositional phenomena in locative semantics, with places and their quantification (compare *everywhere on the sofa*), will probably reconstruct regions as the closure of the possible places of an LO with respect to RO, given some spatial relation.

Concerning functions ('containment', 'support' etc.), it has been argued here that they are not part of the meaning of locative prepositions. Yet they may certainly be involved in (or even determine) the perspectivation of a scene, which is then linguistically categorized by a certain preposition. For example, if I care about whether a certain pan contains enough oil for frying, the oil is probably *in the pan*. If I care about the pan's cleanliness, oil is probably *on the pan* (but even then, the 'close-up view'-perspective might be more relevant than 'support').

With respect to the mono-/polysemy distinction, the *CAS* approach adopts an intermediate position. On the one hand, the propositional semantic specifications above indicate a maximally abstract position, with actual context determining prepositional senses — presupposing that linguistic semantic specification must systematically be distinguished from non-linguistic conceptual representations (see Kelter and Kaup, 2012). On the other hand, it is acknowledged that the interface between the linguistic and the conceptual system cannot be as "narrow" as it is sometimes assumed. The linguistic specifications may be hierarchically structured, and therefore redundant (an early proposal by Langacker), because somewhere the information that an LO is *at the post office* in English and *auf der Post* in German (plus schematic information of being *at some office/auf einem Amt*) has to be stored.

As to the representational elements used in other approaches (regions, vectors, image schemas, functions), the *CAS* approach denies their *explanatory* role in locative semantics. While they may have an important *descriptive* role in metalinguistic discourse (the image schemas in this chapter are of course only meant for illustration, too), only attention-based explicit spatial relations as micro-perspectivations can be shown to explain a wide range of linguistic data (including the combinatorics of prepositions and distance phrases). However, while the *CAS* approach integrates insights from different linguistic viewpoints (language generation, pragmatics) and different cognitive disciplines to expose the presumed explanatory role of attention for locative semantics *in principle*, it is important to point out that it makes no statement about some speaker's actual state of knowledge, representation or processing. For example, when saying *handle on a window*, a speaker (especially a child) might use the preposition simply because of a perceived similarity of doors and windows, not because of using an internalized *CAS* of *on*.

The *CAS* approach has a more direct impact on formal compositional semantics, i.e. on treating (in)compatibilities of distance phrase/preposition combinations. Without going into details spelled out in Carstensen (2002, 2013), the generic *CAS* entry for a locative preposition (corresponding to the one in (4)) is (8). Different from most other proposals, it comprises an additional "referential" argument of the prepositional predicate representing the designated micro-perspective. In Carstensen (2002), I have exemplified how the prepositional predicate can be decomposed and how the featural criteria can be represented as predicates on

the referential variable (see also Carstensen, 2013). As (9) shows, a modifying distance phrase, taking the referential variable as argument, may then either be compatible with this perspective or not.

(8)'Semantics of a locative preposition PREP':
λy λx λr [PREPRELATION(r, x, y)]
(9) *far behind the house*: λx ∃r [BEHIND(r, x, y) & HOUSE(y) & FAR(r)]

When looking at child data one should not forget aspects of language development (Keil and Batterman, 1984). For example, *in*, *on*, and *under* have been found to be the first English prepositions learned by children (J. Johnston and Slobin, 1979; Bowerman, 1996) and are probably indeed associated with functional notions ('containment', 'support', 'covering'). However, the children at that age may simply have a *different* semantics of these prepositions as compared to later developmental stages where they have learned the abstract semantics representative for that language.

When filled with wonder about the cross-linguistic variety in spatial semantics (Levinson, 2003) one should not ignore recent research on concept learning. Since women, fire and dangerous things have been found to be jointly linguistically categorized by a single term according to some cultural principles (Lakoff, 1987), and since even young children use theories in object concept formation (Gelman and Markman, 1986), such variety is culturally/anthropologically interesting, but not astonishing any more. Rather, the question phrased in Landau and Jackendoff (1993) – congenial to the *CAS* approach – remains, why there still appear to be restraining principles in spatial semantics. The recent paradigm of *semantic mapping* (cross-linguistic clustering of senses, see Levinson et al., 2003; Zwarts, 2010; Holmes and Wolff, 2013) seems to be much too coarse and descriptive to be helpful for answering this question ("semantic maps are not a method for arriving directly at mental representations", Haspelmath, 2003, p. 239). In contrast to that, the *CAS* approach offers a more fine-grained analysis on the level of cognitive representation and processing. But even with this appoach there is no silver bullet or short cut when it comes to the problem of translation, as has been demonstrated with *on*, *an*, and *auf*. Correspondingly, both the multidimensional cognitive aspects and the conventionality of locative semantics will continue to be problematic for attempts to find an objective set of spatial senses or to sort spatial senses into decision-tree-like hierarchies or ontologies based on objective criteria like distance, contact, support etc. (Bateman et al., 2010; A. Müller, 2013).

With respect to the special role of spatial expressions for other domains (localist ideas, and the prevalence of spatial metaphors, see Lakoff and M. Johnson, 1980), the *CAS* approach offers the transmodality of selective attention as a plausible source of these phenomena. According to that view, representation/processing in different domains may have *isomorphic* attentional structure, and corresponding domain-crossing as-if conceptualizations may be motivated by the saliency of the spatial domain. For example, cognitive scales can be conceived as axial (Carstensen, 2013) resulting in the use of projective prepositions (*He is over 10 feet long*), and the direction of some scale may be aligned with the relevance/salience distinctions in space ("good is up"). Domain-crossing as-if conceptualizations are most evident in English temporal expressions where spans of time as RO only differing in length are conceived as containers (*in the morning, in this week*), proximal objects (*at noon*) or

platforms (*on thursday*) – which again may not be the same in other languages, compare German *am Morgen [in the morning]* and *am Donnerstag [on thursday]*.

As to neurocognitive results, there is unexpectedly little disagreement although such research is often based on the criticized theoretical approaches. Recent findings in cognitive neuroscience seem to support what is called "simulation framework" by Kemmerer which "treats semantic structures as being grounded in modality-specific sensorimotor systems, as opposed to being completely amodal in character" (Kemmerer, 2010, p. 289). This is in accordance both with the above subdistinction of visual and spatial reference systems and with the LaMP view, i.e. with the reference to actual mental presentations that are perspectivated. Kemmerer also refers to categorical relationships as designated by prepositions (which are represented attentional operations in Kosslyn's model). Finally, Tranel and Kemmerer (2004) face an interesting paradox (similar to the possible mismatch of cognitive semantic theory in general and some speaker's actual cognitive state noted above). On the one hand, they regard spatial semantics as being anchored in perceptual processing *in principle.* On the other hand, however, they observe a double dissociation of both aspects: there can be preserved perceptual processing in spite of damaged semantic processing, and preserved linguistic processing in spite of damaged perceptual processing.

CONCLUSION

In this chapter, a Cognitivist Attentional Semantics (*CAS*) of locative prepositions has been presented. It was shown that other approaches to locative semantics fail to recognize important distinctions (e.g., explicit/implicit), fall prey to some misconceptions of the relation of language and space (e.g., RO-centered search regions), and on the whole are descriptive at best. It was argued that neither regions or vectors, nor image schemas or functions, are of primary importance for locative semantics. Rather, the representational aspects of the mental presentation of a scene, the processing aspects of its attentional perspectivation, the selection of conceptual elements for speaking during language generation and the conventionality of semantics must be regarded as central for an explanatory account of the specification and cross-linguistic variation of locative semantics.

According to the *CAS* approach, locative prepositions designate categorized attentional perspectives on implicit spatial relations. These micro-perspectives as explicit spatial relations involve qualitative aspects of selective attentional engagement in cognitive reference systems. The distinctions based on these aspects (e.g., types of reference systems, reference polarity) are proposed to be at the core of the relevant features for locative semantics, despite the fact that further aspects are sometimes grammatically coded in some language (e.g., gestalt-type of RO). At the same time, while the *CAS* approach relies heavily on cognitive factors, the role of the complex structure of diachronically grown linguistic semantic systems and the limited knowledge of these systems even by native speakers (especially at early developmental stages) is acknowledged.

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REFERENCES

Allport, A. (1993). "Attention and Control: Have We Been Asking the Wrong Questions? A Critical Review of Twenty-Five Years". In: D. E. Meyer, and S. Kornblum (Eds.), *Attention and Performance XIV: Synergies in Experimental Psychology, Artificial Intelligence, and Cognitive Neuroscience.* Cambridge, Mass.: The MIT Press, 183-218.

Aurnague, M. & Vieu, L. (1993). "A Three-Level Approach to the Semantics of Space". In: C. Zelinsky-Wibbelt (Ed.), *The semantics of prepositions: from mental processing to natural language processing*. Berlin: Mouton de Gruyter.

Ballard, D. H. (1987). "Eye Movements and Visual Cognition". In: A. Kak and S. Chen (Eds.), *Spatial Reasoning and Multi-sensor fusion*, 188-200.

Bateman, J. A., Hois, J., Ross, R. J. & Tenbrink, T. (2010). A linguistic ontology of space for natural language processing. *Artificial Intelligence, 174* (14), 1027-1071.

Behrmann, M. & Tipper, S. P. (1994). "Object-Based Attentional Mechanisms: Evidence from Patients with Unilateral Neglect". In: C. Umiltà and M. Moscovitch (Eds.), *Attention and Performance XV: Conscious and Nonconscious Information Processing.* Cambridge, MA: MIT Press, 351-375.

Bierwisch, M. (1967). Some Semantic Universals of German Adjectivals. *Foundations of Language: International Journal of Language and Philosophy*, *3*, 1-36.

Bierwisch, M. (1988). "On the Grammar of Local Prepositions". In: M. Bierwisch, W. Motsch and I. Zimmermann (Eds.), *Syntax, Semantik und Lexikon.* Berlin: Akademie-Verlag Studia Grammatica 29, 1-65.

Bierwisch, M. & Lang, E. (1989). *Dimensional Adjectives: Grammatical Structure and Conceptual Interpretation*. Berlin: Springer.

Bierwisch, M. (1989). "The Semantics of Gradation". In: M. Bierwisch and E. Lang (Eds.), *Dimensional Adjectives*. Berlin: Springer, 71-261.

Bierwisch, M. (2011). "Semantic features and primes". In: K. von Heusinger, C. Maienborn and P. Portner (Eds.), *Semantics. An international handbook of natural language meaning* (HSK 33.1). Berlin: de Gruyter, 322-357.

Bloom, P., Peterson, M. A., Nadel, L. & Garrett, M. F. (Eds.) (1996). *Language and Space.* Cambridge, Mass.: MIT Press.

Bohnemeyer, J. (2012). "A Vector Space Semantics for Reference Frames in Yucatec". In: E. Bogal-Allbritten (Ed.), *Proceedings of the sixth meeting on the Semantics of Under-Represented Languages in the Americas (SULA 6) and SULA-Bar*. Amherst: GLSA Publications, 15-34.

Boroditsky, L. (2003). “Linguistic relativity”. In: L. Nadel (Ed.), *Encyclopedia of Cognitive Science.* MacMillan Press: London, UK, 917-921.

Bowerman, M. (1996). “Learning How to Structure Space for Language: A Crosslinguistic Perspective”. In: P. Bloom, M. A. Peterson, L. Nadel and M. F. Garrett (Eds.), *Language and Space.* Cambridge, Mass.: MIT Press, 385-436.

Brala, M. M. (2002). Understanding and translating (spatial) prepositions. An exercise in cognitive semantics for lexicographic purposes. *Working Papers in English and Applied Linguistics, 7*. University of Cambridge Press, 1-24.

Brugman, C. M. (1988). *The story of over: Polysemy, semantics, and the structure of the lexicon.* New York: Garland.

Buschbeck-Wolf, B. (1995). *Konzeptuelle Interpretation und interlinguabasierte Übersetzung räumlicher Präpositionen.* Doctoral dissertation, University of Stuttgart, Germany. Also published as: *Working Papers of the Institute for Logic and Linguistics, 15*.

Carlson-Radvansky, L. A. & Irwin, D. E. (1993). Frames of Reference in vision and Language: Where is above? *Cognition, 46*, 223-244.

Carlson, L. A. & van der Zee, E. (2005). *Functional features in language and space: insights from perception, categorization, and development.* Oxford: Oxford University Press.

Carlson, L. A. & Kenny, R. (2006). Interpreting spatial terms involves simulating interactions. *Psychonomic Bulletin & Review, 13*, 682-688.

Carlson, L. A, Regier, T., Lopez, B. & Corrigan, B. (2006). Attention unites form and function in spatial language. *Spatial Cognition and Computation, 6*, 295-308.

Carlson, L. A. & Van Deman, S. (2008). Inhibition within a reference frame during the interpretation of spatial language. *Cognition, 106*, 384-407.

Carstensen, K.-U. & Simmons, G. (1991). “Why a hill can’t be a valley: representing gestalt and position properties of objects with object schemata”. In O. Herzog and C.-R. Rollinger (Eds.), *Text understanding in LILOG: Integrating computational linguistics and artificial intelligence*. Berlin: Springer, 632-644.

Carstensen, K.-U. (1992a). An interdisciplinary approach to the representation of route knowledge. Paper presented at the Workshop ‘Spatial Concepts: Connecting Cognitive Theories with Formal Representations’, European Conference on Artificial Intelligence (ECAI 92), 1-4.

Carstensen, K.-U. (1992b). “Approaching the semantics of distance expressions: Problems and perspectives”. In P. Bosch and P. Gerstl (Eds.), *Discourse and lexical meaning*, Workshop-Proceedings of the SFB 340 “Sprachtheoretische Grundlagen für die Computerlinguistik”, Report Nr. 30, 49-59.

Carstensen, K.-U. (1993). “Zur Relevanz fokussierter Aufmerksamkeit für die Repräsentation von Raum [On the relevance of focused attention for the representation of space]”. In: D. Hernàndez (Ed.), *Hybride und integrierte Ansätze zur Raumrepräsentation und ihre Anwendung*. Report FKI-185-93. Technische Universität München. 55-59.

Carstensen, K.-U. (1995). “Semantic and Conceptual Aspects of Local Expressions: Critical Remarks on the 'State of the Art'”. In: M. Bierwisch and P. Bosch (Eds.), *Semantic and Conceptual Knowledge*, Workshop-Proceedings of the SFB 340 “Sprachtheoretische Grundlagen für die Computerlinguistik”, Report Nr. 71, 117-126.

Carstensen, K.-U. (2000). “Räumliche Mikroperspektivierung und die Semantik lokaler Präpositionen”. In: C. Habel and C. von Stutterheim (Eds.), *Räumliche Konzepte und sprachliche Strukturen.* Linguistische Arbeiten 417. Tübingen: Niemeyer, 237-260.

Carstensen, K.-U. (2001). *Sprache, Raum und Aufmerksamkeit [Language, space, and attention]*. Niemeyer Verlag.

Carstensen, K.-U. (2002). Location and distance in language: An attention-based approach. Paper presented at the 3rd ANNUAL LANGUAGE & SPACE WORKSHOP 'Resolution and Granularity in Language and Space'. ZIF, Univ. Bielefeld. 8./9.7.2002.

Carstensen, K.-U. (2007). Spatio-temporal ontologies and attention. *Spatial Cognition and Computation 7(1)*, 13-32.

Carstensen, K.-U. (2011). Toward cognitivist ontologies. *Cognitive Processing, 12 (4*), 379-393.

Carstensen, K.-U. (2013). A cognitivist semantics of gradation. *Zeitschrift für Sprachwissenschaft. 32 (2),* 181-219.

Cave, K. R. und Kosslyn, S. M. (1989). Varieties of size-specific visual selection. *Journal of Experimental Psychology, 118*, 148-164.

Clark, H. H. (1973). "Space, Time, Semantics, and the Child". In: T. E. Moore (Ed.), *Cognitive Development and the Acquisition of Language*. New York: Academic Press, 27-63.

Coventry, K. R., Carmichael, R. & Garrod, S. C. (1994). Spatial Prepositions, Object-Specific Function, and Task Requirements. *Journal of Semantics, 11*, 289-309.

Coventry, K. R. & Garrod, S. C. (2005). "Spatial prepositions and the functional geometric framework. Towards a classification of extra-geometric influences". In: L. A. Carlson and E. van der Zee (Eds.), *Functional features in language and space: Insights from perception, categorization and development*. Oxford: Oxford University Press, 149-162.

Coventry, K. R., Lynott, D., Cangelosi, A., Monrouxe, L., Joyce, D. & Richardson, D. C. (2010). Spatial language, visual attention, and perceptual simulation. *Brain & Language, 112 (3)*, 202-213.

Evans, V. (2010). "The Perceptual Basis of Spatial Representation". In: V. Evans and P. Chilton (Eds.), *Language, Cognition and Space: The State of the Art and New Directions*. London, Oakville: Equinox publishing, 21-48.

Finke, R. A. (1989). *Principles of Mental Imagery*. Cambridge, Mass.: MIT Press.

Fortis, J.-M. (2012). On the history and speciation of Localism. Paper presented at "Language, Culture and Mind V", Lisbon, 26-29 June 2012, CECC-FCH & Universidade Católica Portuguesa.

Friederici, A. & Levelt, W. J. M. (1990). Spatial reference in weightlessness: Perceptual factors and mental representations. *Perception and Psychophysics, 47*, 253-266.

Garrod, S., Ferrier, G. & Campbell, S. (1999). *In* and *on*: investigating the functional geometry of spatial prepositions. *Cognition*, 72, 167-189.

Gelman, S. & Markman, E. M. (1986). Categories and induction in young children. *Cognition, 23*, 183-209.

Grady, J. (2005). "Image schema and perception: Refining a definition". In: B. Hampe and J. Grady (Eds.), *From Perception to Meaning: Image Schemas in Cognitive Linguistics*. Berlin: Mouton de Gruyter.

Hampe, B. & Grady, J. (Eds.) (2005). *From Perception to Meaning: Image Schemas in Cognitive Linguistics*. Berlin: Mouton de Gruyter.

Harnad, S. (2003) "Categorical perception". In: *Encyclopedia of Cognitive Science*. Nature Publishing Group/Macmillan.

Haspelmath, M. (2003). "The geometry of grammatical meaning: Semantic maps and cross-linguistic comparison". In: M. Tomasello (Ed.), *The new psychology of language*, vol. 2. New York: Erlbaum, 211-243.

Herskovits, A. (1986). *Language and Spatial Cognition. An interdisciplinary study of the prepositions in English.* Cambridge Univ. Press.

Hill, C. (1982). "Up, Down, Front, Back, Left, Right. A Contrastive Study of Hausa and English". In: J. Weissenborn and W. Klein (Eds.), *Here and there: Crosslinguistic studies on deixis and demonstration.* Amsterdam: Benjamins, 13-41.

Hogan, J. M., Diederich, J. & Finn, G. D. (1998). "Selective attention and the acquisition of spatial semantics". In: J. Burstein and C. Leacock (Eds.), *Proceedings of the joint conference on new methods in language processing and computational language learning*. Somerset, New Jersey: Association for Computational Linguistics, 235-244.

Hogan, J. M. & Diederich, J. (2001). Encoding of spatial relations semantics through selective attention. *Proceedings of the 4th australasian natural language processing workshop.* Sydney. 1-8.

Holmes, K. J., & Wolff, P. (2013). "When is language a window into the mind? Looking beyond words to infer conceptual categories". In: M. Knauff, S. N. Pauen and I. Wachsmuth (Eds.), *Proceedings of the 35th Annual Conference of the Cognitive Science Society*. Austin, TX: Cognitive Science Society.

Jackendoff, R. (1983). *Semantics and cognition*. Cambridge, Mass.: MIT Press.

Johnson, M. (1987). *The Body in the Mind: The Bodily Basis of Meaning, Imagination, and Reason.* Chicago, IL: University of Chicago Press.

Johnston, J. & Slobin, D. I. (1979). The development of locative expression in English, Italian, Serbo-Croatian and Turkish. *Journal of Child Language, 6*, 529-545.

Johnston, W. A. and Dark, V. J. (1986). Selective Attention. *Annual Review of Psychology, 37*, 43-75.

Kahneman, D. & Treisman, A. (1992). The Reviewing of Object Files: Object-Specific Integration of Information. *Cognitive Psychology, 24*, 175-219.

Katz, J. J. & Fodor, J. A. (1963). The Structure of a Semantic Theory, *Language, 39*, 170-210.

Keil, F. C. & Batterman, N. (1984). A characteristic-to-defining shift in the development of word meaning. *Journal of Verbal Learning and Verbal Behavior, 23*, 221-236.

Kelleher, J. D. & Costello, F. J. (2009). Applying Computational Models of Spatial Prepositions to Visually Situated Dialog, *Computational Linguistics, 35 (2)*, 271-306.

Kelter, S. & Kaup, B. (2012). "Conceptual knowledge, categorization, and meaning". In: K. von Heusinger, C. Maienborn and P. Portner (*Eds*.), *Semantics. An International Handbook of Natural Language Meaning* (HSK 33.3). Berlin: de Gruyter, 2775-2805.

Kemmerer, D. (2006). The semantics *Neuropsychologia, 44*, 1607-1621.

Kemmerer, D. (2010). "How words capture visual experience: The perspective from cognitive neuroscience". In: B. Malt, and P. Wolff (Eds.), *Words and the world: How words capture human experience*. Oxford, UK: Oxford University Press, 289-329.

Klein, W. & Stutterheim, C. von (2002). "Quaestio and L-perspectivation". In: C. F. Graumann and W. Kallmeyer (Eds.), *Perspective and Perspectivation in Discourse*. Amsterdam, 59-88.

Kosslyn, S. M. (1994). *Image and brain: The resolution of the imagery debate*. Cambridge, Mass.: MIT Press.

Kreitzer, A. (1997). Multiple levels of schematization: a study in the conceptualization of space. *Cognitive Linguistics*, *8 (4)*, 291-325.

Kuhn, W. (2005). Geospatial Semantics: Why, of What, and How? *Journal on Data Semantics* III (Special Issue on Semantic-based Geographical Information Systems, Spring 2005, LNCS 3534), Berlin/Heidelberg: Springer.

Lakoff, G. (1977), "Linguistic Gestalts". In: W. A. Beach, S. E. Fox and S. Philosoph (Eds.), *Papers from the Thirteenth Regional Meeting of the Chicago Linguistic Society* (Chicago Linguistic Society 13). University of Chicago, 236-287.

Lakoff, G. (1987). *Women, fire, and dangerous things: What categories reveal about the mind*. Univ. of Chicago Press.

Lakoff, G. & Johnson, M. (1980). *Metaphors we live by*. Univ. of Chicago Press.

Landau, B. & Jackendoff, R. (1993). "what" and "where" in spatial language and spatial cognition. *Behavioural and Brain Sciences*, *16*, 217-265.

Lang, E., Carstensen, K.-U. & Simmons, G. (1991). *Modelling spatial knowledge on a linguistic basis: Theory - prototype - integration*. Lecture Notes in Artificial Intelligence No. 481. Springer.

Lang, E. & Maienborn, C. (2011). "Two-level semantics: Semantic form and conceptual structure". In: K. von Heusinger, C. Maienborn and P. Portner (Eds.), *Semantics. An international handbook of natural language meaning* (HSK 33.1). Berlin: de Gruyter, 709-740.

Langacker, R. (1987). *Foundations of cognitive grammar I: Theoretical prerequisites.* Stanford University Press.

Langacker, R. (2009). Reflections on the Functional Characterization of Spatial Prepositions. *Belgrade English Language & Literature Studies*, *1*, 9-34.

Levelt, W. J. M. (1989). *Speaking: From Intention to Articulation.* Cambridge, Mass.: MIT Press.

Levelt, W. J. M. (1996). "Perspective Taking and Ellipsis in Spatial Descriptions". In: P. Bloom, M. A. Peterson, L. Nadel and M. F. Garrett (Eds.), *Language and Space.* Cambridge, Mass.: MIT Press, 77-108.

Levinson, S. C. (1996). "Frames of reference and molyneuxs question: Crosslinguistic evidence". In: P. Bloom, M. A. Peterson, L. Nadel and M. F. Garrett (Eds.), *Language and space*. Cambridge, Mass.: MIT Press, 109-169.

Levinson, S. C. (2003). *Space in Language and Cognition: Explorations in Cognitive Diversity*. Cambridge, UK: Cambridge University Press.

Levinson, S. C., Meira, S. & the Language & Cognition Group (2003). 'Natural concepts' in the spatial topological domain - Adpositional meanings in crosslinguistic perspective: an exercise in semantic typology. *Language, 79 (3)*, 485-516.

Lewis, D. (1970). General Semantics. *Synthese*, *22*, 18-67.

Logan, G. D. (1995). Linguistic and conceptual control of visual spatial attention. *Cognitive Psychology*, *28*, 103-174.

Marchetti, G. (2006a). A presentation of attentional semantics. *Cognitive Processing*, *7*, 163-194.

Marchetti, G. (2006b). A criticism of Leonard Talmy's Cognitive Semantics. Available from: www.mind-consciousness.

Miller, G. A. & Johnson-Laird, P. N. (1976). *Language and Perception.* Cambridge, Mass.: Belknap Press.

Mozer, M. C. & Sitton, M. (1998). "Computational Modeling of Spatial Attention". In: H. E. Pashler (Ed.), *Attention*. Hove, East Sussex: Psychology Press Ltd, 341-393.

Mozer, M. C. & Vecera, S. P. (2005). "Object- and space-based attention". In: L. Itti, G. Rees and J. Tsotsos (Eds.), *Neurobiology of attention*. New York: Elsevier, 130-134.

Müller, A. (2013). *Spatiale Bedeutungen deutscher Präpositionen. Bedeutungsdifferenzierung und Annotation*. Doctoral dissertation, University of Bochum, Germany.

Posner, M. I. (1980). Orienting of Attention. *Quarterly Journal of Experimental Psychology, 32*, 3-25.

Olson, D. R. & Bialystok, E. (1983). *Spatial cognition*. Lawrence Erlbaum Associates.

Paivio, A. (1983). "The Empirical Case for Dual Coding". In: J. C. Yuille (Ed.*), Imagery, memory, and cognition: Essays in Honor of Allan Paivio*. Lawrence Erlbaum Assoc Inc., 307-332.

Partee, B. (1996). "The development of formal semantics in linguistic theory". In: S. Lappin (Ed.), *The Handbook of Contemporary Semantic Theory*. Oxford: Blackwell, 11-38.

Pylyshyn, Z. W. (2009). "Perception, representation and the world: The FINST that binds". In: D. Dedrick and L. Trick (Eds.), *Computation, Cognition and Pylyshyn*, Cambridge, MA: MIT Press, 3-48.

Regier, T. (1995). A model of the human capacity for categorizing spatial relations. *Cognitive Linguistics, 6 (1*), 63-88.

Regier, T. & Carlson, L. A. (2001). Grounding spatial language in perception: An empirical and computational investigation. *Journal of Experimental Psy*chology: *General, 130*, 273-298.

Robertson, L. C. (2003). Binding, spatial attention and perceptual awareness. *Nature Reviews: Neuroscience, 4*, 93-102.

Rohrer, T. (2005). "Image Schemata in the Brain". In: B. Hampe and J. Grady (Eds.), *From Perception to Meaning: Image Schemas in Cognitive Linguistics*. Berlin: Mouton de Gruyter, 165-196.

Roy, I. & Svenonius, P. (2009). "Complex prepositions". In: J. François, E. Gilbert, C. Guimier and M. Krause (Eds.), *Autour de la préposition. Actes du Colloque International de Caen (20-22 septembre 2007).* Caen: Presses Universitaires de Caen, 105-116.

Sandra, D. (1998). What linguists can and can't tell us about the mind: a reply to Croft. *Cognitive Linguistics, 9 (4).* 361-78.

Sandra, D. & Rice, S. (1995). Network analyses of prepositional meaning: mirroring whose mind – the linguist's or the language user's? *Cognitive Linguistics, 6 (1*). 89-130.

Scholl, B. J. (2001). Objects and attention: The state of the art. *Cognition,* 80 (1/2), 1-46.

Slobin, D. I. (1996). "From 'Thought and Language' to 'Thinking for speaking". In: J. J. Gumperz and S. C. Levinson (Eds.), *Rethinking linguistic relativity*. Cambridge University Press, 70-96.

Spencer, J. P., Lipinski, J. & Samuelson, L. K. (2010). "It's in the Eye of the Beholder: Spatial Language and Spatial Memory Use the Same Perceptual Reference Frames". In: K. S. Mix, L. B. Smith and M. Gasser (Eds.), *Spatial Foundations of Language and Cognition.* Oxford/ New York: Oxford University Press, 102-131.

Sperling, G. & Wurst, S. A. (1991). Selective attention to an item is stored as a feature of the item [Abstract]. *Bulletin of the Psychonomic Society, 29*, 473.

Talmy, L. (2000). *Toward a cognitive semantics, vol. I.* Cambridge et al.: The *MIT Press.*

Talmy, L. (2007). "Attention phenomena". In: D. Geeraerts and H. Cuyckens (Eds.), *Handbook of cognitive linguistics.* Oxford University Press, 377-393.

Tanenhaus, M. K., Spivey-Knowlton, M. J., Eberhard, K. M. & Sedivy, J. E. (1995). Integration of visual and linguistic information in spoken language comprehension. *Science*, *268*, 1632-1634.

Tranel, D. & Kemmerer, D. (2004). Neuroanatomical correlates of locative prepositions. *Cognitive Neuropsychology*, *21*, 719 - 749.

Treisman, A. (1988). Features and Objects: The Fourteenth Bartlett Memorial Lecture. *The Quarterly Journal of Experimental Psychology*, *40*, 201–237.

Tyler A. & Evans V. (2003). *The semantics of English prepositions*. Cambridge: Cambridge University Press.

Tyler A. & Evans V. (2004). "Reconsidering Prepositional Polysemy Networks: The Case of Over". In: B. Nerlich, L. Todd, V. Herman and D. D. Clarke (Eds.), *Polysemy: Flexible Patterns of Meaning in Mind and Language*. Reprinted from *Language*, 2001. Berlin: Mouton de Gruyter, 95-160.

Vandeloise, C. (1991). *Spatial prepositions: A case study from French* (A. R. K. Bosch, Trans.). Chicago: University of Chicago Press.

Wunderlich, D. (1982). Sprache und Raum. *Studium Linguistik*, *12*, 1-19.

Wunderlich, D. & Herweg, M. (1990). "Lokale und Direktionale". In: A. von Stechow and D. Wunderlich (Eds.), *Handbuch der Semantik*, 758-785.

Zlatev, J. (2007). "Spatial semantics". In: D. Geeraerts and H. Cuyckens (Eds.), *The Oxford Handbook of Cognitive Linguistics.* New York: Oxford University Press, 318-350.

Zwarts, J. (1997). Vectors as Relative Positions: A Compositional Semantics of Modified PPs. *Journal of Semantics*, *14*, 57-86.

Zwarts, J. & Winter, Y. (2000). Vector space semantics: a model-theoretic analysis of locative prepositions. *Journal of Logic, Language and Information*, *9*, 169-211.

Zwarts, J. (2010). Semantic map geometry: Two approaches. *Linguistic Discovery*, *8 (1)*, 377-395.

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Chapter 5

ATTENTIONAL STATE: FROM AUTOMATIC DETECTION TO WILLFUL FOCUSED CONCENTRATION

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ABSTRACT

Despite the fact that attention is a core property of all perceptual and cognitive operations, our understanding of its neurophysiological mechanisms is far from complete. There are many theoretical models that try to fill this gap in knowledge, though practically all of them concentrate only on either involuntary (bottom-up) or voluntarily (top-down) aspect of attention. At the same time, both aspects of attention are rather integrated in the living brain. In this chapter we attempt to conceptualise both aspects of attentional state within the theory of Operational Architectonics of brain and mind functioning, which provides a plausible theoretical basis for neurophysiological understanding of how attention is brought to existence in the living brain.

> "Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought"
>
> (James, 1890/1981, pp. 403-404).

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1. INTRODUCTION

It is trivial knowledge that when any human (and animals included) goes about its daily routine, he/she is constantly faced with a continuous stream of complex multimodal sensory stimuli, as well as with many possible responses to them (Seeley et al., 2007; Wu, 2011; Macaluso and Doricchi, 2013). The brain (human or animal) somehow manages this onrush of extremely diverse environmental stimuli in a flexible and rapid manner by selectively channeling them into specific spatial-temporal patterns (so-called category attractors; Tsuda, 2001; Kozma and Freeman, 2001; Perlovsky and Kozma, 2007; Chialvo, 2010) and links them to related behaviors (Schöner and Kelso, 1988; Noack, 2006; Kelso, 2012; Yufik, 2013). Environmental scene or event segmentation (structuring) is believed to be critically important during such channeling for the efficient distribution of cognitive resources and optimized organization (in space and time) of key features of perceived objects in memory (Zacks, 2010; Watzl, 2011; Marchetti, 2012). This process is intuitively understood and usually termed as '*attention*' (James, 1890/1981).

Attentional process selects, modulates and sustains focus on information that is most relevant for performing a cognitive task or drive behavior at each given moment (Rabinovich et al., 2013). *Involuntary* or bottom-up attention (sometimes also called 'external attention' or 'stimulus-driven attention') refers to the selection and modulation of sensory information, e.g., extracting features from input stimuli and selecting locations in space, instants in time, or modality-specific inputs (Prinzmetal et al., 2009). *Voluntary* or top-down attention (sometimes termed as 'internal attention' or 'goal-directed attention') refers to the selection, modulation and maintenance of internally generated information (e.g., task rules, responses, long-term memory, or working memory), and in such a way it selects information for perceptual enhancement that is important to immediate task goals (Prinzmetal et al., 2005).

One of the problems in understanding and modeling attention is how both bottom-up and top-down aspects of it are combined in brain function. Usually researchers stress either bottom-up strategies like in the 'saliency based approach' (Koch and Ullman, 1985; Niebur and Koch, 1998; Itti and Koch, 2000) or top-down strategies such as the Corchs and Deco approach, for example (2001). We argue that such one-sided approaches are simplistic and do not adequate to a real situation in the brain, where both processes are intimately integrated and even interrelated within the same functional architecture.

In this chapter we shall analyze attention from the perspective of Operational Architectonics (OA) theory of brain and mind functioning (Fingelkurts and Fingelkurts, 2001, 2008; Fingelkurts et al., 2010, 2013). In short, OA theory is centered on the notion of "operation". The notion of operation plays a central role in bridging the gap between brain and mind[1]: it is precisely by means of this notion that it is possible to identify what at the

[1] Humans' struggle to understand the mind (consciousness) and its relationship to a matter (brain) – currently called brain-mind problem – stretches back to ancient times. For example, Pythagoras had the notion that "the brain served as the organ of the mind and the temple of the soul" (Hansotia, 2003). Plato argued that the soul is temporarily united with the body and would only be separated at death (Silverman, 2012). Aristotle saw the relation between soul and body as the soul is a property exhibited by the body and when the body perishes, so does the soul (Shields, 2011). Descartes believed that mind exerts control over the brain and that it is distinct from the brain (Lokhorst, 2013). This relation gets known as 'Cartesian dualism'. Currently, this brain-mind debate is known as the "hard problem" – the problem of understanding how the brain (or, more generally, physical matter) could produce any subjective, phenomenal experiences at all (Chalmers, 1995). To make

same time belongs to the mental level and to the neurophysiological level of brain activity organization, and acts as a mediator between the two (Fingelkurts and Fingelkurts, 2001, 2008).

Indeed, both, the material neurophysiological organization that characterizes the brain and the informational order that characterizes the mind necessarily involve such events as operations at their cores (Benedetti et al., 2010). Operation is broadly defined as the process or state of being in effect and it has a beginning and an end (Collins Essential English Dictionary, 2006). It should be stressed that this is so regardless of whether this process is conceptual / mathematical / phenomenal or physical / biological / physiological. In fact, everything which can be represented by a process is an operation. Understanding of the operation as a *process* and considering its *combinatorial nature*, seems especially well suited for describing and studying the mechanisms of how information about the objective physical entities of the external world can be integrated, and how unified/coherent mental objects, thoughts or decisions can be presented in the internal subjective domain by means of entities of distributed neuronal brain assemblies (Fingelkurts et al., 2010, 2013). In line with this conceptualization, simple cognitive operations that present some partial aspect of the whole object/scene/concept are presented in the brain by local 3D-fields produced by discrete and transient neuronal assemblies. More complex operations that constitute the whole object or scene are brought into existence by joint (synchronized) simple operations in the form of coupled 3D-fields – so called operational modules (OMs) of varied complexity. Further synchronization of several OMs (complex field spatial-temporal patterns) forms even more coarse scales of the nested functional hierarchy[2] (Feinberg, 2000) capable of cognitively and/or mentally (subjectively) presenting very complex sensual inputs as coherent perceptions of the world, and create internal complex images and conscious decisions (Fingelkurts et al., 2010, 2013). The recombination of neuronal assemblies and their operational modules in new configurations makes it possible to present a practically infinite number of different qualities, patterns, objects, scenes, concepts and decisions.

In the following sections we will discuss the place of attention in this architecture and analyze mechanisms that serve as the realization base of attention as a psychophysiological phenomenon.

2. INVOLUNTARY (BOTTOM-UP) ATTENTION

At the bottom of brain operational architectonics there is a high multiplicity of local extracellular fields that are best captured by the electroencephalogram (EEG) measurement (Nunez, 2000; Freeman, 2007). Local EEG waves recorded from the scalp are the result of self-organized integrated excitatory and inhibitory post-synaptic potentials of neuronal membranes in the neuronal mass under the recording electrodes. Since they reflect extracellular currents caused by synchronized neural activity within the local brain volume (John, 2002; Nunez, 2000; Nunez and R. Srinivasan, 2006; Freeman, 2007), they are expressed within local EEG signals in the form of quasi-stationary segments, each

progress in solving this hard problem, the neural counterparts directly constituting phenomenal consciousness must be localized and identified (Fingelkurts et al., 2013).

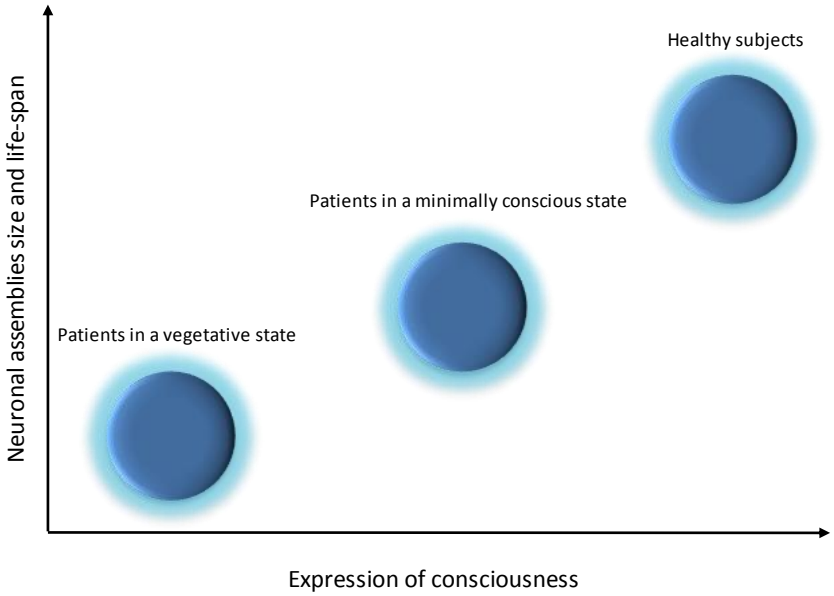
[2] In a nested hierarchy, all the elements comprising the lower levels of the hierarchy are physically combined or nested within higher levels to create increasingly complex wholes (Feinberg, 2000).

representing an envelope of amplitude modulation (so-called a 'common mode'/'wave packet' (Freeman and Vitiello, 2006) or a 'standing wave' (Nunez and R. Srinivasan, 2006) in the neuronal mass. The more neurons transiently synchronize their post-synaptic potentials the higher the amplitude of a common local 3D-field, which is an indication of the collective behavior (neuronal assembly formation) at an emergent mesoscopic scale (Freeman, 1975; Nunez, 2000; Buzsaki, 2004, 2006). Such a property of neurons relies on their capability to select appropriate information from incoming input depending on the context set by their own history and the activity of other neurons (Nasuto et al., 1999).

Because the transient neuronal assembly is formed to perform a particular operation/function of certain duration, this period (reflected in the EEG as a stabilized segment of quasi-stationary activity; Fingelkurts and Fingelkurts, 2001, 2006) corresponds to the functional duration of operation produced by the given assembly. It has been proposed that quasi-stationary EEG segments (within which the local 3D-fields generated by transient functional neuronal assemblies are expressed) are equivalent to simple mental operations (phenomenal qualities, primary cognitive operations and emotions) (Fingelkurts and Fingelkurts, 2001; Fingelkurts et al., 2009, 2010, 2013). Indeed, it has been shown experimentally that EEG segments are reliably and consistently correlated with changes in the phenomenal (subjective) content during both spontaneous (stimulus independent) and induced (stimulus dependent) experimental conditions (Fingelkurts and Fingelkurts, 1995; Kaplan and Borisov, 2003; Verevkin et al., 2007; Putilov et al., 2007; for a review see Fingelkurts and Fingelkurts, 2010). Moreover, it has been documented that different neuronal assemblies' local 3D-fields correlate with different simple conscious percepts (Singer, 2001; Freeman, 2007) and that in the absence of cognitive processing these specific transient neuronal assemblies do not appear (Pulvermueller et al., 1994) or are so small and short-lived that they are unable to support self-awareness and consciousness, as is the case for patients who are in a vegetative state (see Figure 1; Fingelkurts et al., 2012a).

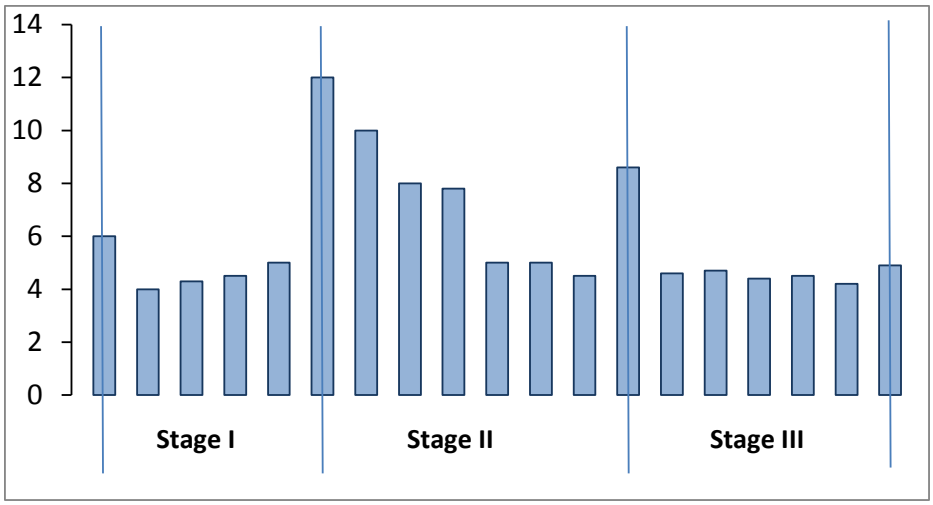
The quasi-stationary EEG segments within each local EEG signal are 'glued' to one another by means of rapid transitional processes/periods (RTPs). RTPs are observed within a short-time window, when EEG amplitude changes abruptly (Fingelkurts, 1998). Each RTP has a very short duration in comparison to quasi-stationary segments length and can therefore be treated as a point or near-point (Fingelkurts and Fingelkurts, 2001, 2008; Kaplan et al., 2005; Rabinovich et al., 2008). Thus, RTPs (or abrupt jumps in EEG amplitude) are, in fact, the markers of boundaries between concatenated quasi-stationary segments. The transition from one segment to another then reflects the moment of abrupt switching from one neuronal assembly's operation to another (Fingelkurts and Fingelkurts, 2008).

As we have suggested elsewhere (Fingelkurts et al., 2013), in physics terms, one could interpret such a transition as the offloading of entropy (Bak, 1996; H. J. Jensen, 1998; Annila, 2010) and resetting of the system (neuronal assembly) memory (Allegrini et al., 2009, 2010; Paradisi et al., 2012). Neurophysiologically, RTP represents a loss of constraints among neurons constituting one neuronal assembly, followed by a rapid arrival of them at a new configuration, leading the new neuronal assembly to exhibit a different (new) structure to self-present a new simple operation (Fingelkurts et al., 2013).



This scheme is based on data published in Fingelkurts et al., 2012a.

Figure 1. Schematic representation of the expression of consciousness as a function of neuronal assembly size and life-span. The size and life-span of neuronal assemblies are indicated by the Y-axis; the X-axis represents the category of subjects with different expression of consciousness. Notice that vigilance level is comparable (nearly identical) between these three conditions (not shown). The vigilance is defined as a state of arousal or tonic alertness (Head, 1923).



The figure is adopted from Fingelkurts, 1998.

Figure 2. Dynamics of RTPs as a function of cognitive task switching. The Y-axis represents the number of RTPs in % from the total number of observations in all trials. The X-axis marks the three stages of cognitive task: Stage I – anticipation of the visual image, Stage II – presentation of the image and its memorization, Stage III – retention of the image in the mind without external presentation. RTP – rapid transitional process.

Cognitively, RTP could be interpreted as the *breakpoints of involuntary (bottom-up) attention* leading to an attentional disengagement, shift, and allocation to a new operation. In

this sense it could be interpreted as a self-organized (Rabinovich et al., 2013) innate attentional mechanism (J. Mandler, 2010) that is 'used' by the brain to place self-presented entities of available information in relation to one another (Marchetti, 2012; Duncan, 2013). Indeed, most RTPs are seen, for example, at the boundary between perceived events, for example at the transition between one movement and the next in a visual scene or auditory stimuli (Fingelkurts, 1998; Fingelkurts et al., 2003; Kaplan and Borisov, 2003) or associated with the major change of cognitive context required in task switching (Figure 2; for an overview, see Fingelkurts and Fingelkurts, 2015).

Using the conceptualization presented above we can give a more detailed description of how involuntary (or bottom-up) attention arises from self-organized behavior of neuronal assemblies. When a particular sensory stimulus appears, neurons that are sensitive to that stimulus (either due to phylogenetic or ontogenetic constrains) get self-activated and start to act synchronously (indicating emergence of a transient functional neuronal assembly), collectively forming a local common 3D-field that cognitively self-presents the perceived stimulus. This process constitutes the automatic attention and it can be experimentally assessed in the orientation reaction[3] (Sokolov, 1963; Luria, 1973). The shifts between stimuli are reflected in a frame-like dynamics of the correspondent local 3D-field, where the RTPs between the frames indicate the breakpoints of automatic (bottom-up) attention. In humans such frame-like sequences (or microstates) represent the basic building blocks of mentation, i.e. the basic elements of conscious thinking and imagination (Lehmann et al., 1998; Benedetti et al., 2010; Fingelkurts et al., 2012b).

Neurons within the neuronal assembly that receive a transitory suprathreshold stimulus will continue to fire for some period of time if they are properly biased (or preferentially primed) by another source of subthreshold excitatory input, – either through *arousal* (mesencephalic reticular formation and thalamus; Kinomura et al., 1996; Steriade, 1997; Kang et al., 2005; Sarter et al., 2006), or *affective reinforcement* (limbic system; Pribram and McGuinness, 1975; Damasio, 1994). It has been shown experimentally that the thalamic intralaminar nuclei and the mesencephalic reticular formation, together with their connections to the thalamic reticular nucleus, play a key role in linking arousal states to the control of moment-to-moment attentional gating (Llinas et al., 2002; Minamimoto and Kimura, 2002; Wyder et al., 2004). We argue that these brain structures (responsible for the arousal states) determine the duration of simple operations that could be executed by local transient neuronal assemblies in the cortex and thus affect the sequences of event or scene segmentation. If such durations get extremely short (leading to inattention, hyperactivity, and impulsivity) (Ivanov et al., 2010; López Hill and Scorza, 2012) or, on the contrary, very long (as during so-called 'absorption' or 'attentional inertia' – a state of attention, fully engaging one's representational resources, which results in imperviousness to distracting events; Tellegen and Atkinson, 1974; Anderson and Lorch, 1983), one may imagine that the proper dynamics of automatic attention could not be supported and both scenarios will lead to a malfunctioning and maladaptive behavior.

As an illustration of the affective reinforcement, we bring an example from Noack (2012, p. 1058): "if an animal is hungry, its salience network sends signals to the neocortex that

[3] The orienting reaction or response is an involuntary shift of attention that appears to be a fundamental biological mechanism for survival. It is a rapid response to a new, unexpected, or unpredictable stimulus, which essentially functions as a 'what-is-it' detector (Friedman et al., 2001).

serve to trigger wave packets and category attractors there related to food items. If the animal is in estrus, the salience network sends signals that serve to trigger wave packets related to conspecifics, and so on. In the former example, it can be said that the animal manifests a hunger attractor landscape. In the latter example, the animal manifests a copulation attractor landscape. Thus, an animal manifesting a hunger attractor landscape will ordinarily find itself interacting with food items, such as bananas, since that interaction is facilitated and, therefore, reinforced […]. Similarly, an animal not manifesting a hunger-related attractor landscape may find itself largely ignoring food items since their representation […] is not reinforced. To put it simply, the current, cortical attractor landscape an animal manifests at any given moment reflects the current needs, drives, and motivation of the animal as governed by the current state of its salience network."

Here we come closely to the next level of brain operational architectonics, where the voluntary or top-down attention emerges. This type of attention will be looked at in the next section.

3. VOLUNTARY (TOP-DOWN) ATTENTION

At the macro-level of brain operational architectonics, the electromagnetic brain field is dominated by self-organized and transitory spatio-temporal patterns (operational modules) formed by synchronized local 3D-fields that are generated by spatially dispersed local neuronal assemblies (Fingelkurts and Fingelkurts, 2001, 2015; Fingelkurts et al., 2010). As it has been mentioned in the Introduction section, individually, each neuronal assembly presents only a partial aspect of the whole object/scene/thought/concept, while the wholeness of 'perceived' or 'imagined' is brought into existence by joint (synchronized) operations of many functional and transient neuronal assemblies in the brain (for a thorough discussion, see Bressler and McIntosh, 2007; Fingelkurts et al., 2009, 2010; Baldauf, 2010). Because the beginning-and-end of discrete operations performed by local neuronal assemblies are marked by sharp changes (RTPs) in local EEG fields, the simultaneous occurrence of these RTPs throughout different local EEG signals within a multichannel EEG recording could provide evidence of synchronization of neuronal assemblies (located in different brain areas) that participate in the same functional act as a group – operational module (OM), e.g. executing a particular complex operation responsible for a subjective self-presentation of complex objects, scenes, concepts or thoughts (Fingelkurts and Fingelkurts, 2001; Fingelkurts et al., 2009, 2010). Any single OM thus signifies the binding of multiple sensory percepts or motor programs in a context-dependent way as a function of a saliency, priori knowledge and expectancies. It somehow 'freezes', and 'classifies' the ever changing and multiform stream of our cognition and conscious experiences (Fingelkurts et al., 2010, 2013). Such classification is a signature of a *top-down focused attention* (Rabinovich et al., 2013). Metaphorically speaking, it acts as a mental magnifying lens that keeps our consciousness focused at the attended object or scene and leads to a more veridical perceptual presentation (Prinzmetal et al, 2009).

The main feature of voluntary attention is that we can attract it by will to any perceived or imagined object, scene or thought with respect to the meanings that are stored in our mind. This means that semantic orientation provides individuals with the ability to selectively attend

to sensory information as well as 'higher order information', such as language, mathematics, and abstract categories (Klimesch, 2012). How is this process guided in the brain operational architecture?

Overwhelming experimental studies provide evidence that voluntary attention involves a particular net of cortical areas (mostly frontal and parietal areas) that together constitute the so-called 'seat' of top-down attentional signals (Dehaene et al., 1998; Daffner et al., 2003; Machinskaya, 2003; Posner et al., 2006; Buschman and E. K. Miller, 2007; Li et al., 2010; Tsuchiya et al., 2012). We argue that through feedback into thalamic intralaminar nuclei and the mesencephalic reticular formation, as well as limbic system, these top-down attentional signals modify the sequences of RTPs in the dynamics of the activity of local transient neuronal assemblies; and in doing so select a cortical OM that matches the working memory content and is most appropriate for performing a cognitive task or driving a behavior during the present moment.

Simultaneously, top-down attentional signals dynamically and transiently block (or inhibit) formation of other OMs that are unrelated to a specific cognitive task or behavior at this present moment (Dodds et al., 2011). From this perspective, using the words of Rabinovich et al. (2013), top-down attention "can be viewed as a higher-order process that emerges from the interactions of complex dynamical modes (structures) that are functionally united by a common cognitive task". In other words, this fronto-parietal network of brain areas serves as an order parameter[4] (Noack, 2012).

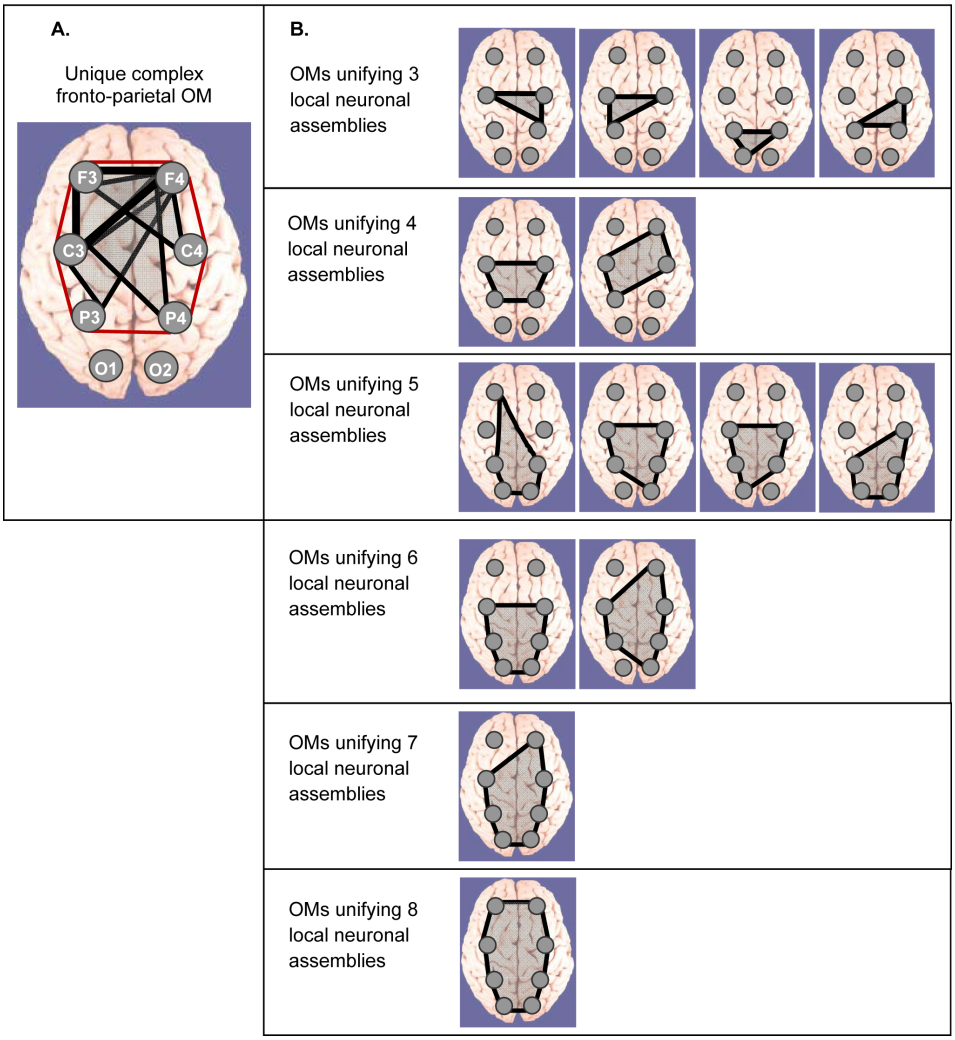
Our own studies have shown that top-down attentional signals that serve as so-called order parameters are indeed represented by an *unique complex* OM that involves several frontal and parietal *simpler* OMs (Fingelkurts, 1998). This fronto-parietal OM was specifically presided over cortical dynamics each time a subject had to explicitly and voluntary concentrate his/her attention (Figure 3 A). At the same time tasks that involved attention only implicitly[5], but were dominated by the particular cognitive task or visual image, were characterized by multitude of different OMs that were specific to these concrete cognitive tasks or images (Figure 3 B; Fingelkurts, 1998). These data confirm the governing role of the specific top-down attentional OM in the voluntary shifts of attention.

Importantly, the frontal component within this unique complex OM was always dominant in comparison with other cortical areas that constituted this OM (see thick-lined frontal simple OM in Figure 3 A). It is well-known that frontal cortical areas represent general polymodal gestalts and mental attributes that many consider to be uniquely human, such as symbolic thought, language, and creativity (Noack, 2012). Since the frontal areas increase in size in the phylogeny (in a primitive prosimian primate the ratio of frontal cortex to total cortex is only 8.5%, in the macaque monkey it is 11.5%, and in the chimpanzee, it rises to 17%) (Changeux, 2004; see also Goldberg, 2001; Fuster, 2002) and reach their maximum in modern humans (the ratio of frontal cortex to total cortex is the largest among the mammals – more than 30%, almost a full third of the total amount of neocortex) (Changeux, 2004), it is of no surprise that humans master voluntary attention as no other animal (including primates) can do.

[4] In general terms, order parameter means the parameter that determines (or enslaves) the behavior of individual parts of a system at the subordinate level (Haken, 1977, 2004; Freeman and Vitiello, 2009).

[5] By 'implicitly' we mean here that the dominant task, which the subject needs to perform, was not of an attentional kind.

Essentially, humans alone possess the ability to internally direct their attention to combine symbols in an essentially unlimited and temporally extended fashion which can be independent of external training or presence of actual stimuli-objects in the external environment (Yufik, 2002; Noack, 2012). Though some 'animal-cognition'-oriented researchers have repeatedly tried to demonstrate such internal skill to voluntary attention in non-human mammals (Preuss, 2006), all such attempts have failed to do so (Terrace et al., 1979; Povinelli and Bering, 2002; Rivas, 2005; Preuss, 2006; Gazzaniga, 2008; Penn et al., 2008).



The figure is adopted from Fingelkurts, 1998.

Figure 3. Unique (A) and specific (B) OMs during cognitive tasks (indexed by synchrony of operations executed by different neuronal assemblies). The most frequent/representative OMs, that occurred (i) in the largest number of repetitions (in %) across all trials and (ii) more than in 80% of EEGs, are mapped onto schematic brain maps as connecting lines between the EEG channels involved. Grey shapes are used for easier visual representation and are indicative of simple OMs. Red line marks a complex OM. OM – operational module.

4. INTEGRATION OF TWO MODES OF ATTENTION (INVOLUNTARY AND VOLUNTARY)

We start this section with the description of involuntary bottom-up attention processes, since they are biologically successful and continue to be the primary functional mechanism of attention utilized in every mammalian species (including humans) alive today. The self-emergence of bottom-up attention has several stages. In the first stage, a particular simple sensory stimulus automatically triggers the activation of those neurons that are sensitive (due to phylogenetic and ontogenetic predispositions) to that concrete stimulus. At second stage, the collective behavior of these neurons leads to the formation of a transient neuronal assembly emitting the local 3D-field. This 3D-field self-presents sensory information.

Which set of neurons will respond at any given temporal moment depends on the arousal and reinforcement brain systems (Borisyuk and Kazanovich, 2004). This bottom-up attention allows selecting locations in space, instants in time, or modality-specific inputs.

Complexity of the stimulus is represented by the coupling of several 3D-fields (responsible for the separate simple features) within the unified operational module (OM) that self-presents an already polymodal gestalt – the meaning and significance of that complex stimulus to that particular organism (Fingelkurts et al., 2010). In other words, within the OM's activity the components of an attentional episode are bound together, constructing the specific conjunction of processing events fulfilling the current behavioral requirements. Thus, the emergence of an OM indicates the appearance of attentional focus (top-down attention), that serves to (i) preferentially prime the neuronal assemblies that are included in the given OM (using the arousal and reinforcement systems of the brain) and (ii) instruct or trigger an associated motor behavior (see large, blue arrow that starts from the frontal lobe and goes to the parietal-occipital ones at the Figure 4 A,B). This top-down attention allows the selection, modulation, maintenance and order of internally generated information (e.g., task rules, responses, short-term or long-term memories). It is at this stage that animals and humans diverge.

In animals, at this final stage, the overt motor behavior triggered by the OM changes the proximate sensory environment of the animal as well as the activity of reinforcement system in the brain; these changes together present new sensory stimuli to the animal. This new sensory stimulation then starts the next cycle in the loop, and so on (Figure 4 A). Thus, in animals the bottom-up attention dominates.

In humans, due to an anatomical and functional organization of the brain (see the previous section), OMs dominate the neurodynamics of the brain leading to a symbolic thought, language, creativity, self-awareness, and even consciousness (Fingelkurts et al., 2013). This unique property allows the human brain to voluntary concentrate its attention on specific stimulus or task without the actual presence of stimuli-objects in the external environment in order to manipulate them and also to construct uniquely novel behaviors without external training (Figure 4 B). Thus, in humans the top-down attention dominates and serves as a *dynamic bridge* between arousal and the content of consciousness. At the same time, some stimuli acquired high importance (intrinsic value) during the course of evolution, so that even in humans, when present, they immediately switch the attentional dominance to an automatic (bottom-up) mechanism that, even when the stimulus event is unrelated to the current goal-directed activity, usually interrupts the current voluntary (top-down) attention

(Figure 4 A). For example, a sudden onset of motion, such as a moving car, turn of the head or hand movement, automatically capture attention of the person in a stimulus-driven manner (Levin and Varakin, 2004; Buschman and E. K. Miller, 2010).

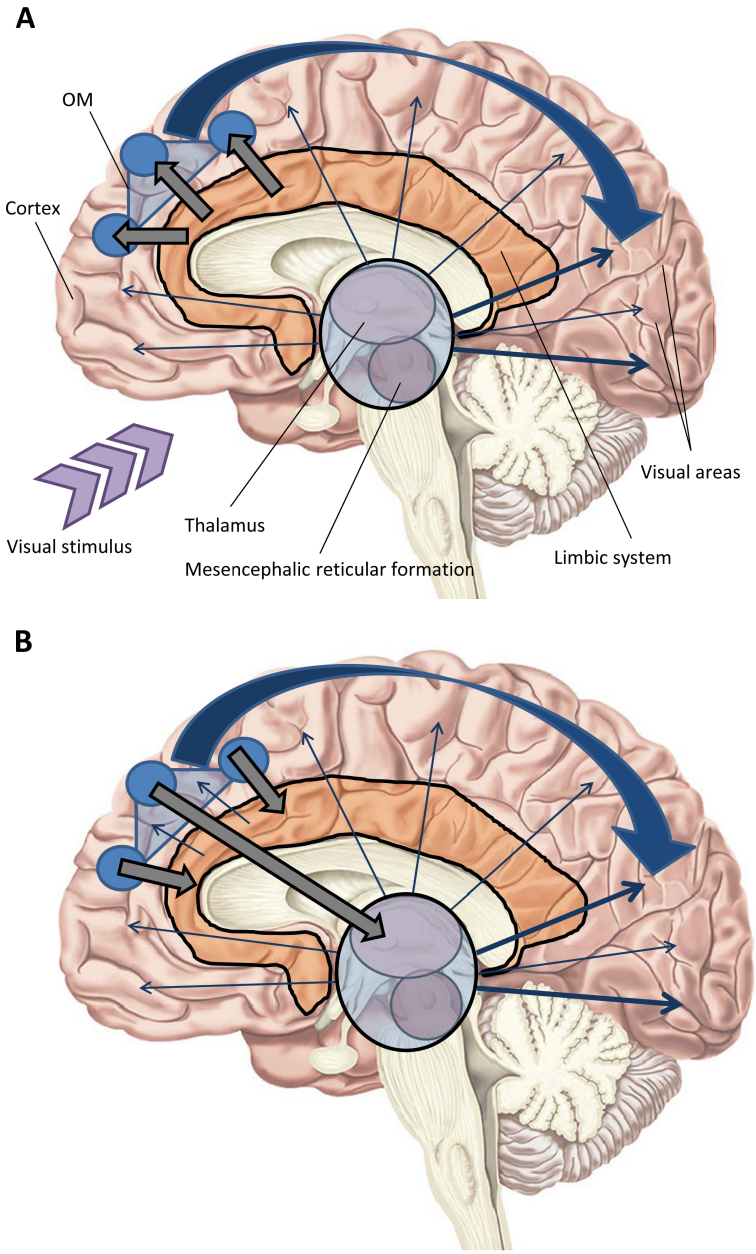


Figure 4. Simplified schematic representation of bottom-up (A) and top-down (B) attention processes in the brain. As an example, processes related to a visual stimulus (or image) are shown. OM – operational module. Arrows indicate activated influences/reinforcement/priming. Different thickness of arrows represents different strength of influences. Further explanations are provided in the text. Large, blue arrow that starts from the frontal lobe and goes to the parietal-occipital ones indicates the appearance of attentional focus, that serves to either instruct or trigger an associated motor behavior or preferentially prime the neuronal assemblies that are included in the given OM (using the arousal and reinforcement systems of the brain).

CONCLUSION

Even though the subject of attention has a long history in the philosophical studies and neurobiological research, it still poses a serious problem when one considers the whole multitude of phenomena associated with it and attempts to understand its neurophysiological mechanisms. In this chapter we tried to conceptualize attention within the theory of Operational Architectonics of brain and mind functioning (Fingelkurts and Fingelkurts, 2001; Fingelkurts et al., 2010, 2013). Our analysis has shown that involuntary (bottom-up) attention arises as a result of self-organized formation of neuronal assemblies whose operations are divided by rapid transients that signify the breakpoints of attention. The duration of these operations is determined by external stimuli and modulated by arousal as well as affective reinforcement. Voluntary (top-down) attention emerges due to a binding of multiple operations responsible for sensory percepts or motor programs in a context-dependent way as a function of a saliency, priori knowledge and expectancies. During this process, the ever changing and multiform stream of our cognition and conscious experiences is somehow 'frozen' and 'classified', thus representing focused attention. The skill to voluntary attract attention to a specific image, object or thought is guided by a specific fronto-parietal operational module that serves as an order parameter and determines which particular operational module of cortical dynamics should be reinforced at any given moment of time in order to present a particular image, object or thought in the focus of attention.

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REFERENCES

Allegrini, P., Menicucci, D., Bedini, R., Fronzoni, L., Gemignani, A., Grigolini, P. et al. (2009). Spontaneous brain activity as a source of ideal 1/f noise. *Physical Review E,* 80, 061914.

Allegrini, P., Paradisi, P., Menicucci, D. and Gemignani, A. (2010). Fractal complexity in spontaneous EEG metastable-state transitions: new vistas on integrated neural dynamics. *Frontiers in Physiology*, 1, 128.

Anderson, D. R. and Lorch, E. P. (1983). "Looking at television: Action or reaction?" In: J. Bryant, and D. R. Anderson (Eds.), Children's Understanding of Television: Research on Attention and Comprehension. New York: Academic Press, 1-34.

Annila, A. (2010). All in action. *Entropy*, 12, 2333–2358.

Bak, P. (1996). How Nature Works: The Science of Self-Organized Criticality. New York: Springer.

Baldauf, D. (2010). Binding into sequence: Temporal dynamics of sequential movements modulate the attentional pre-selection of subsequent goals. *Journal of Vision,* 9, 255–255.

Benedetti, G., Marchetti, G., Fingelkurts, Al. A. and Fingelkurts, An. A. (2010). Mind operational semantics and brain operational architectonics: A putative correspondence. *The Open Neuroimaging Journal,* 4, 53-69.

Borisyuk, R. M. and Kazanovich, Y. B. (2004). Oscillatory model of attention-guided object selection and novelty detection. *Neural Networks,* 17, 899-915.

Bressler, S. L. and McIntosh, A. R. (2007). "The role of neural context in large-scale neurocognitive network operations". In: V.K. Jirsa, and A.R. McIntosh, (Eds.), Handbook of Brain Connectivity. Springer, 403–419.

Buschman, T. J. and Miller, E. K. (2007). Top-down versus bottom-up control of attention in the prefrontal and posterior parietal cortices. *Science,* 315, 1860–1862.

Buschman, T. J. and Miller, E. K. (2010). Shifting the spotlight of attention: evidence for discrete computations in cognition. *Frontiers in Human Neuroscience,* 4, 194.

Buzsaki, G. (2004). Large-scale recording of neuronal ensembles. *Nature Neuroscience,* 7, 446–451.

Buzsaki, G. (2006). Rhythms of the Brain. Oxford: Oxford University Press.

Chalmers, D. (1995). Facing up to the problem of consciousness. *Journal of Consciousness Studies,* 2, 200-219.

Changeux, J. P. (2004). The Physiology of Truth: Neuroscience and Human Knowledge. Cambridge, MA: Belknap Press.

Chialvo, D. R. (2010). Emergent complex neural dynamics. *Nature Physics,* 6, 744–750.

Collins Essential English Dictionary. (2006). 2nd ed. Harper Collins Publishers.

Corchs, S. and Deco, G. (2001). A neurodynamical model for selective visual attention using oscillators. *Neural Networks,* 14, 981-990.

Daffner, K. R., Scinto, L. F. M., Weitzman, A. M., Faust, R., Rentz, D. M., Budson, A. E. and Holcomb, P. J. (2003). Frontal and parietal components of a cerebral network mediating voluntary attention to novel events. *Journal of Cognitive Neuroscience,* 15, 294-313.

Damasio, A. R. (1994). Descartes' Error: Emotion, Reason, and the Human Brain. New York: Putnam.

Dehaene, S., Kerszberg, M. and Changeux, J. P. (1998). A neuronal model of a global workspace in effortful cognitive tasks. *Proceedings of the National Academy of Sciences of the United States of America,* 95, 14529–14534.

Dodds, C. M., Morein-Zamir, S. and Robbins, T. W. (2011). Dissociating inhibition, attention, and response control in the frontoparietal network using functional magnetic resonance imaging. *Cerebral Cortex,* 21, 1155–1165.

Duncan, J. (2013). The structure of cognition: Attentional episodes in mind and brain. *Neuron,* 80, 35-50.

Feinberg, T. E. (2000). The nested hierarchy of consciousness: a neurobiological solution to the problem of mental unity. *Neurocase,* 6, 75–81.

Fingelkurts, An. A. (1998). Temporal–Spatial Organization of Human EEG Segment's Structure. Ph.D. dissertation. Moscow, Russian Federation: Moscow State University, 401 p [in Russian].

Fingelkurts, An. A. and Fingelkurts, Al. A. (1995). Microstructural Analysis of Active Brain EEG: General Characteristics and Synchronization Peculiarities of Change-Point Pprocess. Diploma project. Moscow, Russian Federation: Moscow State University, 207 p [in Russian].

Fingelkurts, An. A. and Fingelkurts, Al. A. (2001). Operational Architectonics of the human brain biopotential field: Towards solving the mind-brain problem. Brain and Mind, 2, 261–296.

Fingelkurts, An. A. and Fingelkurts, Al. A. (2006). Timing in cognition and EEG brain dynamics: discreteness versus continuity. *Cognitive Processing,* 7, 135–162.

Fingelkurts, An. A. and Fingelkurts, Al. A. (2008). Brain-mind Operational Architectonics imaging: Technical and methodological aspects. *The Open Neuroimaging Journal,* 2, 73-93.

Fingelkurts, An. A. and Fingelkurts, Al. A. (2010). Alpha rhythm operational architectonics in the continuum of normal and pathological brain states: current state of research. *International Journal of Psychophysiolpgy,* 76, 93–106.

Fingelkurts, An. A. and Fingelkurts, Al. A. (2015). "Operational Architectonics methodology for EEG analysis: Theory and results". In: V. Sakkalis (Ed.), Electroencephalographic Assessment Techniques: Theory and Applications. NEUROMETHODS book series. Springer, Vol. 91, pp. 1-59.

Fingelkurts, An. A., Fingelkurts, Al. A. and Neves, C. F. H. (2009). Phenomenological architecture of a mind and operational architectonics of the brain: the unified metastable continuum. *New Mathematics and Natural Computation*, 5, 221–244.

Fingelkurts, An. A., Fingelkurts, Al. A. and Neves, C. F. H. (2010). Natural world physical, brain operational, and mind phenomenal space–time. *Physics of Life Reviews,* 7, 195–249.

Fingelkurts, An. A., Fingelkurts, Al. A. and Neves, C. F. H. (2013). Consciousness as a phenomenon in the operational architectonics of brain organization: Criticality and self-organization considerations. *Chaos, Solitons and Fractals*, 55, 13–31.

Fingelkurts, An. A., Fingelkurts, Al. A., Krause, C. M., Möttönen, R. and Sams, M. (2003). Cortical operational synchrony during audio–visual speech integration. *Brain and Language*, 85, 297–312.

Fingelkurts, An. A., Fingelkurts, Al. A., Bagnato, S., Boccagni, C. and Galardi, G. (2012a). Toward operational architectonics of consciousness: Basic evidence from patients with severe cerebral injuries. *Cognitive Processing*, 13, 111–131.

Fingelkurts, Al. A., Fingelkurts, An. A., Bagnato, S., Boccagni, C. and Galardi, G. (2012b). EEG oscillatory states as neuro-phenomenology of consciousness as revealed from patients in vegetative and minimally conscious states. *Consciousness and Cognition,* 21, 149–169.

Freeman, W. J. (1975). Mass Action in the Nervous System. New York: Academic Press.

Freeman, W. J. (2007). Indirect biological measures of consciousness from field studies of brains as dynamical systems. *Neural Networks,* 20, 1021–1031.

Freeman, W. J. and Vitiello, G. (2006). Nonlinear brain dynamics as macroscopic manifestation of underlying many-body field dynamics. *Physics of Life Reviews,* 3, 93–118.

Friedman, D., Cycowicz, Y. M. and Gaeta, H. (2001). The novelty P3: an event-related brain potential (ERP) sign of the brain's evaluation of novelty. *Neuroscience and Biobehavioral Reviews,* 25, 355–373.

Fuster, J. M. (2002). Frontal lobe and cognitive development. *Journal of Neurocytology,* 3–5, 373–385.

Gazzaniga, M. (2008). Human: The Science Behind What Makes Us Unique. New York: Harper Collins.

Goldberg, E. (2001). The Executive Brain. Oxford: Oxford University Press.

Haken, H. (1977). Synergetics. An Introduction. Berlin: Springer.

Haken, H. (2004). Synergetics. Introduction and Advanced Topics. Berlin: Springer.

Hansotia, P. (2003). A neurologist looks at mind and brain: "The enchanted loom". *Clinical Medicine and Research*, 1, 327–332.

Head, H. (1923). The conception of nervous and mental energy. II. Vigilance: a physiological state of the nervous system. *British Journal of Psychology*, 14, 126-147.

Itti, L. and Koch, C. (2000). A saliency-based search mechanism for overt and covert shifts of visual attention. *Vision Research*, 40, 1489-1506.

Ivanov, I., Bansal, R., Hao, X., Zhu, H., Kellendonk, C., Miller, L. et al. (2010). Morphological abnormalities of the thalamus in youths with attention deficit hyperactivity disorder. *American Journal of Psychiatry*, 167, 397-408.

James, W. (1890/1981). The Principles of Psychology. Cambridge, MA: Harvard University Press.

Jensen, H. J. (1998). Self-Organized Criticality: Emergent Complex Behavior in Physical and Biological Systems. Cambridge: Cambridge University Press.

John, E. R. (2002). The neurophysics of consciousness. *Brain Research. Brain Research Reviews*, 39, 1–28.

Kang, K., Williams, L. M., Hermens, D. and Gordon, E. (2005). Neurophysiological markers of contextual processing: The relationship between P3b and Gamma synchrony and their modulation by arousal, performance and individual differences. *Cognitive Brain Research*, 25, 472–483.

Kaplan, A. Ya. and Borisov, S. V. (2003). Dynamic properties of segmental characteristics of EEG alpha activity in rest conditions and during cognitive load. *Zhurnal Vyssheĭ Nervnoĭ Deiatelnosti imeni IP Pavlova*, 53, 22–32. [in Russian].

Kaplan, A. Ya., Fingelkurts, An. A., Fingelkurts, Al. A., Borisov, S. V. and Darkhovsky, B. S. (2005). Nonstationary nature of the brain activity as revealed by EEG/MEG: methodological, practical and conceptual challenges. *Signal Processing*, 85, 2190–2212.

Kelso, J. A. S. (2012). Multistability and metastability: understanding dynamic coordination in the brain. *Philosophical Transactions of the Royal Society B*, 367, 906–918.

Kinomura, S., Larssen, J., Gulyas, B. and Roland, P. E. (1996). Activation by attention of the human reticular formation and thalamic intralaminar nuclei. *Science*, 271, 512-515.

Klimesch, W. (2012). Alpha-band oscillations, attention, and controlled access to stored information. *Trends in Cognitive Sciences*, 16, 606-617.

Koch, C. and Ullman, S. (1985). Shifts in selective visual attention - towards the underlying neural circuitry. *Human Neurobiology*, 4, 219-227.

Kozma, R. and Freeman, W. J. (2001). Chaotic resonance: Methods and applications for robust classification of noisy and variable patterns. *International Journal of Bifurcation and Chaos*, 10, 2307-2322.

Lehmann, D., Strik, W. K., Henggeler, B., Koenig, T. and Koukkou, M. (1998). Brain electric microstates and momentary conscious mind states as building blocks of spontaneous thinking: I. Visual imagery and abstract thoughts. *International Journal of Psychophysiology*, 29, 1–11.

Levin, D. T. and Varakin, D. A. (2004). No pause for a brief disruption: Failures of visual awareness during ongoing events. *Consciousness and Cognition,* 13, 363–372.

Li, L., Gratton, C., Yao, D. and Knight, R. T. (2010). Role of frontal and parietal cortices in the control of bottom-up and top-down attention in humans. *Brain Research*, 1344, 173–184.

Llinas, R. R., Leznik, E. and Urbano, F. J. (2002). Temporal binding via cortical coincidence detection of specific and nonspecific thalamocortical inputs: a voltage-dependent dyeimaging study in mouse brain slices. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 449–454.

Lokhorst, G.-J. "Descartes and the pineal gland". In: E. N. Zalta (Ed.), The Stanford Encyclopedia of Philosophy (Fall 2013 Edition), URL = http://plato.stanford.edu/archives/fall2013/entries/pineal-gland/

López Hill, X. and Scorza, M. C. (2012). Role of the anterior thalamic nucleus in the motor hyperactivity induced by systemic MK-801 administration in rats. *Neuropharmacology,* 62, 2440-2446.

Luria, A. R. (1973). The Working Brain. New York: Basic Books.

Macaluso, E. and Doricchi, F. (2013). Attention and predictions: control of spatial attention beyond the endogenous-exogenous dichotomy. *Frontiers in Human Neuroscience*, 7, 685.

Machinskaya, R. I. (2003). Neurophysiological mechanisms of voluntary attention: A review. *Zhurnal Vyssheĭ Nervnoĭ Deiatelnosti imeni IP Pavlova,* 53, 133-150.

Mandler, J. M. (2010). The spatial foundations of the conceptual system. *Language and Cognition*, 2, 21-44.

Marchetti, G. (2012). "How consciousness builds the subject through relating". In: R. J. Jenkins and W. E. Sullivan (Eds.), Philosophy of Mind. Nova Science Publishers, Inc., 37-69.

Minamimoto, T. and Kimura, M. (2002). Participation of the thalamic CM-Pf complex in attentional orienting. *Journal of Neurophysiology*, 87, 3090–3101.

Nasuto, S. J., Dautenhahn, K. and Bishop, M. (1999). "Communication as an emergent metaphor for neuronal operation". In: C. L. Nehaniv (Ed.). Computation for Metaphors, Analogy, and Agents. Heidelberg: Springer-Verlag, 365–379.

Niebur, E. and Koch, C. (1998). "Computational architecture for attention". In: R. Parasuraman (Ed.), The Attentive Brain. Cambridge, MA: The MIT Press, 163-186.

Noack, R. A. (2006). The frontal feedback model of the evolution of the human mind: Part 1. The "pre"-human brain and the perception-action cycle. *Journal of Mind and Behavior*, 27, 247–274.

Noack, R. A. (2012). Solving the "human problem": The frontal feedback model. *Consciousness and Cognition*, 21, 1043–1067.

Nunez, P. L. (2000). Toward a quantitative description of large-scale neocortical dynamic function and EEG. *The Behavioral and Brain Sciences*, 23, 371–398.

Nunez, P. L. and Srinivasan, R. (2006). A theoretical basis for standing and traveling brain waves measured with human EEG with implications for an integrated consciousness. *Clinical Neurophysiology*, 117, 2424–2435.

Paradisi, P., Allegrini, P., Gemignani, A., Laurino, M., Menicucci, D. and Piarulli, A. (2012). Scaling and intermittency of brain events as a manifestation of consciousness. *American Institute of Physics Conference Proceedings*, 1510, 151–161.

Penn, D. C., Holyoak, K. J. and Povinelli, D. J. (2008). Darwin's mistake: Explaining the discontinuity between human and nonhuman minds. *Behavioral and Brain Sciences,* 31, 109–130.

Perlovsky, L. I. and Kozma, R. (2007). "Neurodynamics of Cognition and Consciousness". In: L. I. Perlovsky and R. Kozma (Eds.), Neurodynamics of Cognition and Consciousness. Heidelberg, Germany: Springer Verlag, editorial.

Posner, M. I., Sheese, B. E., Odludas, Y. and Tang, Y. (2006). Analyzing and shaping human attentional networks. *Neural Networks,* 19, 1422–1429.

Povinelli, D. J. and Bering, J. M. (2002). The mentality of apes revisited. *Current Directions in Psychological Science,* 11, 115–119.

Preuss, T. M. (2006). Who's afraid of Homo sapiens? *Journal of Biomedical Discovery and Collaboration,* 1, 17; doi:10.1186/1747-5333-1-17

Pribram, K. H. and McGuinness, D. (1975). Arousal, activation, and effort in the control of attention. *Psychological Review,* 82, 116-149.

Prinzmetal, W., McCool, C. and Park, S. (2005). Attention: Reaction time and accuracy reveal different mechanisms. *Journal of Experimental Psychology: General,* 134, 73–92.

Prinzmetal, W., Zvinyatskovskiy, A., Gutierrez, P. and Dilem, L. (2009). Voluntary and involuntary attention have different consequences: The effect of perceptual difficulty. *The Quarterly Journal of Experimental Psychology,* 62, 352–369.

Pulvermueller, F., Preissl, H., Eulitz, C., Pantev, C., Lutzenberger, W., Elbert T, et al. (1994). Brain rhythms, cell assemblies and cognition: evidence from the processing of words and pseudowords. *Psycoloquy,* 5(48), brain-rhythms.1.pulvermueller.

Putilov, D. A., Verevkin, E. G., Donskaya, O. and Putilov, A. A. (2007). Segmental structure of alpha waves in sleep-deprived subjects. *Somnologie,* 11, 202–210.

Rabinovich, M., Huerta, R. and Laurent, G. (2008). Neuroscience. Transient dynamics for neural processing. *Science,* 321, 48–50.

Rabinovich, M., Tristan, I. and Varona, P. (2013). Neural dynamics of attentional cross-modality control. *PLoS ONE,* 8(5), e64406. doi:10.1371/journal.pone.0064406

Rivas, E. (2005). Recent use of signs by chimpanzees (Pan troglodytes) in interactions with humans. *Journal of Comparative Psychology,* 119, 404–417.

Sarter, M., Gehring, W. J. and Kozak, R. (2006). More attention must be paid: The neurobiology of attentional effort. *Brain Research Reviews,* 51, 145–160.

Schöner, G. and Kelso, J. A. (1988). Dynamic pattern generation in behavioral and neural systems. *Science,* 239, 1513-1520.

Seeley, W. W., Menon, V., Schatzberg, A. F., Keller, J., Glover, G. H., Kenna, H. et al (2007). Dissociable intrinsic connectivity networks for salience processing and executive control. *Journal of Neuroscience,* 27, 2349–2356.

Shields, C. (2011). "Aristotle's psychology". In: E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Summer 2011 Edition), URL = http://plato.stanford.edu/archives/spr2011/entries/aristotle-psychology/

Silverman, A. (2012). "Plato's middle period metaphysics and epistemology". In E. N. Zalta (Ed.), The Stanford Encyclopedia of Philosophy (Summer 2012 Edition), URL = http://plato.stanford.edu/archives/sum2012/entries/plato-metaphysics/

Singer, W. (2001). Consciousness and the binding problem. *Annals of the New York Academy of Sciences,* 929, 123–146.

Sokolov, E. N. (1963). Perception and the Conditioned Reflex. Oxford: Pergamon Press.

Steriade, M. (1997). "Thalamic substrates of disturbances in states of vigilance and consciousness in humans". In: M. Steriade, E. G. Jones, and D. A. McCormick (Eds.), Thalamus. Vol II. Amsterdam: Elsevier, 721-742.

Tellegen, A. and Atkinson, G. (1974), Openness to absorbing and self-altering experiences ('absorption'), a trait related to hypnotic susceptibility. *Journal of Abnormal Psychology*, 83, 268–277.

Terrace, H. S., Petitto, L. A., Sanders, R. J. and Bever, T. G. (1979). Can an ape create a sentence? *Science*, 206, 891–902.

Tsuchiya, N., Block, N. and Koch, C. (2012). Top-down attention and consciousness: comment on Cohen et al. *Trends in Cognitive Sciences*, 16, 527.

Tsuda, I. (2001). Towards an interpretation of dynamic neural activity in terms of chaotic dynamical systems. *Behavioral and Brain Sciences*, 24, 793-810.

Verevkin, E., Putilov, D., Donskaya, O. and Putilov, A. (2007). A new SWPAQ's scale predicts the effects of sleep deprivation on the segmental structure of alpha waves. *Biological Rhythm Research*, 39, 21–37.

Watzl, S. (2011). "Attention as structuring of the stream of consciousness". In: C. Mole, D. Smithies, and W. Wu (Eds.), Attention: Philosophical and Psychological Essays. New York: Oxford University Press, 145-173.

Wu, W. (2011). "Attention as selection for action". In: C. Mole, D. Smithies, and W. Wu (Eds.), Attention: Philosophical and Psychological Essays. New York: Oxford University Press, 97-116.

Wyder, M. T., Massoglia, D. P. and Stanford, T. R. (2004). Contextual modulation of central thalamic delay-period activity: representation of visual and saccadic goals. *Journal of Neurophysiology*, 91, 2628–2648.

Yufik, Y. M. (2002). How the mind works: An exercise in pragmatism. *Neural Networks*, 3, 2265–2269.

Yufik, Y. M. (2013). Understanding, consciousness and thermodynamics of cognition. *Chaos, Solitons and Fractals*, 55, 44–59.

Zacks, J. M. (2010). How we organize our experience into events. *Psychological Science Agenda*, 24(4), http://www.apa.org/science/ about/psa/2010/04/sci-brief.aspx

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Chapter 6

ATTENTION AND THE EXPERIENCE OF LANGUAGE

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ABSTRACT

Attention and language mutually determine each other. Therefore, any large-scale theory of language should be rooted in the human attention system. This chapter explores the relationship between attention, language, and discourse. This chapter advocates a view of the human attention system as a tripartite scheme of the signaling, selecting, and interpersonalizing dimensions of language. This contribution presents in broad outline an array of language phenomena as attention phenomena.

1. INTRODUCTION: A COLLECTOR'S CONCEIT

Our subject begins with a curious experience that happened as I toured the famous Frick Gallery on East 70th Street, overlooking Fifth Avenue and Central Park in New York City. As I entered the Living Hall, an oak paneled room at the center of the gallery housing some of Henry Clay Frick's most famous acquisitions, and oriented myself toward the fireplace, I took notice of three paintings: El Greco's portrait of St. Jerome (circa 1590) hanging directly above the fireplace mantle, flanked by a portrait of Sir Thomas More (1527) to my left and Thomas Cromwell (1532) to my right, both creations of Hans Holbein, the Younger. The portrait of More in three-quarter-view facing left, while the portrait of Cromwell presents the subject in a more severe profile facing right. Gazing out from the center of the room as I listen intently to the commentary about each portrait, I experience the odd feeling that Thomas Cromwell is staring at Thomas More, as if he were plotting against him, the imputation of such iniquitous intent no doubt prompted by the commentator's disclosure that Cromwell was More's arch political enemy and partly responsible for his execution in 1535.

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Although gazing in Cromwell's general direction, More appears unaware of his arch enemy's presence. It seems as if Cromwell has More clear in his sights.

This odd feeling was not mine alone, as my companion, standing next to me and listening to the same commentary, agreed that Cromwell was indeed staring at More. Overhearing our conversation, a third patron perforce let out a short laugh at the situation presenting itself to us. We all thought that Frick probably savored the irony of this hang[1].

As strange as this feeling may seem, it is an absolutely normal occurrence based on the workaday cognitive operations, namely the ability to construct on the fly mental simulations of scenes and states of affairs displaced in time and space and involving disparate experiential domains (in this case from the domains of artistic portraiture, curatorial practices, and political infighting). Understanding why and how such effects happen is the subject of this chapter.

This curious experience is a prime instance of human beings forging dramatic meanings from static images by blending things that do not normally go together; hence, it is a prime example of conceptual blending, the general model of human meaning construction, the mechanics of which involve the construction, completion, and elaboration of mental spaces, or dynamic scenes and scenarios created as human beings think, talk, and interact. But most fundamentally, this curious incident is important for what it says about human attention, in my view the *sine qua non* of human meaning construction.

2. THE GREATER ATTENTION SYSTEM: AN OVERVIEW

The greater attention system consists of three distinct but interdependent systems: the *signal system*, the *selection system*, and the *interpersonal system*[2]. These three systems can only be apperceived relative to eight elements of attention that comprise them. A gerundive listing of the eight elements is as follows: *alerting* and *orienting* comprise the signal system; *detecting*, *sustaining*, and *controlling* comprise the selection system; and *sharing*, *harmonizing*, and *directing* comprise the interpersonal system. Taken together, these eight elements capture the phenomenology of human attentional engagements with the entirety of mental and conscious life. This heuristic model then serves as the basis for a subsequently determining how language is experienced in real life in its acoustical and optical modes.

Before explication of the greater attention system can begin, a first attempt to describe how the greater attention system works as a seamless whole is in order. Taken completely, the system operates on a continuum such that targets within the field of attention can occupy a place on a scale from *inactive* to *active* to *salient*, with inactive items remaining preconscious and active and salient items occupying explicit awareness (cf. R. C. Anderson, 1982). Salient

[1] The living hall is the only room left unchanged since Frick's death.

[2] Development of this system was inspired by many sources in phenomenology, cognitive science and psychology, and cognitive neuroscience, including textbooks by R. C. Anderson (1982), Gazzaniga et al. (1998), A. Johnson and Proctor (2004), Matlin (1987), Posner and Raichle (1994), and Styles (2005); monographs and edited collections by Baars (1988), Baddeley (1986), Broadbent (1958), Deacon (1997), Groeger (2000), Jeannerod (1997) Kahneman (1973), Kosslyn (1994), LaBerge (1995), Merleau-Ponty (1962), Parasuraman (1984, 1998), Pashler (1998), Reisberg (1997), and Tomasello (1999); and research reports and articles by Lavie et al. (2004), Masuda and Nisbett (2006), Treisman (1960), Wickens (1984), and Yantis and D. N. Johnson (1990).

items readily play determining roles in thought and action, for they are immediately accessible with little or no effort; active items also play a conscious role in thought and action but require slightly more effort to bring them into focal awareness; and inactive items play a preconscious role in thought and action, constituting the background from which one can extract salient items. Bringing inactive items into full conscious attention requires greater ffort or cognitive load, and greater shunting of information from long-term memory, and, concomitantly, greater effort in damping the flow of sensory stimulation.[3]

A stimulus can become salient and active by two routes: exogenously through the bottom-up capture of external prompts, or endogenously through top-down imposition of memory. If an item impinges directly on visual, auditory, tactile, olfactory, or gustatory senses, one then places it momentarily in focal attention. An item can become salient as a byproduct of direct sensory experience, should further processing effort connect the focal concept to a closely connected concept, through a process known as spreading activation. For instance, direct auditory of a nearly gallery patron's loud voice may activate the concept MUSEUM ETIQUETTE.

The curious drama of the confrontational Holbein portraits and an ethnographically inspired analysis of the museum space offer an occasion for the explication of the Greater Attention System.

2.1. The Signal System

Human beings are like any other organism. We sense signals embedded in noise. These signals constitute a change in the immediate environment. A perceived change in the organism's environment serves as stimulus to produce a particular response. Many of our responses are reflexive, involuntary, and unintentional and reflect the objective properties of the human life-world. Many of them are culturally uniform. On the other hand, a signal can only become meaningful if it is a difference that makes a difference to us. The two elements of the signaling system (alerting and orienting) comprise at once the sensory and dispositive boundary conditions of human meaning making: they determine that which is significant without being significant in themselves.

All human sensory-perception operates within specific bandwidths. For visual perception of the environment, light frequencies between 400nano- meters –700nanometers can become signals, sandwiching the visual spectrum between the ultraviolet (below 400nm) and infrared (above 700nm) spectra. In auditory perception, frequencies between 20 kHz– 20,000 kHz can become signals, sandwiching the sonic spectrum between two bands of ultrasonic frequencies.

In brief, alerting refers to the processes of maintaining a general readiness to process novel items, while orienting refers to the factors that dispose one to select particular items over others.

[3] Some words of caution are in order. While the above description of the relationship between attention and consciousness holds, particularly as it relates to language, the scientific literature on the relationship between attention and consciousness is not always so clear-cut as the above account implies (see Marchetti, 2012, for a review of this complex associations and dissociations of attention and consciousness). The above description should be taken as a heuristic for discovering systematic relations, not as a scientific theory is the narrow sense.

Two axioms characterize thinking about the signal system: *not all information is equally important*, and *different organisms are alerted to different items*. Human beings are highly attuned to human speech of any kind (i.e., phonetic recognition). In any given situation, the superior temporal gyrus on the sylvan fissure is primed to recognize incoming sensations of human voices (regardless of the language). When a human voice fills a silent space, we are automatically alerted to pay attention and process its message. The mere presence of voice "disturbs" present consciousness. Language is a powerful tool because the awake and alert brain will nearly always mind it; oral or written language is powerful, because it can alert us to something not present, operating as a *virtual alerting system* portable from situation to situation, moving addressees from the world of actuality to the world of potentiality. In a greater semantic and pragmatic context, this element names the class of prosodic devices, such as syllabic stress, intonation peaks, and intonation contours, eliciting attention through variable intensity of the signal. In a similar vein, alerting correlates with typographic phenomena in written communication, such as ALL CAPITAL spellings or **bold face** type.

Orienting, on the other hand, refers to the disposition to select particular *kinds* of incoming information over others based on spatial, temporal, and cultural frames of reference. When I occupy a space filled with many voices, I am undoubtedly alerted to voice but now have to select one and filter out the others while remaining peripherally aware of those other voices. Phonemic recognition is largely a function of orienting insofar as I am more likely to be alerted to the sounds of English than any other language. In a room filled with unfamiliar sounds, I will be specifically attuned to the sounds of English. Linguistic constructions are primarily used to orient and direct others to events, actions, and states of affairs in particular ways from particular perspectives and vantage points. Let us consider these elements of the signaling system within the Frick Gallery. Alerting refers to the process by which one maintains sensory readiness to process novel signals, while orienting refers to one's disposition to select particular kinds of input over others. Alerting tells us precious little about the combative Holbeins other than to note that human beings must possess a capacity to function and that the specific patterns of alerting are typical of all human beings regardless of geography, history, and culture. When combined with orienting, however, one begins to see the genius of museums as sites designed to minimize the broad bandwidth of sensory signals that facilitate exogenous, bottom-up attention capture (especially when compared to the goings on outside) and maximize a narrower bandwidth of sensory signals that facilitate endogenous, top-down attention structures. With respect to the two Holbein portraits, the virtual drama elicited by Frick's arrangement only came about by virtue of my spatial orientation toward the fireplace. Had I been closer, the two portraits would not have fit in the field of attention. Spatial orientation within the Living Hall has a determining effect on what items occupy the same stage at the same time. More generally, this quiet setting facilitates a particular orientation, too.

Patrons are encouraged (and indeed cannot do much of anything else) to examine individual works of art and to compare them from their own vantage points. They can walk up close to the works, take a few steps back, move from side to side, and otherwise "zoom in" or "zoom out" in order to alter their own dispositions to attend to the works on display. If, for instance, patrons like me were not permitted to stand about five meters from the fireplace, they would have a very difficult time seeing the two Holbein portraits as two protagonists in the same political drama.

2.2. The Selection System

Human beings are unlike other organisms in the degree of conscious rehearsal of past, present, future, and imagined scenes and situations, in the degree to which multi-tasking (doing more than one thing at a time) comprises the quotidian, and in the degree to which one is aware of one's own mental states. Human beings are better planners, projectors, controllers, and monitors of their own cognition than any other species. Greater governance of cognition and consciousness depends on the selection system, consisting of detecting, sustaining, and controlling.

2.3. Detecting

Detecting names the element of attention that corresponds most closely to William James' influential account given in *Principles of Psychology* (1998 [1890]). Detecting itself works on the economic principle of scarcity: distribution of attention depends on a transfer of resources from one area to another. The primate brain evolved mechanisms for data extraction based on selective attention for the purpose of coping with information processing, and information processing is really a matter of making readings of present, past, future, or imagined happenings in the world that are deemed valuable. Detecting directs attention toward items and away from other items. Such a process can be a response to a strong external stimulus (James' "passive selection") or imposed voluntarily (James' "active selection"). This process can be viewed either as a process of filtering, in which case a stimulus is blocked and hence unidentified, or as a process of depriving, in which case an already identified stimulus is simply denied sufficient cognitive resources to remain in consciousness. Detecting is the process that initiates conscious execution of a task or set of tasks. Patrons of the Frick Gallery routinely detect portraiture as their main object of attention and in doing so are invited to ruminate on the meaning of these objects. A gallery effectively governs the range of detecting states. In this instance, detecting includes focusing on the two Holbein portraits at the expense of other proximate items, namely El Greco's *St. Jerome* hanging directly above the fireplace. In summary, detecting facilitates mental processing of one task while inhibiting the completion of other tasks. It accounts for the fact that I must choose which painting to examine first. Without detecting attention, cognitively modern human beings would be incapable of effective action in the face of a distracting sensorium.

2.4. Sustaining

While detecting attention supports the choice of goal-directed tasks of all sorts, *sustaining* attention ensures a task's completion by taking up the greatest share of cognitive resources. The need for focused attention defines a component of attention distinct from selection in that it involves concentration, which in turn, involves narrowing the field of attention. While detecting is subject to the contingencies of bottom-up perception, sustained attention depends on top-down framing of a situation or scene. It is largely endogenously driven and impervious to exogenous capture. Turning to pay attention to something, detecting, is different from concentrating on something.

Once attention settles on the two Holbein portraits in dialogue, it gives way to absorbed attention to the details of their fictional encounter. Ruminating on the curious scene of Cromwell staring on More requires sustaining attention, effectively marshaling the greatest share of cognitive resources. Sustaining attention requires time and effort, thus museums and other exhibition sites create conditions for sustained attention – spaces dedicated to orienting attention toward the objects therein while mitigating distractions from without. Mentally simulating a mini-drama of Cromwell gazing with pernicious intent at More can be understood as a dynamic mental simulation anchored in the here-and-now of a museum visit but referencing the past events of Tudor England.

While detecting and sustaining attention can function as mutually reinforcing processes, they can also oppose each other, most notably in rich sensory environments where the alerting and orienting mechanisms are prone to respond to any sensory cue from above and below, front and back, and left and right. In this respect, it is perhaps best to think of detecting and sustaining as antagonistic forces that ensure balance between exogenous and endogenous control: a high rate of stimulus presentation induces iterations of detecting, thence decreasing sustained attention. A sudden sound of an explosion will force me to reckon a different attentional budget to deal with a possible threat. The stimulus and its aftermath may be so intense or consequential as to supplant my original plan.

Cognitive psychologists have identified two mental activities associated with sustained attention: *vigilance* and *search* (see Matlin, 1987 for an accessible overview of this research).

Individuals engage in vigilance tasks when they detect signals presented to them only infrequently over a long time span in unpredictable intervals but in predictable locations.[4] An apparent example of a vigilance task would be a museum security guard standing vigil in the Living Hall of the Frick Gallery, where he watches patrons look at the paintings. The exact numbers of patrons who actually misbehave are unpredictable but this potential misbehavior will surely occur in this location, otherwise it is not significant. Another unrelated example would be driving a car on an unfamiliar stretch of highway. You remain vigilant to the task of taking a certain exit. You know it is somewhere on this stretch of highway, but have little idea where, so you cannot calculate exactly when to turn off. Because you know that a situation will arise requiring you to turn off, you remain in a state of alertness, even as you must switch to other immediate tasks, such as breaking, shifting gears, passing slower drivers, talking to the passenger, and so on.

Whereas uncertainty persists with respect to *when* and *what kind of* signals will be detected with vigilance tasks, uncertainty persists with respect to *where* a signal will be detected with respect to search tasks. Imagine a patron visiting the Frick Gallery for the first time. He knows in advance that Frick collected seventeenth century Dutch masters and had a few works by Johannes Vermeer, his favorite painter. Unfamiliar with the museum layout, he has no idea where to find the Vermeer paintings. So intent on seeing the Vermeers first, he rushes through the gallery examining the placards next to each painting while ignoring the paintings themselves. The aperture of attention actually narrows to a small portion of the placard – the name. In fact, it is quite possible that our impatient patron is not reading every name but only searching for either a capital "J" and small case "o" and "h" or a capital "V "and small case "e" in his task as a quick search strategy. He finally hits pay dirt in the West Gallery. Here he comes across the letter combination "Jo" and suspends his search long

[4] Psychologists usually study vigilance tasks that last more than an hour.

enough to read the full name and title of the painting: *Mistress and Maid*. He then moves his head slightly to the left to find the painting on the wall, recalibrating and narrowing the field of attention to the elements within the painting.

2.5. Controlling

Sustaining attention over time in the face of many competing distractions is one means of maintaining goal-directed behavior. The activity may need to be stopped (in order to respond to some other contingency) and then be resumed; there may be other concurrent activities and their future fulfillment must be coordinated with meeting the primary task. The punctuated nature of goal-directed behavior coupled with the ability to coordinate several strands of information simultaneously, keeping them in their proper order, is known as *control* of attention. More precisely, the selection system specifies two types of control: switching and oscillating.

Absorbed ruminations about the fate of Sir Thomas More at the hands of his archenemy are very difficult to sustain for long periods, as too many external contingencies compete for limited attention, even in sites dedicated to the art of rumination. A truck horn blasting from Fifth Avenue, a call from my companion to look at Giovanni Bellini's *St. Francis in the Desert* on the opposite wall, or an announcement that the gallery is closing, interrupt my reverie about More and Cromwell. The ability to engage in one cognitively laborious task, suspend that task to attend to something else only to return to it later on, seems a uniquely human ability. Switching attention is vital for functioning in heterogeneous, social, and technological environments. I can ruminate, but I have to cross the street safely if I want to live to ruminate later. Switching is particularly critical in theories of working memory and planning.

Oscillating attention differs from switching in that it operates within a single, homogenous domain and thus constitutes controlled sustain.[5] Here is an example. Ruminations about More, Cromwell, and political intrigue in the court of Henry VIII are syncopated with close examination of features within the paintings themselves. I notice, for instance, that More appears unshaven and that Cromwell's eyes are puffy. A few seconds later, I pick up the political drama, this time More's scruffy demeanor and Cromwell's puffy-eyed scowl come to signify great stress and toil, as though each were disregarding sleep and hygiene in the service of some cause. Notice that such fanciful interpretations depend on oscillation between attention to the painting as a pictorial object and attention to the greater political drama for which the paintings are props. I look *at* the paintings then *through* them, then at them, then through them, with each oscillation contributing something to the meaning of this engagement with Holbein's work. In short, oscillating refers to phenomenon of switching between two bi-stable properties of the same object. I can attend to the representations of Holbein's portraits – in effect, looking through the painting to the historical figures and their times; or, I can attend to Holbein's every brush stroke, examining light, color, and shadow—in effect, looking at the paintings. Oscillating attention captures the person-level experiences of "looking at" and "looking through" something. The phenomenological oscillation may be recapitulating what is happening at the sub-personal,

[5] Lanham (2006, pp. 84–86; *passim*) identifies *oscillatio* as a predominant mode of attention when reading texts.

neuronal level. VanRullen et. al. (2007) found spontaneous oscillations of neuronal activity, even as subjects were focusing on a single target, suggesting that oscillation reveals a disposition for periodic sampling in visual attention. This period sampling dynamic may reflect how we attend to the world more generally.

2.6. The Interpersonal System

Although primate species are social animals and thus possess some form of intersubjective engagement, no other known species than human beings has social interaction and cultural niche construction as its defining behavior.[6] Most of what we do and how we do it involves other bodies and other minds. A phenomenology of attention and its relation to meaning cannot be fully explained without understanding the ontogenesis of the interpersonal attention system, which consists of sharing, harmonizing, and directing.

2.7. Sharing

Complex human behaviors and abilities never occur in a vacuum; in fact, they will not even get off the ground without shared attention. One fundamental condition of the human infant seems to be that she comes into the world expertly prepared to appropriate the entirety of her caretakers' attention. She spends nearly all of her precious mental resources attending to the caretaker as the caretaker in turn attends to her. Together, they engage in shared attention.

Trevarthen (1980) has conducted pioneering research in the development of interpersonal and cooperative understanding in infants. He argues that infants engage in "proto-conversations" with caregivers. Caregivers and infants gaze at each other, sharing looks, vocalizations, and touch behaviors associated with the expression of basic emotions. What is more, Trevarthen suggests these proto-conversations acquire a turn-taking structure, the caregiver makes a facial expression and the infant, in turn, tries to make a similar expression. Sharing attention names the ontogenetically basic condition of constant perceptual accessibility of others as a permanent constituent of the attentional field. However, sharing of attention is itself insufficient to bring about the shared understanding, as the infant does not yet understand that the other being is a subject of experience. In other words, sharing refers to the condition of being sensitive to the presence of other beings as self-propelled, "mechanical" agents without attending to them as intentional agents.

In the adult world, sharing attention can be described as the peripheral awareness of another. For instance, a patron absorbed into the fictive world of More and Cromwell might make momentary eye contact with another patron then quickly look away. In that instance, the patron may share attention with the other patron but does not necessarily become aware of the patron as another patron. She is simply another person in the commons.

[6] This is not to deny that other species – from bowerbirds to bonobos – engage in cultural practices.

2.8. Harmonizing

If sharing attention is the *sine qua non* of human symbolic development, then, without it, human beings cannot take their place as individuals in successive cultural environments. The next step in that process is joint attention. Tomasello (1999, pp. 56–93) argues that children do not develop language and symbolization without being able to (1) know that others are subjects of experience, (2) maintain an interest in them as subjects, and (3) track the attention that others pay to objects or subjects in the environment. Human attention requires the harmonization of other minds onto a focal item in attention.

Harmonizing attention is the metaphoric name used to identify the element of focal attention that is nearly unique to human beings. Adult meaning making is an individual act dependent upon the individual's singular attitude, temperament, and knowledge, while simultaneously and paradoxically a richly social act dependent upon a community of shared signs, values, and needs. I adopt the position that meaning does not arise without the presence of the other (either real or imagined). Human learning is predicated on joint attention. I attend to the same objects in space as my companion, for this odd feeling about the two portraits was shared. Standing next to me listening to the same commentary, she remarked: "He's staring at him." Another patron, overhearing her remark, nodded in agreement.

All three of us came to focus on the More-Cromwell portraits as props for creating a three-part harmony. We produced a set of simultaneous melodies on a common theme: the dramatic tension between Cromwell and More. I use the term harmony to suggest two crucial points: we were paying attention to the same objects and running similar mental simulations at the same time that we were doing so from subtly different perspectives – slight variations in spatial orientations, autobiographical memory, and, potentially, variations in cultural alignments (as the third patron may assign different significance to these objects based on distinct patterns of identification). The result is a rich harmony of meaningful experiences with each tone at different intervals. Harmonizing serves an important social pragmatic function of promoting human conviviality, as it is easier to place a "spotlight" on a third object than keeping it trained on each other.

Two variants of harmonic attention also exist. One variant of this harmonization activity is a phenomenon known as *refracting* attention. It refers to the activity or state of attending to another agent as she attends to something else. It often occurs as an initial step in harmonization, wherein the first step is detecting the other person with the subsequent step being the detection of the object of that person's attention, hence creating a 'prismatic' gaze as refracted through the first person. There is also a *reflecting* (or voyeuristic) version of harmonizing, whereby the first person becomes the object of attention as she attends to something else; what is being reflected is not the final object of the other person's gaze but the person's attentional posture itself. If this other person could see what you are seeing, she would see herself looking at something else, as if in a mirror.

2.9. Directing

Harmonizing attention focuses on the affective side of human meaning making. The three patrons happen to be focusing attention on the More & Cromwell portraits, but the corollary

to this event is that the gallery has been arranged in this way. We all thought that Frick probably savored the irony of this hang. In attending to the arrangement of the portraits, we subsequently focus on the intentions of the collector, for we feel that our attention was being intentionally manipulated to regard them in this manner. Frick, we reasoned, must have wanted us to see Cromwell gazing at More and More oblivious to Cromwell's malice; this was his attempt to direct our attention to the historical subjects of Holbein's painting. *Directing* attention is the term I use to speak about the intentional manipulation of another's attention. Whether this was in fact Frick's intention is beside the point. It may be that Frick was simply following the convention that portraits should face the center of the room, and thus the effect of Cromwell engaging More is an emergent property he himself never really appreciated. But the point is that these patrons ascribe an intentional agent or agency directing their attention.

2.10. Summary

This general account of attention is intended to provide grounding for modeling human meaning making. Therefore, the eight elements of alerting, orienting, detecting, sustaining, controlling, sharing, harmonizing, and directing attention distributed among the signal, selection, and interpersonal systems of attention count as the basic phenomenological scaffolding for a theory of meaning. Table 1 provides an overview of the Greater Attention System.

3. ATTENTION IN LANGUAGE AND DISCOURSE

3.1. Language

Language has two characteristic functions: semiotic and interactive. Language functions as a semiotic system for initiating and maintaining symbolization of thought by means of sound, gesture, and inscriptions. This section explores the possibility of theorizing language as being both conditioned by the greater attention system and as a means of continuously adjusting the capacity to detect, sustain, control, harmonize, and direct attention.

Language and attention mutually determine each other, for there must be pre-linguistic and extra-linguistic systems leading to symbolization. Symbolization remains dependent on this lower stratum but contains causal powers of its own that reciprocally affect the pre-linguistic and extra-linguistic systems. Candidates for the grounding symbolization include the basic biomechanical architecture of kinesthetic experiences– i. e., exteroception (visual, auditory, tactile, olfactory and gustatory) and proprioception (perception of spatial orientation, postures, and movements of one's own body) – and emotional resonances– i. e., interoception (pain, pleasure, hunger, thirst, desires, passage of time, feelings, moods, and temperaments). Another candidate is primordial social pragmatic experiences of sharing and harmonizing attention with others within the larger ecology. The dual grounding (cf. Sinha, 1999) of language in body and social environment implies the nascent existence of a signal system ready to be tuned and adjusted, a selection system for detecting meanings important to

bodies moving in space and through time, and an interpersonal system for calibrating those meanings with other bodies moving in space and through time. As beings continue to function in successive generations of cultural niches – with increasingly complex patterns of behavior – the symbolic routines inherited by successive generations feed back to the three attention systems. Languages and language families develop and maintain their own specific signal systems; they develop and maintain classes of items for selecting, sustaining, and controlling attention; they develop and maintain classes for harmonizing and directing attention in others – symbolic routines for communicating. Language marks an apotheosis of the human propensity to convert an object of attention into an intention and then convert that intention into an object of someone else's attention. It ensures a continuous dialectical interplay of attention and intention, a dialectic initiated between two or more people and only later, with time and practice, becoming an internalized concept. Such is the general view of language pursued here, with the goal being to describe language structures and use under a unifying system of attention.[7]

Table 1.

Signal System	Selection System	Interpersonal System
Alerting Sensitivity to the intensity of stimuli		*Sharing* Sensitivity to the presence of other beings as self-propelled, "mechanical" beings without attending to them as intentional beings
Orienting Spatial, temporal, and cultural disposition to attend prompted by cultural frames of reference	*Detecting* Conscious recognition of something as relevant to the performance of a task; identification of a task	*Harmonizing* Sensitivity to the intentional states of other agents toward a common object of interest (i.e., joint attention); the feeling that others are attending to the same thing.
	Sustaining Concentration of mental resources on something; the feeling of narrowing the aperture on the "zoom lens" of attention	*Directing* The ability to manipulate the attention of other agents; the feeling of being manipulated by another
	Controlling Switching attention between two heterogeneous tasks; oscillating between two aspects of a single object or task	

[7] The phylogenic and ontogenetic arguments for this view of language will not be discussed in detail here, as the goal of this exploration is more descriptive than explanatory. Sustained arguments for the social pragmatic origins of language from an ontogenetic perspective can be found in Sinha (1999); Sinha and Jensen de Lopez (2001), and Tomasello (1999; 2004). Sustained arguments for a phylogenic and comparative account of a social pragmatic origins of language based on bodily mimesis can be found in Donald (1991; 1998) and Zlatev et al. (2005).

This section explores the relationship between language, discourse and attention, and takes its place programs in Cognitive Linguistics, such as Langacker's *Cognitive Grammar* (1987, 1991, 1999) and Talmy's *Cognitive Semantics* (2000a–b), both well developed theories of linguistic form that presuppose attention and conscious experience as a determining factor in the acquisition and use of language. Both cognitive grammar and cognitive semantics postulate grammar as conceptualization. To know a language is to have at one's disposal a distributed set of "construal operations" for tailoring conscious experience. For Langacker, construal operations entail "focal adjustments," which include figure/ground alignment, perspective and viewpoint, selection, scalar adjustments (coarse-grained versus fine-grained), active zones, and subjectification. For Talmy, construal operations entail a set of schematic systems that likewise include perspective, structural schematizations, force dynamics, and distribution of attention, which in its current state of development consists of four levels, ten categories, and fifty factors as means of assigning variable degrees of salience to forms in a given speech situation. Fauconnier's *Mental Spaces Theory* ([1985] 1994) and Fauconnier and M. Turner's *Mental Spaces and Blending* framework likewise see language and conceptualization as determined by other cognitive processes, including attention. The basic of mental spaces is that meaning construction occurs within, among, and across networks of mental models of scenes and scenarios (sometimes blending them for specific purposes). These mental space networks presuppose a cognitive system for signaling, selecting, and sharing attention. A fourth relevant research program is Chafe's approach to discourse (1994). For Chafe, discourse management is really about managing the attentional dispositions and flow of conscious experiences among the participants – be they speakers, listeners, writers, or readers. In his view, the great error of contemporary linguistic theory (the formal orientations of Generative Linguistics being a prime example) lies in their factoring out conscious experience (and by implication attention and other relevant cognitive operations) from any theory of linguistic competence. Finally, a group of Italian scholars are formulating their own research program of attentional semantics (see in particular Bernedetti, 2011; Ceccato, 1969; Ceccato and Zonta 1980; Marchetti 1997; Marchetti, 2006a; and Marchetti, 2010). The Italian's work is based on the general premise that the meaning of words are "condensed instructions on the attentional operations one must perform" in order to convey meaning (Marchetti 2006b, p.12).

This exploration intersects with each of these programs and reference to some of them will appear throughout the course of this chapter; however, I will avoid making extensive connections and commentary on them in favor of presenting my own ideas, leaving it to others to compare and contrast. In some respects, the following account is principally an exercise of rendering a diverse range of technical notions under a common metalanguage. Doing so is no meager feat, however, given that a large measure of doing general linguistic is trying to fit language within a framework that is descriptively adequate and psychological plausible. With the possible exception of the Italian scholars, many of the above cognitive linguistic approaches tend to see attention as one facet of language rather than as a general framework for understanding language use. It is the latter aim that I attempt to satisfy (albeit impressionistically) in the sections below. (See Oakley, 2009, chapter 3 for a more comprehensive treatment.)

3.2. The Greater Attention System and Language

The account offered below contributes to a general description of language as part of the semiotic signal system, as a function of the selection system, and as motivated, calibrated, and controlled by the interpersonal system.

3.2.1. The Signal System

With respect to language structure, use, and acquisition, the signal system corresponds most directly to the range of detectable sounds and letters that count as a sound and letter in a semiotic system.

3.2.2. Alerting

Alerting, you recall, refers to an individual's general readiness to process incoming or new information based on stimulus intensity. Alerting phenomena originate exogenously in most instances and thus are functions of exteroception; however, they can originate endogenously on occasion, as when one suddenly feels a sharp pain with no perceived external cause. With respect to language, alerting points to the primordial role that human speech plays in the sensorium. In any given situation, we are primed to recognize incoming sensations of human voices, regardless of the language (see Ramus, et al., 2001). Prosodic features of intonation and stress are prime examples of alerting. For instance, yelling is a blunt instrument for alerting attention and it also has the effect of magnifying the qualities of one's voice. Whispering, in contrast, hides the qualities of one's voice. The general correlation of loudness with greater attentional salience is defeasible, as it is possible to imagine situations wherein salient attention affords the soft-spoken person. Alerting is compatible with Hjelmslev's notion of expression-substance (1961, pp. 56-58): particular acoustic features of pronunciation, especially those features marking varieties of idiolects and sociolects. In the discourse analysis tradition of Chafe, alerting is compatible with exaggerated pitch contours, as might be the case with an overemphasized rising contour useful in the expression of incredulity (at least as it pertains to varieties of English) and other vocal prominences, such as vowel lengthening (1994, pp. 58–59). With respect to gesture, alerting also correlates with demonstrative hand waving, as when one tries to flag down a cab or gets the attention of a friend amidst a crowd.

3.2.3. Orienting

Orienting, you recall, refers to an individual's disposition to detect particular kinds of information over other kinds of information. Orienting is compatible with Hjelmslev's notion of expression-form: phonemic distinctions and the application of phonological rules are prime examples. Phonotactic constraints – restrictions on the kind of sounds and sound sequences possible – are functions of orienting. For instance, English and German favor consonant-first syllables and allow up to three consonants at the onset and coda segments of a syllable. They are CCCVCCC type languages. Finnish and Japanese, in contrast, only allow CVC types and thus either have to eliminate consonants or insert vowels within consonant clusters when borrowing words from consonant cluster languages. Finnish speakers tend toward the elimination strategy, with the borrowed German word /strænd/ "strand" (beach) becoming /ranta/. Japanese speakers tend toward the insertion strategy, with the compound /bərθ/

/kəntrol/ (“birth control”) becoming /baːsu/ /kontoroːru/. Phonemic recognition and phonotactic constraints play a determining role in how we attend to expressive form.

The fact that speakers of a language are predisposed to recognize certain structures over others has important implications for theorizing language change as well. Fennell (2001, p. 6) argues that one internal factor in English’s historical emergence as an analytic language is that speakers developed a fixed stress on the nuclear syllable, drawing attention away from the final syllable and ultimately bringing about the loss of inflectional endings. In contrast, languages within the Indo-European family that allowed major stress on any syllable preserved their inflectional characteristics. Over generations, English-acquiring speakers automatically began to orient attention on syntactic placement when surveying the linguistic landscape, because word order became for them the primary means of determining grammatical relations. That is to say, orienting attention to the nuclear syllable of a word meant being alerted to changes in syntax rather than changes in morphology. A polysynthetic language like Siberian Yupik (Eskimo) contrasts markedly with English in that attention to word order does not appear to be a viable disambiguating strategy, because one lexical morpheme often incorporates a complete English sentence. Consider this sample from Comrie (1989, p. 45):

(1) Angya-ghlla-ng-yug-tu
Boat-AUGMENTIVE-ACQUISITIVE-DESIDERATIVE-3PERS SIN
Boat-big-acquire-wants-he
‘He wants to acquire a big boat.’

The expression contains only one lexical item, *angy* (boat), followed by a series of grammatical suffixes: *ghlla* (an augmentive), *ng* (an acquisitive), *yug* (a desiderative), and tuq (a third person singular pronoun). The Eskimo-acquiring speaker is alerted and oriented not to word order, per se, but to word-internal components that reflect pragmatic order rather than grammatical order, the object itself becomes the reference point from which meaning develops, as compared to the English translation which builds meaning relative to a volitional agent. In summary, the signal system can be tuned according to global disambiguation strategies that speakers of a language employ as part of acquiring a language. Bates and MacWhinney (1988) offer ample evidence in my estimation for the claim that English is unusual in the extent to which word order has become the primary interpretive strategy. Among the world’s languages, including other Indo-European languages, inflectional morphology is the prevalent strategy. But there are several less global means by which expression forms perform orienting functions. I will outline three: intonation units, gesture, and perspective taking. In the discourse analysis tradition of Chafe, orienting correlates with the form and function of whole intonation units: spurts of speech articulated and experienced as a whole and that, with a mean length of just under five words, take approximately two-three seconds to produce (1994, p. 64). In discourse, English speakers (at least) exhibit a disposition to focus attention as a series of small chunks. These chunks are either substantive (presenting one new idea) or regulative (devices for managing the flow of information), or fragments (false starts, floor holding or floor claiming techniques). In written communication, it is likewise tempting to suggest a typographical equivalent to the intonation unit, as Chafe does in his discussion of the punctuation unit (1994, p. 291). Intonation units manage the flow of information as we talk and listen, write, and read.

Another feature of orienting is the presence or coexistence of gestures in correlation with spontaneous spoken discourse, as studied extensively by McNeill (1992). For instance, spoken utterances may co-occur with indexical and iconic gestures as well as with beat gesture, usually one gesture per clause. Gestures in concomitant variation with verbal signs may function to orient attention to particular facets of language as the speaker's center of attention. (It is an open question whether spontaneous gestures function as communication devices or function as a means of helping speakers think and speak. In either case, the gestures can be regarded as attention orienting structures either on the production or comprehension end).

Perspective is endemic to language, a topic systematically probed by MacWhinney (2005). According to MacWhinney, languages predispose its speakers to construe events from different perspectives, and indeed, languages vary greatly with respect to the kinds of perspectives its speakers normally take. The perspective system underlying language can code for direct experience, construal of space and time, plans, social roles, and mental acts. Languages orient attention by mapping direct experience onto open class items, such as nouns, verbs, and adjectives. The specific content of mappings is not to be understood as part of the orienting system; rather, the orienting of attention ensures that open class forms enjoy salient attention, all things being equal. It just so happens that the lexicon encodes direct experiences, as direct experiences with objects and others in an environment is revised through mental imagery, a position consistent with Barsalou's theory of simulation semantics. For instance, some researchers, such as Lawrence Barsalou (1999), argue that when we imagine actions elicited by the verb "to paint," we likewise activate the same neural circuits used in direct perception and action. What is more, preliminary evidence suggests that we may be doing something similar for abstractions such as "truth" and "justice," whereby we imagine ourselves with others in concrete situations and scenarios with these concepts play defining roles (Barsalou andWiemer-Hastings, 2005).[8]

Meaning takes place along from three possible frames of reference: the egocentric, the allocentric, and the geocentric (MacWhinney, 2005, pp. 6–9). An egocentric frame of reference uses the position of the speaker as the point of reference. Thus, languages with relative coordinates allow speakers to construe events, objects, and states in egocentric terms, as in (2a):

(2a) Holbein's portrait is to my left.

The same frame allows one to construe the same situation as being near or far from the speaker, as in (2b–c):

(2b) Holbein's paintings are over here.
(2c) Holbein's paintings are over there.

[8] The simulation semantic hypothesis is controversial. Shallice & Cooper (2013), for instance argue that the left lateral inferior frontal cortex supports processing of abstract words. However, Shallice & Cooper's interpretation of the evidence depends on version of the strict localization theory of the brain's functional topography. Barsalou's simulation semantics, however, does find support from advocates of the Massive Redeployment Hypothesis (MRH) of the brain's functional topography. Meta-analysis of neuroimaging data from a variety of domains suggests that dispersed sensory regions involved in a wide variety of cognitive processes involving abstractions. See M. Anderson (2007) for a general overview and argument for MRH.

Languages with intrinsic frames of reference allow speakers to take an object-oriented frame of reference, thereby using properties of inanimate objects or other beings as landmarks for drawing attention to something else, as in (3a–b):

(3a) The front entrance of the museum faces Central Park,
(3b) The gallery is straight ahead in front of that mounted policeman.

Languages with absolute frames of reference allow speakers to guide attention according to a geocentric frame of reference based on fixed landmarks, such as the North Star, mountain ranges, or cardinal directions. Absolutive languages, such as Guugu Yamithirr, do not appear to allow for any other frame of reference than the geocentric one. In other words, the language lacks expressive forms for relative and intrinsic reference points. A speaker of Guugu Yamithirr would, therefore, say something roughly equivalent to (4).

(4) Thomas More hangs Northwest of here, while Thomas Cromwell hangs Southwest of here.

English provides expression forms for expressing all three types of deictic spatial relations, and in similar fashion, speakers of English can likewise create three distinct temporal frames of reference. We can direct attention to events and states in relation to the speaker's time, or coding time (CT), or in relation to reference time (RT), as in (5a–b):

(5a) I tell you, the gallery closes at five o'clock (CT),
or
(5b) I told you the gallery will close at five o'clock (RT).

English in particular uses a combination of inflections and modal auxiliary verbs to code for tense, which is designed to place events and states in time. Other languages use different means of temporal orientation. Likewise, all languages also orient attention to specific temporal qualities of events and states. Thus, the orienting of attention forms a unifying principle for understanding aspectual phenomena, such as whether we are dealing with a completed event, an ongoing event, an enduring state of affairs, a habitual or intermittent occurrence, as exemplified in sentences (6a–e):

(6a) Holbein painted More's portrait in 1527.
(6b) Holbein was painting More's portrait during his first extended trip to England.
(6c) Frick admires the European masters.
(6d) Henry VIII would sometimes execute his advisors.
(6e) Holbein would paint an English dignitary every few years.

English has myriad of construction types in which the same events can be construed from different perspectives. One of the functions of orienting attention is to set the "scope of attention" – setting the "periphery of consciousness" where entities or relations are detectable. Such techniques include passivization, coreference, reflexivity, clefting, nominalization, relativization, subordination, pluralization, just to name a few. These are not to be considered semantically equivalent because each builds the ostensibly same state of affairs from different

perspectives. Passives, for instance, use the affected entity as the original point of reference rather than the agent – attention is oriented from effect to cause (if cause is at all specified). Cleft sentences are an interesting case, because they use a dialogic frame as their reference point. Thus sentence (7),

(7) It is Johannes Vermeer whom I admire most of the Dutch Masters,

advances a claim but only after embedding it in a presentational syntactic formula (cleft), as if the speaker were responding to the question, "which Dutch master do you admire most?" Although clefts do not have to follow direct questions, their presentation structure takes the basic turn-taking structure in spontaneous dialogue as a point of orientation from which to make a claim. Speakers are invariably calling attention to a common dialogic structure.

Tomlin (1995) provides psycholinguistic evidence that the passive construction reflects a speaker's attentional orientation to perceived events. He argues that attentional cuing channels the precise linguistic format of the description. The transition from non-linguistic to linguistic representations means that the perceived events are already detected and participants are to choose the expression-form whose semantic structure best fits the presented scene. We are predisposed to choose one construction over another, and the choice is not arbitrary. Orienting attention may be fundamental in the transition from non-linguistic representations to linguistic representations.

To test this hypothesis, Tomlin developed the following experiment. Twelve native speakers of English viewed two kinds of scenes on a computer. (Tomlin (1997) also conducted these experiments cross-linguistically, using Polish, Russian, and Bulgarian speakers among others). The first experiment is with a visually presented event in which multiple animate entities interact for a brief time. For instance, Tomlin has his participants look at a screen saver program of a repeated scene in which two fishes, one light the other dark, approach each other until, in an instant, one fish swallows the other and continues on swimming. Tomlin asks, "How is that brief scene represented conceptually, and on what sort of conceptual representation does the language-production system operate?" (1995, p. 168).

To answer this question Tomlin asked participants placed in front of a computer monitor to view the fish-swallowing event and verbally report what they had seen. A flashing + sign or flashing arrow appears in the place where one of the fish (predator or prey) will appear either on the prey (yellow fish) 75 milliseconds before the swallowing event or on the predator (blue fish) 75 milliseconds after the action. A mask covers the screen at 500 milliseconds, cuing the subject to produce a report. If the cue appears on the prey 75 milliseconds before event onset, the prediction was that speakers would produce passive constructions (e. g., "The yellow fish was eaten by the blue fish"); if the cue was on the predator 75 milliseconds before event onset, the prediction was that speakers would produce active constructions (e. g., "The blue fish swallowed the yellow fish"). Ten of the twelve subjects performed as predicted. Tomlin's experiments successfully predict that grammatical voice cue for complementary distributions of attention to semantic agents and patients, thus suggesting a causal relation between grammatical voice and the way we remember and represent events, actions, and situations (1995, p. 178).

In addition to locating events and states in space and time, languages can orient attention to social reality of interpersonal actions and interactions as well as orienting attention to the mental states of such actors. Again, the orienting system is not concerned with organizing the

precise content thereof, but seems only concerned that languages provide sufficient means of ensuring that some categories of being and some categories of thinking are made available for construing events and states from the some socially and cognitively privileged point of view. Modes of address have the effect of prescribing certain relationships between language users and their subjects from the moment verbal exchange begins. For instance, it matters greatly whether one refers to Thomas More by means of sentence (8a) or (8b):

(8a) Thomas More admired Hans Holbein's portraits,
or
(8b) Thomas More admired Erasmus's friend's portraits.

The choice of epithet in sentences 8a and 8b does not change the truth- functionality of the claim and does not change the referent either. But the former refers to the person through the role of "portrait artist," while the latter refers to the person through the social role of "friend" (implying greater empathy for Erasmus than for More). The expression forms of language provide speakers with an extensive range of appellations, titles, pronouns, and kinship nomenclature to characterize social roles. What is more, presence or absence of social roles has a determining effect on our dispositions toward the value of that role.

Lastly, language affords the means of expressing mental acts, particularly mental acts attributed to others. Hence epistemic verbs such as "think," "believe," "conclude," and "surmise," permit speakers to characterize the mental states from either an egocentric or allocentric perspective.

To summarize, the signal system encompasses the semiological categories of expression-substance and expression-form as a basic outline of the manifestations of stimuli and the categorical intuitions such instances license, the former being a property of alerting the later a property of orienting. Of the two elements, orienting attention plays a determining role in language structure, as the substances that speakers can spatially and temporally orient to, or "frame", delimits the categorical range of linguistic forms. I argue that a linguistic theory based on attention will necessarily admit as basic to any language system properties of intonation units – particularly the one-new idea constraint proposed by Chafe – and levels of perspective taking as it pertains to exteroception, proprioception, and interoception, space and time, event construal, social roles, and mental acts. In addition, I suggest that languages vary greatly in the range of perspective taking available to its speakers. These expression forms must exert reciprocal effect on the means and manner in which we attend, perceive, remember, learn, and act.

3.2.4. The Selection System

The selection system of attention correlates with the semiological categories: *content substance* and *content form* (cf. Hjelmslev, 1961, pp. 51–52). When we speak of grammar as part of a conceptual system, we mean at once a set of open-class and closed-class forms that determine the means and manner by which we select and train attention onto meaningful events and states worthy of communication. Open-class items correspond to classes of morphemes whose membership is large and non-exclusive (e.g., root forms of nouns, verbs, and adjectives); closed class items correspond to classes of morphemes whose membership is by comparison small and exclusive (e.g., pronouns, prepositions, tense and aspect markers, other derivations and inflections, determiners, and conjunctions). It bears repeating that the

linguistics of attention broadly outlined here presupposes that the distinction made between open- and closed-classes cannot be made on the basis of form alone, as all linguistic forms are inherently meaningful. But it is fair to assume that open-class items presuppose greater attentional salience and finer details of semantic content than do closed-class items. Talmy (2007) argues that open-class items facilitate detection over their closed-class counterparts, and that language users are more readily able to introspect accurately on the meaning of open-class in comparison to closed-class items. Talmy further speculates that human beings are more attentive to open-class forms because it aids language acquisition. This answer seems at best only partially right. The selection system in general is attentive to those forms providing greatest access to the norms of thought and action that allow speakers to share an environment and to coordinate their activities. We attend to lexical items because they are normatively weighted. Of course, this general rule is defeasible, as when the prosodic features of an utterance place greatest stress on the preposition or when the speaker compares two utterances, the only difference between them being a single grammatical form.

In its broadest characterization, the selection system can be viewed as a repository of open-class and closed class content forms repeatable from situation to situation, with aspects of semantic structure remaining invariant across situations. But an account of the selection system would be incomplete if we were to ignore the role content-substance plays in giving shape to the inventory. Every linguistic form has its origin in use. And astute observers of language-in-use can point to occasions of linguistic novelty in which a new usage enters conscious awareness and, subsequently, is added to the inventory of grammatical resources. An account of just this instance will set the stage for exploring the influence of the selection system on the structure of language and discourse.

The setting is a hot summer day in the middle of July. My youngest son, Simon, comes into the kitchen and asks me for a Popsicle® (frozen juice on a stick). He then takes it outside to eat it as he plays in the sandbox. Several minutes later, he comes inside with the stick and sticky cherry-flavored syrup running between his fingers and down his palms. The next day, he comes into the kitchen and asks me for a "lick-it-quick." Initially nonplussed, I soon realized that he is pointing to the freezer, and I determine that he is referring to the same things he had called "popsicle" the day before. I give it to him and he goes outside to eat it, returning only a few minutes later with an empty stick and (comparatively) clean fingers and hands. Why this inventive naming? Surfaces and substances in our immediate environment produce sensations in the individual that may play a significant role in generating mental models. This instance illustrates the role these sensations play in shaping, at least momentarily, the structure and use of language. It evidences content-substance in the sense that it is traceable to the instance when it enters my own inventory of form-meaning pairs. The actual circumstances of its production are integral to its meaning and function, such that I cannot help simulate the idiosyncratic communicative situation of its initial utterance. That particularity is a part of its meaning. It also evidences a potential for content form, insofar as this phrasal noun can become a commonly held idiom, and it did flirt with commonality for a time as family members routinely referred to these frozen treats as "lick-it-quicks." As near I can tell, this content form never extended beyond members of the immediate family, and presently has fallen out of use entirely in the Oakley "nucleolect." It is now an historical artifact; a piece of fossil poetry.

3.2.5. Detecting

Detecting, you recall, refers to initial assignment of an item or items from perception or from short-term and working memory into the attentional field. Detection refers to incoming information, a participant, a role, an object, artifact, event, action, or abstract idea, and as suggested above, is entirely dependent on orienting. Proper nouns, common nouns, verbs and other linguistic foci (e.g. adverbial and prepositional phrases) are typical elements of linguistic constructions designed to detect entities, objects, and relations for further processing. It is the semantic side of event construal in the orienting of attention.

The combination of open-class and closed-class forms combine in lexical and grammatical complexes for the purpose of *eliciting* or *suppressing* he detection of one idea to the exclusion of related but competing ideas, or of rendering one idea more salient than others, and so on.[9] Position of emphasis in a clause and prosodic features of an intonation unit are phonological means of accomplishing this, but the mere presentation or suppression of content-form in discourse also needs to be taken into account. The selection system comprises those content-forms that pick out parts of our experiences.

Languages provide us with multiple means of construing the same situation. For example, given a motion event with a conceivable image-schematic components of initial, medial, and final points the options available to discourse participants are three-fold: eliciting all three image schematic components, eliciting two and suppressing one, or eliciting one and suppressing two.

Consider sentence (9a):

(9a) We went to the Frick Gallery.

This version of events presents the final point and suppresses the initial and medial points of the referent scene and does so from the egocentric perspective of the two agents – this clause ensures that the agents and the destination will be detected over, say, the path and origin. Alternatively, the same event could be framed this way:

(9b) We left our hotel and came to the Frick gallery.

In contrast, this version of events presents the origin and the destination while suppressing most everything in between. What is more, it construes the point of view allocentrically, prompting the interlocutors to imagine (if only briefly and coarsely) the scene from the perspective of the destination rather than the origin. Finally, the same event could be construed so that all three image-schematic components of volitional motion claim center stage, as in (9c):

(9c) We came upon the Frick Gallery while walking from our hotel, through Central Park and onto 5th Avenue.

This version presents the destination, origin, landmark and secondary destination through a series of four intonation units, each of which presents one new detectable idea from

[9] Eliciting and suppressing are used instead of Talmy's notions of *windowing* and *gapping*, respectively (2000, pp. 257-309). They are conceptually the same; however, many, including myself, find Talmy's nomenclature too obscure.

allocentric, then egocentric, then geocentric spatial perspectives. (Parsing this sentence also entails sustaining attention and, thus, will be analyzed again in the next section.)

In addition to image schematic structure, semantic domains are another means of licensing and constraining linguistic meaning.

A domain – a spatial metaphor for capturing the idea that anything meaningful is meaningful in a specific context – is central to the Cognitive Linguistics enterprise, for it emphasizes the essentially encyclopedic nature of linguistic conceptualization[10]. It is also not a mere matter of coincidence that Croft and Cruse (2004, p. 51) first introduce the idea in their influential textbook during their discussion of the attention, suggesting that semantic domains may be critical features of the selection system. Detecting attention in essence means fitting a particular semantic "profile" in a relevant set of contexts that structure and stabilize meanings. A structured set of semantic domains exists for detecting, sustaining, and controlling attention – and for doing so in harmonized synchrony. Unfortunately, the concept of a semantic domain as a theory and method of language analysis has developed over the years a certain *ad hoc* and unsystematic flavor to it. Aside from the consensus view that semantic domains are grounded in bodily experience and that these basic domains allow for both configurational and locational profiles (see Clausner and Croft, 1999), few attempts to present a theory of domains grounded in the layers of phenomenological engagements in the life-worlds are existent.[11] The present discussion of the types of conceptual and practical behaviors that limn the detectable limits of conscious experience takes its lead from P. A. Brandt's description of the "architecture of semantic domains" (2004, pp. 33–66).

P. A. Brandt's "geography of the life-world," in my opinion, is best understood as forming stable lexical realizations of human attention. The orderly unfolding of our semantic architecture begins with the gesture-based domains of exteroception, proprioception, and interoception in accordance with the primordial forms of socialization. From these basic domains arise another set of action-domains, and from this practical set of domains emerges a set of exchange-based, then discourse-based, then knowledge-based domains. I will now discuss each set of domains in detail, a task that should give a fairly global view of the types of stable contexts over which the selection system operates.

The first set of domains defines basic personal and interpersonal experiences. These are gesture-based domains in that they give coherence to the primordial, face-to-face social cognitive operations.

The first domain, *physis* (D1), covers attention to external physical existence, or more specifically the feelings and reflections of having a body affected by external forces. Image schematic structures of forces and barriers to motion along paths, and so on, are thought to emerge from experiences encompassed by this domain. Items keyed to this domain are exemplified by verbs "be," "push," "pull," "cause," the auxiliary verbs "keep" and "let," and preposition "despite" (cf. Talmy, 2000, pp. 409-470). The second domain, *demos* (D2), comprises the collective intentions and actions, where attention focuses on the social reality. It is in this domain that basic moral postures and obligations become meanings. Grammatical forms keyed to this domain include pronouns "us" and "them," "we" and "they." The third

[10] Cognitive linguists consider the term domain equivalent to Fillmore's "frame" – "a system of concepts related in such a way that to understand any one of them you have to understand the structure in which it fits" (1982, p. 111).

[11] Langacker (1987, p. 148) distinguishes between basic and abstract domains but does not provide an inventory of either.

domain, *psyche* (D3), turns the aperture of attention inward to focus on the epistemic flow of experience, of thinking. Conceptual Metaphor Theory (Lakoff and M. Johnson, 1980) posits the systematic transfer of structure from *physis* to *psyche*, such that we use the domain of physical existence to structure the domain of thinking, which allows us to think of mental states (including emotions) as analogues of extero-, intero-, and proprioception: KNOWING IS SEEING; ANGER IS HEAT; HAPPINESS IS UP; and so on.

Grammatical forms keyed to this domain include mental state verbs "to think," "to know," "to believe," and "to conclude." The fourth domain, *logos* (D4), focuses attention on the relationship between utterances and actions, also known as *speech acts*. This domain trains us to see certain forms of speech as altering social reality; as such this domain can only emerge from the first three. Forms keyed to this domain include verbs "to pronounce," and "to name" and "to proclaim."

These four domains are grounded in bodily gestures and interactions with others in the lived environment. The principal feature of these first four domains is that they comprise the phenomenological building blocks of consciousness that include attention to perception and patterns of causation and intelligible causality.

A second set of "satellite" domains emerges from the first four by means of semantic integration. These domains constitute a basis of a social ontology, for they offer a set of culturally meaningful types of reality that all members of a society must sufficiently recognize in order to function in the wider vistas of activities that characterize a person's life. The three practical domains, P. A. Brandt argues, give coherence to our moment-by-moment realizations of work, love, and worship (2004, p. 53). The first (physis) and second (demos) domains integrate, engendering a reality of *polis* (D5). This is the fifth domain of "place," of an inhabited territory or "land," and of people "doing things together." Attention in the domain of *polis* brings to the fore ideas of being part of a large, diffuse, and impersonal collective of "We, the People." The second and fourth domains integrate, giving birth to the reality of *oikos* (D6), or "household" (a micro-economy). Attention in this domain focuses on the experiences of goal directed activities and expressive exchanges between intimates or like-minded folk, be they "lovers," "relatives," "colleagues," "comrades," "friends" or other intimate co-agents. Domestic life being a prototype, attention at this level of reality is often emotionally intense (both euphoric and dysphoric) and "tribal." A progeny of the first and fourth domains is the reality of *hieron* (D7), the domain of the sacred. This layer of social reality encompasses experiences associated with rituals, "motivated by empathic interactions with 'others-as-everybody' in a setting of worshipped nature," as P. A. Brandt characterizes it (2004, p. 54). This domain appeals to the sense of invisible (perhaps divine) causal forces acting on us, but it can even encompass "institutional forces" greater than ourselves but often invested in select individuals. The investiture ceremony for a president of Case Western Reserve University is one secular manifestation of this reality – for universities are nothing if not hierarchical. These practical domains frame most of what can be termed institutional reality (cf. Searle, 1995, *passim*), and thus frame how we attend and intend during acts of meaning and communication. Consider the following claim in (10):

(10) Neither More nor Cromwell survived Tudor England,

It presents its two grammatical subjects in relation to a vast but nevertheless historically specific political reality. The noun phrase "Tudor England," brings into conscious awareness

the larger political reality of the time. The key is that we focus on their fate in terms of the larger, necessary conditions of a geographically delimited sovereignty. Likewise, the modifier, "Tudor," has the effect of bringing into conscious awareness the kinships and loyalties associated with a family name; it is at once a small group, a household (i.e., The house of Tudor) that wields sovereign power over a vast land, and it calls attention to the dramatic tensions among members of that household.

Sentence (11),

(11) Thomas More refused to take the Oath of Supremacy,

emphasizes a hierarchical reality, or, more specifically, the non-occurrence of a ritual act the meaning of which is ambiguous, with More claiming that his silence on the matter signals tacit consent and with Henry and his minions claiming silence signals dissent.

These gestural and practical domains need to be in place in order to construct "higher-order" and indispensable concepts of "wealth," "beauty," and "justice" (P. A. Brandt 2004, p. 56), the meanings of which depend on interpersonal, dative exchange. An explanation of interpersonal exchange recommends a semantic theory of attuned attention to intersubjective and intentional practices, thus the semantic results of the interpersonal attention system (see below). As P. A. Brandt argues, the basis for all exchange domains comes from the primordial dative: the intended act of transferring an object from person 1 to person 2 followed by the inverse operation of person 2's response to person 1's intention. The fifth and sixth domains integrate into the domain of *economy* (D8). If we detect that person 1 is "in" a *polis* and also "in" *oikos* and, in addition, we detect an object, then we have the semantic basis of distribution of goods, services, tools, weapons, and other markers of wealth. Domains of *oikos* and *hieron* combine to form the domain of *aesthetics* (D9). A participant simultaneously in *oikos* and in *hieron*, say an artist or some person of authority, can act in such a way that the exchange is ritualized and the result is in some measure made sacred, which can entail a product – a painting, a building, a religious amulet – acquiring a "surplus" value over and above its functional value. The domain of politics and the sacred combine to form the domain of *jurisdiction* (D10). Acts detected in *polis* can be compared and evaluated as good or bad relative to standards detected in *hieron* to give us right and wrong. Some acts become obligatory, some criminal, others permitted but debased according to an agreed upon codex, or Law.

The visit to the Frick Gallery is meaningful in relation to domain eight if attention focuses on the exchange between the individual and the museum and expressed as "price of admission." The same event is meaningful in relation to domain nine if attention focuses on intrinsic properties of the objects on display. Examining the detail in Vermeer's genre paintings or Rembrandt's mastery of chiaroscuro techniques is the province of this ninth domain. Likewise this event will take on an entirely different tincture if attention settles in domain ten wherein topics of justice, right, or wrong are detected. Judicious abstraction can be fairly trivial in terms of right and wrong artistic techniques, such as, "this painter is better at portraits because of x," to grand pronouncements, such as, "Henry VIII was a tyrant."

The next set of domains is necessary for metalinguistic and metacognitive activities, as they limn out symbolic assemblies, realities especially important in literate societies. The third generation of satellite domains gives us three fundamental discourse types: description, argument, and narrative.

When interests from an economic domain (D8) mix with interests from the aesthetic domain (D9) we get *descriptions* (D11). In this domain, human beings attend to something with the attitude that anything observed by one mind can be observed by other minds with the same attitude. One mind can direct other minds to facets of reality in harmonized synchrony and sustain attention on it for some time. The object of description is exchangeable as long as one discourse participant places other participants in the right position to "see" it. Scenes and scenarios may function as descriptions and can be lexicalized as acts of "showing," "explicating," "analyzing," and "inspecting." An exclamation in the descriptive domain is as follows:

(12) Holbein is staring at More!

When interests from the aesthetic domain (D9) – of stylized modes of self-presentation and social interaction as "staged performances" – mix with interests from the jurisdiction (D10) domain, we get *arguments* (D12). In this domain, aesthetic values associated with form and play combine with conceptions of right or wrong, virtue or vice. Scenes and scenarios function as staged debates and are lexicalized as acts of "arguing," "proving," "disproving," "persuading," "cajoling," "intimidating," "convincing," and "reasoning." A hypothetical statement in the argumentative domain is as follows:

(13) If Thomas More had persuaded King Henry VIII that his silence meant consent, he would have outlived his rival, Sir Thomas Cromwell.

When interests from the jurisdiction domain (D10) mix with interests from the economic domain (D8), we get *narrative* (D13). The modern journalistic enterprise depends on a narrator who positions "other minds" toward events concerning relationships between wealth and conduct, as in crimes, and other legally challenging activities and circumstances. Narratives become valuable "commodities" for a public because they dramatize problematic actions and conflicts, and human conflict is intrinsically interesting. Scenes and scenarios may function as narratives and are lexicalized as acts of "informing," "telling," "reporting," "revealing," "divulging," "leaking," and "testifying." A hypothetical statement in the narrative domain is a follows:

(14) Soon afterwards, his life took a turn for the worse. The King invited him to the marriage with Boleyn. More chose not to attend and the King took this as a great personal offence. Had More attended, perhaps the king would not have overreacted by instituting the Act of Supremacy.

Linguistics is at base the study of discursive agents, with keen interest in describing and explaining how *H. sapiens* evolved into discursive agents, how toddlers develop (or sometimes fail to develop) into discursive agents, and how symbolic systems are structured and how they serve manifold agentive functions. Linguistics operates in knowledge-based domains, the fourth level of social reality comprising the "genres of knowledge."

When the interests of systematic and controlled descriptions (D11) intersect with interests in claims about what did happen, what is happening, and what will happen (D12), a mode of knowing often called *science* emerges (D14). The scientific domain integrates empirical

investigation with speculation. When talk focuses on evidence and hypothesis, the conversation operates in the semantic domain of science, where abstractions and descriptions are the primary focus of attention.

When interests of systematic argumentation (D12) and interests in narratives of experience (D13) intersect, a mode of knowing called *philosophy* emerges (D15). When talk focuses on what is to be believed and what is to be doubted, on the conditions necessary for belief and doubt, and when the means of substantiating these arguments are narratives of situations where believing and doubting are the center of interest, it operates in the semantic domain of philosophy, where again hypothetical narratives in the form of *Gedanken* experiments prevail.

When interests of narration (D13) and description (D11) intersect with concepts of change, cause, and contingency, a mode of knowing called *history* emerges (D16). When talk focuses attention on descriptively relevant changes through time, and when the means of relating those descriptions take the form of a diachronic story or set of stories, it operates in the domain of history, where descriptive narratives of what was the case prevail.

Of course, science, philosophy, and history, as discourses are continuously cross-pollinating. When talk in history focuses on arguments and evidence, it operates in a scientific semantic space, but typically for purposes of evaluating (jurisdiction) or assessing the merit of the descriptive narrations produced. When talk in science focuses on dramas of discovery or the social and political impediments to discovery, it operates in an historical semantic space, often for purposes of "humanizing" the scientific enterprise. When talk in philosophy settles on minute descriptions of phenomena, it operates in a scientific semantic space, but it should be noted that descriptions are not systematic and sustained as they are in scientific disciplines. Neurophysiological descriptions almost always serve grander speculative and programmatic ends in philosophy than in neuroscience proper, a source of tension between the two disciplines.

P. A. Brandt's sixteen semantic domains, presented at a glance in table 2, offer a more systematic account of semantic structures.

In the present study, these sixteen domains limn out a range of detectable events and states comprising the selection system. I believe P. A. Brandt's classification is sufficiently comprehensive, although further investigations may necessitate the positing of new semantic domains, but the method of proliferating domains should not be arbitrary. Take as a final consideration the possibility of a new semantic domain, the *military*. Image schemas for force, counterforce, balance, and barriers; adverbials such as "against," nouns like "enemy," "civilian," "campaign," "sortie," and "weapon," verbs such as "fight," "kill," "combat," "annihilate," partitives such as "rules of engagement," "chain of command," and "code of conduct," phrases such as "follow orders," "kill or be killed," "collateral damage," "acceptable losses," and a host of other items can function as content-forms and constructions in a military register. What domains might have given rise to it and where in P. A. Brandt's series of satellites might we place this semantic domain?

Militarism issues from the intersection of *polis* and *hieron*. Soldiers are constituted within a *polis*, a large and diffuse collective organized around common goals and/or enemies. They are also constituted with a *hieron*, a hierarchy constituted and maintained through rituals and ceremonies motivated by an external force (be it temporal or spiritual or both). Soldiers are decidedly not individuals, but functionaries in a chain-of-command. The *polis* they serve may take individualism as a basic organizing principle, but that principle only defines the external

force motivating the creation of the military institution and does not affect any internalized existential condition of being a soldier; *hieron* contributes the internal existential order of a soldier's life.

Table 2.

Gesture	physical (D1): a body moving in space and meeting resistance from other bodies	social (D2): bodies interacting in space	mental (D3): cogito – attention to the thoughts, feelings, moods, and dispositions	speech act (D4): symbolic action – doing things with words and other symbol systems
Practical	political (D5): many persons living and striving together (D2+D1)	ethnic (D6): identity of intimates and other smaller affiliations via shibboleths (D2+D4)	sacred (D7): attention to that which inspires awe and which carries ultimate value (D1+D4)	
Exchange	economic (D8): attention to status by means of the industrial arts (D5+D6)	aesthetic (D9): attention to form and sensual features of artifacts (D6+D7)	judicial (D10): attention to the restoration of the "good" (D5+D7)	
Discourse	descriptive (11): attention to form and status (D9+D8)	argumentative (12): attention to speaker attitude and involvement in a debate format (D9+D10)	narrative (13): attention to the relationship between ethically problematic scenarios and the status of participants therein, with a focus on change (D8+D10)	
Knowledge	science (14): attention to the description of phenomena in the service of an argument (D11+D12)	philosophy (15): attention to the evaluative narrative of a situation in the service of believing and doubting (D13+D12)	history (16): attention to description of something and to its relevant changes through time (D11+D13)	

The answer I am about to provide to the second question may seem counterintuitive. The intuitive answer is to define this semantic domain as action-based and practical, after all soldiers returning from combat are said to have "seen action." I think this is the wrong answer, however. A more accurate way to understand militarism writ large is as an exchange-based domain, for a common denominator among this set of domains is the interactions between diffuse or dissimilar groups, be they *poleis* (external) or *oikoi* (internal). The economic domain, for instance, focuses attention on exchanges that extend well beyond subjects in the same *polis* (i. e., trade); jurisdiction focuses attention on conflicts between subjects by instituting modes of exchange for their settlement, and these modes of exchange can and do extend beyond the *polis*. *Aesthetic* exchanges based on notions of beauty can expand or contract accordingly. The *military* exchange, as with jurisdiction, is defined around conflict, but the conflict is not so much among subjects in a single *polis* (be it a nation, state, or empire) but conflict between *poleis*. The upshot of this discussion is this: the architecture

of semantic domains, as developed by P. A. Brandt, allows for a more systematic investigation of kinds of attention-structures to which human beings are semantically attuned than do the standard *ad hoc* accounts of domains in the cognitive linguistics literature.

3.2.6. Sustaining

Sustaining, you recall, refers to the narrowing the attention aperture on an entity, event, action, or relation, so as to conscript multiple resources, particularly from long-term procedural, semantic, and episodic memory in order to recall, reason, plan, and decide. Sustaining attention means adding new closely related information to the mental spaces currently online. As it pertains to language and discourse, sustaining attention follows the rhythms of topic and comment, or old and new information. In the tradition of Chafe (1994, pp. 140–145), sustaining attention corresponds to his notion of "center of interest," an accumulation of multiple substantive intonation units on a single topic. If the empirical mean length of substantive intonation units measures out between two-three seconds, then we can surmise that sustaining attention in language approximates a temporal duration greater than three seconds.

Pronouns, reflexive pronouns, appositives, restricted relative clauses, prepositional phrases, definite articles (among other devices for achieving cohesion and coherence) are elements of linguistic structure made for sustaining attention by focusing in and elaborating on a center of interest. For instance, the speaker introduces the addressee to a third party, thereby attracting his attention to a new being in the conscious present. Together, detecting and sustaining of attention constitute the attentional field as it composes, completes, and elaborates a network of discourse topics and foci. Consider once again sentence (9c):

(9c) We came upon the Frick Gallery while walking from our hotel, through Central Park and onto 5th Avenue.

My own repeated attempts to find the most fluid enunciation pattern for this sentence leads me to posit four intonation units, the first with emphasis on "Frícк Gàllery," the second with emphasis through vowel lengthening on "walking," the third with a rising intonation of the "through," and the fourth with similar rising intonation of "onto." The prominence of the location in the phrase sets the stage for focusing attention on the other landmarks selected in the last two IUs, but the prominence in the second IU on the co-agents' action recalibrates the orientation to an egocentric frame in order to stress momentarily the fact that the geographic landmarks are *landmarks for someone*. The subsequent chain of prepositions and their corresponding prosodic stresses refine attentional awareness according to a series of precise relational landmarks against which cognizers conceptualize the actions of the protagonists. The mental space of finding a location and retracing the path to that location is the scene that is unfolding, and it takes several phrases to establish it. In contrast, sentence (15),

(15) We came upon the Frick Gallery,

compresses the whole event complex into a single clause (on my pronunciation). In this utterance, attention to the means and manner of arrival is accessible but not salient, and thus not of primary interest in the discourse, neither is the identity of the agents, which we assume corresponds to the speaker and her companion. The key notion here is that the closed seriatim

presentation of three prepositional phrases headed by "from," "through," and "onto" in sentence (9c) function as forms for sustaining attention to a mini-travelogue in which the origin, path, and destination landmarks are equally important.

3.2.7. Controlling

Recall that control refers to the ability to perform two tasks simultaneously (dividing); or, to start one task, put it on hold for something else while attending to something else and return to the primary task (switching); or, to fluctuate (oscillate) between two or more facets of the same scenario. Language has little relevance to the first manifestation of control, for it is impossible to divide full attention among two linguistic tasks simultaneously. Close examination of spoken and written discourse reveals successful and unsuccessful attempts to control information flow. Discourse markers (e. g., "now," "anyway"), adverbial phrases and nonrestrictive relative clauses used as asides, complement clauses following epistemic and speech act complement-taking verbs (e. g., "I presume that…," "I propose that…") instruct recipients to oscillate attention between epistemic grounding of speaker attitude and the content of the message. Register shifts within discourse prompt participants to attend to a new discursive grounding within a single conversation. Deictic and iconic gestures can be used to oscillate attention between objects of conversation within the same scene or scenario. A dramatic example of this phenomenon is reported by C. Müller and Tag (2007), in which a native German speaker retells a story from childhood in which his mother ran after the school bus waving his lunch bag. When the narrative focuses on the bus driver's action, the speaker makes a gesture on his left imitating hands on a steering wheel. The gesture is both clear and prominently enacted at or near eye level. When the narrative shifts to the mother running after the bus, the speaker's left hand drops down to about belt level and the articulation of the same iconic gesture persists in attenuated form just as his right hand rises in a grasping posture as if holding a bag, which he then proceeds to wiggle demonstrably. Here we have a nice example of iconic gesture complexes that appear to be guiding attention to different facets of the same scenario. Other expressive devices for controlling the flow of information when speaking and listening, writing and reading include verbal asides, parenthetical remarks and footnotes, all of which are particularly good for oscillating and switching attention.

English has several prepared phrases for performing regulatory functions within discourse. Here is as small sample:

(16) ↕anyway…,[12]
(17) As I was saying,
(18) Getting back to the previous point,
(19) Returning to the last subject,
(20) To make a long story short, [shifting attention to story's end]
(21) Now onto the next issue.

As these examples demonstrate, control of attention governs the switching and oscillating of topic and comment at the phrasal, clausal, sentential and discourse layers. Linguistically, devices that comprise regulatory IU's and punctuation units in the tradition of Chafe are

[12] This first example may be opaque to non-native speakers. It is a common adverbial used during spoken conversations when the topic has drifted and one of the interlocutors wishes to return to the established principal topic. Pronunciation occurs with a singsong pronunciation (noted with before ↕ the word).

perhaps the clearest manifestation of these attention structures (except agreement markers, such as "mhm," used to sustain attention). Deictic and iconic gestures and gesture complexes are particularly useful for differentially marking for salient attention to facets of the same scene or scenario within a discourse topic.

At this point, an objection may be raised that these controlling devices are as much (if not more so) a function of the interpersonal system as the selection system and thus should be treated therein. I concede as much, but this is true of virtually every aspect of language. The description of the language functions within the Greater Attention System is only meant as a unifying heuristic for exploring the multiple dimensions of meaning construction taking place at one time and is not meant to be a description of discrete category sets intended to carve up of language "at the joints."

3.2.8. The Interpersonal System

One acquires language in a macro-social environment. An attention based theory of language then must place heavy emphasis on the role of the interpersonal system in language acquisition, structure, and use.

Although the interpersonal system influences virtually every aspect of language structure and use, it bears special relevance to topics discussed in linguistics and discourse analysis that fall under the headings of sociology of language (i. e., how conventions associated with social situations influence the structure of language) and the linguistics of society (i. e., how language behaviors mark group membership and identity). With respect to the former category, the study of turn-taking characteristics in different ethnic and geographic groups, such as high occurrences of cooperative overlaps among speakers of Eastern European Jewish descent, as well as gender variable usages (i.e., different patterns and pronunciations whose statistical variations run along gender lines), and gender-exclusive markings within languages (as in the case of the gender-based enclitic markings of Lakota verbs) are of chief interest. More generally, the sociology of language concerns itself with matters of solidarity and power in language and encompasses variations in politeness phenomena and forms of address. With respect to the latter category, the study of dialects and vernaculars, the study of variations in language attitude among groups (i. e., the extent to which specific populations of speakers exhibit "linguistic insecurity"), and debates on the status of official versus non-official languages and language planning are of chief interest. I leave it for another occasion to mine the rich vein of sociolinguistic data for evidence of the interpersonal system in favor of a briefer and narrower sample of English constructions with interpersonal meanings.

One final generalization before proceeding is in order. The interpersonal system has special bearing on the architecture of semantic domains, for without the ability to calibrate and attune attention there would be no ability to extend beyond the first domain of *physis*.

3.2.9. Sharing

Sharing attention means being aware of the presence of others as occupying the same space but without regard to their status as intentional agents. For instance, one might be standing in line and focusing attention on a particular task all the while being dimly aware of the fact that you are one of several persons comprising the cue: you are not, however, focusing on what the other persons are thinking or attending to but only on your narrow self-interests.

There are few if no instances of sharing attention relevant to language structure and use. The only thing to be said about sharing attention is that it is a necessary condition of interacting though discourse. Sharing attention, or the inability thereof, may be a critical element of attention to focus on theories of psychopathologies that manifest language deficits, such as autism and schizophrenia, or sociopathic and psychopathic disorders. But these are broad speculations beyond the scope of this exploration. More germane, however, is the fact that when we share a common space, we conform to culture specific norms of behavior that presuppose the presence of others and we calibrate our actions accordingly.

With respect to semantic domains, the ability to share attention structures our basic experiences of sociality (D2).

3.2.10. Harmonizing

Harmonizing occurs when two or more people train attention on a common object (broadly construed). The importance to harmonic (or joint) attention for language structure, use, and acquisition is self-evident to linguists, particularly of cognitive and functional persuasions. Tomasello (1999), for instance, places the "joint attentional scene" at the very heart of language acquisition, and even David Lightfoot (1999), who otherwise assiduously avoids mingling explanations of language acquisition and language change with general cognitive operations, still must invoke joint attention as a trigger for the expression of innate syntactic categories.

In many respects, all linguistic structure can and should be understood as the harmonizing of attention. It is nevertheless analytically useful to suggest that certain linguistic structures perform harmonizing functions. I will rehearse a limited sample. Exclamations, for instance, can harmonize attention along an alerting dimension, insofar their initial articulation can arouse the attention in others. Phatic utterances can function as harmonic sustainers of attention. On the listener's side, agreement markers, like "uh huh," allow the speaker to proceed with her or his turn. On the speaker's side, periodic queries, such as "you know what I mean?" or "do you follow," solicit permission to proceed with the turn.

With respect to semantic domains, harmonizing attention may be considered a cognitive prerequisite for all action-based and exchange-based domains.

3.2.11. Directing

Harmonized discourse participants enjoy the privilege of directing one another's attention. Language may in fact be broadly defined as the symbolic means of directing attention. Within this broad definition of language sits a narrower set of devices for performing directive functions, not the least of which being grammatical mood, as manifest in imperatives and optatives exemplified in sentences (22) and (23):

(22) Look at that painting!
(23) Would that Thomas Cromwell suffer the same indignities as More did!

Imperatives are useful for directing interlocutor exteroception, while optatives are useful for directing an interlocutor's interoception.

Aside from mood, there are several constructions useful for directing attention in particular ways. For instance, English provides verbal recipes for directing spatial orientation:

(24) That Holbein portrait over there.

In addition to spatial deixis, English provides recipes for directing temporal orientation, or when to attend:

(25) You can see the two Holbein portraits now.
(26) The train will be coming by in a few seconds.

There are verbal recipes for directing the length and intensity of attention:

(27) Look closely at the Holbein's painting for a few minutes and you'll begin to see stubble growing on More's face, as if he had neglected to shave that morning.

There are verbal recipes for viewpoint:

(28) Step back ten feet into the center of the room and look on each side of the fireplace. What do you see?

There are verbal recipes for manipulating the scope of attention:

(29) Listen only to the voice on the Artphone Commentary, ignoring everything else.

Finally, with respect to semantic domains, directing attention may be considered a cognitive prerequisite for discourse-based and knowledge-based domains.

3.2.12. Overview

To illustrate the linguistics of attention more precisely, consider fabricated examples (30–35) inspired by the opening story.

(30a) He's staring at him.[13]
(30b) He's staring at him.
(31) Look. It's the portrait of Thomas Cromwell I was talking about.
(32) Look. Frick was the best connoisseur of Renaissance painting in America.
(33) See … I told you Frick was an astute collector.
(34) This solemn figure never took the Oath of Supremacy.
(35) Anyway … that solemn figure never took the Oath of Supremacy.

Utterances (30a–b) appear identical but, in fact, may elicit functionally distinct interpretations when one considers intonation and gesture. Both instances exemplify Chafe's (1994, p. 85) notion of the *light subject constraint*, in as much as the use of a third person pronoun suggests a lighter information load, because the speaker assumes its referent as given information. It is the exact nature of how each referent is being construed that marks the difference. Suppose that my companion utters (30a) standing next to me. Prosodic emphasis on the verb signals the attentional *sustain* if we remember that the topic is already active in the conversation. Thus, prosodic stress characterizes the precise nature of the encounter rather

[13] Underlining signals prosodic emphasis.

than focusing attention on the mere fact of an interpersonal encounter between the two historical figures represented therein. Utterance (30a) is particularly useful in situations where the hearer is already aware of the scene evoked by the portraits but may not be aware of the precise characterization thereof. If (30a) suggests an anaphoric use of the third person pronouns (i.e., reference to represented men as topics of an ongoing discourse as opposed to new objects in the perceptual environment), utterance (30b), with prosodic emphasis on the two pronouns, suggests a gesture deictic use of these third person pronouns. Such gesture deictics imply attentional directing, with the speaker instructing the hearer to focus attention on the historical figure of More as the object of Cromwell's gaze. (In this case, the scope of attention takes place inside the blended mental space of fictive surveillance, whereby the two personages of More and Cromwell interact in the perceptual here and now.)

Utterance (31) is an explicit example of directing attention by alerting, given prosodic emphasis on the initial verb. Directing leads to harmonic attention, to an already established reference. The subsequent utterance functions as a metalinguistic control device for reorienting the hearer's attention to a previous discourse topic.

Contrast utterance (31) with (32). The presence of the same imperative verb with considerably less intonation intensity exemplifies a different attention function: it orients and harmonizes for a different relationship (or "footing") between speaker and hearer. The speaker already assumes the undivided attention of the hearer but does not assume that he shares the same perspective. She is trying to persuade him rather than command him, and *look* orients the hearer toward such a footing as it relates to the current sensorial and intellectual field. Utterance (31) harmonizes by directing; utterance (32) harmonizes by orienting. Utterance (33), on the other hand, differs from (31) and (32) with respect to detecting, if we assume that both speaker and hearer are standing in front of the two Holbein portraits. The speaker selects the entire Frick collection as the intellectual object of attention (with the two portraits as immediate instances). This utterance performs an interpersonal function by focusing on the interpersonal relationship, or "footing," between the two participants. In my dialect, the preposed verb "see" with vowel lengthening and loudness focuses attention on speaker attitude, in this case an attitude approaching condescension. A potentially hostile or otherwise adversarial relationship seems to be developing between the discourse participants. Suppose that utterance (34) picks up on a previously established notion that the portrait of Sir Thomas More renders him a solemn figure. The speaker then uses the portrait as a reference point for discussing an historical fact about the man depicted in the painting. (Solemn, indeed, for he was executed!). Now let us assume that the actual utterance in the same circumstances was exemplified in (35), with a rising-falling pronunciation of "anyway." This utterance exemplifies a form of attentional control. The adverbial instruction projects back to a previous discourse topic, and the demonstrative pronoun construes the topic as conceptually removed from the current discourse space, such that the discourse participants have to "get back to" the topic.

CONCLUSION

The theoretical framework constructed in this chapter serves to orient linguistic and discourse theory in the direction of attention, for language is really a semiotic system for

directing and harmonizing the attention and intentions of others. It is the unifying principle of attention with the eight elements of the greater attention system that offers a consistent and phenomenologically defensible starting point for relating language to the broader conscious mental lives of those who use it. A brief recapitulation of the theory sketched out in this chapter suggests that, with respect to language and discourse, the signal system determines the conditions by which a signal can become a communicable sign, thus the different intensities of a signal alerts us to the presence of something meaningful, while certain grammatical categories provide us with the temporal, spatial, and cultural frames of reference from which all meanings take shape. The selection system determines the range of semantic domains against which particular meanings emerge as well as dictates the expressive conditions by which we can focus and concentrate on a task while ignoring other competing tasks, or by providing us with the means of managing to switch and oscillate between tasks. The interpersonal system determines the boundary conditions of interaction; we can attend to others as other beings with only minimal engagement with them (sharing), or we can direct and harmonize our attention states for extended periods of time. A comprehensive theory of language and discourse has to at least account for the conditions of usage stipulated by the elements of the attention system.

REFERENCES

Anderson, M. (2007). The massive redeployment hypothesis and the functional topography of the brain. *Philosophical Psychology*, *20.2*, 143-174.

Anderson, R. C. (1982). *Allocation of attention during reading.* Champaign, IL: Bolt Beranek and Newman, Inc.

Baars, B. (1988). *A cognitive theory of consciousness.* Cambridge, UK: Cambridge University Press.

Baddeley, A. D. (1986). *Working memory.* Oxford, UK: Oxford University Press.

Barsalou, L. (1999). Perceptual symbol systems. *Behavioral and Brain Sciences*, *22*, 577–660.

Barsalou, L. & Wiemer-Hastings, K. (2005). "Situating abstract concepts". In: D. Pechler, & R. A. Zwaan (Eds.), *Grounding cognition: The role of perception and action in memory, language, and thought*. Cambridge, UK: Cambridge University Press, 115-128.

Bates, E. & MacWhinney, B. (1987). "Competition, variation, and language, learning". In: B. MacWhinney (Ed.), *Mechanisms of language acquisition*. Hillsdale, NJ: Lawrence Erlbaum, 231-259.

Bernedetti, G. (2011). *The enigma of language. The meaning of the fundamental linguistic elements. A possible explanation in terms of cognitive functions: Operational semantics.* New York: Nova Science Publishers.

Brandt, L. (2008). "A semiotic approach to fictive interaction as a representational strategy in communicative meaning construction". In: T. Oakley, & A. Hougaard (Eds.), *Mental spaces in discourse and interaction*. Amsterdam, NL: John Benjamins Publishing, 109-148.

Brandt, P. A. (2004). *Spaces, domains, and meaning.* European Semiotics Series, Volume 4. Bern: Peter Lang Verlag.

Broadbent, D. (1958). *Perception and communication.* London: Pergamon Press.

Broadbent, D. (1982). Task combination and selective intake of information. *Acta Psychologia, 50*, 253–290.

Ceccato, S. (1969) (Ed.). *Corso di linguistica operativa*. Milano: Longanesi.

Ceccato, S. & Zonta, B. (1980). *Linguaggio consapevolezza pensiero*. Milano: Feltrinelli.

Chafe, W. (1994). *Discourse, consciousness, and time: The flow and displacement of conscious experience in speaking and writing.* Chicago: University of Chicago Press.

Clausner, T. & Croft, W. (1999). Domains and image schemas. *Cognitive Linguistics, 10*, 1–31.

Comrie, B. (1989). "Some general properties of reference-taking systems". In: D. Arnold, M. Atkinons, J. Durand, C. Grover, & L. Sadler (Eds.), *Essays on grammatical theory and universal grammar*. Oxford, UK: Clarendon Press, 37-51.

Croft, W. & Cruse, D. A. (2004). *Cognitive linguistics.* Cambridge, UK: Cambridge University Press.

Deacon, T. (1997). *The symbolic species: The co-evolution of language and the brain.* New York: W. W. Norton.

Donald, M. (1998). "Mimesis and the executive suite: Missing links in language evolution". In: J. Hurford, M. Studdert-Kennedy, & C. Knight (Eds.), *Approaches to the evolution of language: Social and cognitive bases*. Cambridge, UK: Cambridge University Press, 44-67.

Donald, M. (1991). *Origins of the modern mind: Three stages in the evolution of culture and cognition.* Cambridge, MA: Harvard University Press.

Fauconnier, G. & Turner, M. (2002) *The way we think*. New York: Basic Books.

Fauconnier, G. (1997). *Mappings in thought and language.* New York: Cambridge University Press.

Fauconnier, G. (1994 [1985]). *Mental spaces: Aspects of meaning construction in natural language*. New York: Cambridge University Press.

Fennell, B. (2001). *A history of English: A sociolinguistic approach.* Oxford, UK: Backwell Publishers.

Fillmore, C. (1982). "Frame semantics". In: L. S. Korea (Ed.), *Linguistics in the Morning Calm*. Seoul, ROK: Hanshin Publishing Company, 111-137.

Gazzaniga, M., Irvy, R. & Mangun, G.R. (1998). *Fundamentals of cognitive neuroscience.* New York, NY: W. W. Norton & Co.

Groeger, J. (2000). *Understanding Driving: applying cognitive psychology to a complex everyday task.* Philadelphia, PA: Psychology Press.

Hjelmslev, L. (1961 [1943]). *Prolegomena to a theory of language.* (F. Whitfield, Trans.) Madison, WI: University of Wisconsin Press.

James, W. ([1890] 1998). *Principles of psychology, 2 volumes.* Bristol, UK: Theommes.

Jeannerod, M. (1997). *The cognitive neuroscience of action.* Oxford, UK: Blackwell.

Johnson, A. & Proctor, R. W. (2004). *Attention: Theory and practice.* Thousand Oaks, CA: Sage Publications.

Kahneman, D. (1973). *Attention and effort.* Englewood Cliffs, NJ: Prentice-Hall.

Kosslyn, S. M. (1994). *Image and brain: The resolution of the imagery debate.* Cambridge, MA: MIT Press.

LaBerge, D. (1995). *Attentional processing: The brain's art of mindfulness.* Cambridge, MA: Harvard University Press.

Lakoff, G. & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.

Langacker, R. W. (1987). *Foundations of cognitive Grammar, volume 1: Theoretical prerequisites.* Stanford, CA: Stanford University Press.

Langacker, R. W. (1991). *Foundations of cognitive grammar, volume 2: Descriptive applications.* Stanford, CA: Stanford University Press.

Langacker, R. (1999). *Grammar and conceptualization.* Berlin: Mouton De Gruyter.

Lanham, R. A. (2006). *The Economics of attention: Style and substance in the age of information.* Chicago, IL: University of Chicago Press.

Lavie, N., Hirst, A., Fockert, J. & Viding, E. (2004). Load theory of selective attention and cognitive control. *Journal of Experimental Psychology, 133* (3), 339–354.

Lightfoot, D. (1999). *The development of language: Acquisition, change, and evolution.* Oxford, UK: Blackwell.

MacWhinney, B. (2005). "The emergence of grammar from perspective". In: D. Pechler, & R. A. Zwaan (Ed.), *Grounding cognition: The role of perception and action in memory, language, and thinking*. Cambridge, UK: Cambridge Univeristy Press, 198-223.

Marchetti, G. (1997). *La macchina estetica. Il percorso operative nella costruzione dell'atteggiamento estetico*. Milano: Franco Angeli.

Marchetti, G. (2006a). A presentation of attentional semantics. *Cognitive Processing, 7*, 163– 194.

Marchetti, G. (2006b). *A criticism of Leonard Talmy's cognitive semantics*. Retrieved from Mind, Consciousness, & Language: <www.mind-consciousness (last access 8/15/08).

Marchetti, G. (2010). *Consciousness, attention, and meaning.* New York: Nova Science Publishers.

Marchetti, G. (2012). Against the view that consciousness and attention are fully dissociable. *Frontiers in Psychology*, *3*, 1-14. doi: 10.3389/ fpsyg.2012.00036.

Masuda, T. & Nisbett, R. (2006). Culture and Change Blindness. *Cognitive Science, 30*, 381–399.

Matlin, M. (1987). *Perception.* Boston, MA: Allyn and Bacon.

McNeill, D. (1992). *Hand and mind: What gestures reveal about thought.* Chicago, IL: University of Chicago Press.

Merleau-Ponty, M. (1962 [1945]). *Phenomenology of perception.* (C. Smith, Trans.) New York, New York, USA: Humanities Press.

Müller, C. & Tag, S. (2007). Why gesture? On the role of focal attention in speech, gesture, and gesture-complexes. Presentation: *10th International Cognitive Linguistics Conference*, Krakow, Poland, 17 July.

Oakley, T. (2009). *From attention to meaning: Explorations is semiotics, linguistics, and rhetoric*. European Semiotics Series, Volume 8. Bern: Peter Lang Verlag.

Parasuraman, R. (1998). *The attentive brain.* Cambridge, MA: MIT Press.

Parasuraman, R. and Davie, D. R. (1984). *Varieties of attention*. New York: Academic Press.

Pascual, E. (2008). "Fictive interaction blends in everyday life and courtroom settings". In: T. Oakley, & A. Hougaard (Eds.), *Mental Spaces in Discourse and Interaction*. Amsterdam, NL: John Benjamins Publishing, 79-107.

Pashler, H. E. (1998). *The psychology of attention.* Cambridge, MA: MIT Press.

Pöppel, E. (1997). A hierarchical model of temporal perception. *Trends in Cognitive Science, 1*, 56-61.

Posner, M. & Raichle, M. (1994). *Images of Mind.* New York, NY: Scientific American Library.

Ramus, F., Hauser, M., Miller, C., Morris, D. & Mehler, J. (2001). "Language discrimination by human newborns and by cotton-top tamarin monkeys". In: M. Tomasello, & E. Bates (Eds.), *Language Development: The essential readings*. Oxford: Blackwell Publishers, 34-41.

Reisberg, D. (1997). *Cognition: Exploring the science of mind.* New York, NY: W. W. Norton & Co.

Saussure, F. de (1972 [1913]). *Course in general linguistics*. (R. Harris, Trans.) Chicago: Open Court.

Searle, J. (1995). *The construction of social reality.* New York, NY: The Free Press.

Shallice, T. & Cooper, R. P. (2013). Is there a semantic system for abstract words? *Frontiers in Human Neuroscience 7*, 175.

Sinha, C. & Jensen de Lopez, K. (2001). Language, culture, and the embodiment of spatial cognition. *Cognitive Linguistics, 11*, 17–41.

Sinha, C. (1999). "Grounding, mapping, and acts of meaning". In: T. Janssen, & G. Redeker (Eds.), *Cognitive Linguistics: Foundations, scope, and methodology*. Berlin: Mouton De Gruyter, 163-194.

Styles, E. A. (2005). *Attention, Perception and Memory: An Integrated Introduction.* New York: Psychology Press.

Talmy, L. (2007). "Attention phenomena". In: D. Geeraerts, & H. Cuyckens (Eds.), *Handbook of Cognitive Linguistics*. Oxford, UK: Oxford University Press, 264-293.

Talmy, L. (2000a). *Toward a cognitive semantics, volume 1: Concept structuring systems.*Cambridge, MA: MIT Press.

Talmy, L. (2000b). *Toward a cognitive semantics, volume 2: Typology and process in concept structuring.* Cambridge, MA: MIT Press.

Tomasello, M. (2004). *Constructing a language: A usage-based theory of language acquisition.* Cambridge: Harvard University Press.

Tomasello, M. (1999). *The cultural origins of human cognition.* Cambridge, MA: Harvard University Press.

Tomlin, R. (1995). "Focal attention, voice and word order". In: P. Downing, & M. Noonan (Eds.), *Word order in discourse*. Amsterdam, NL: John Benjamins Publishing, 517-552.

Tomlin, R. (1997). "Mapping conceptual representations into linguistic representations: The role of attention in grammar". In: J. Nuyts, & E. Pederson (Eds.), *Language and conceptualization*. Cambridge, UK: Cambridge University Press, 162-189.

Treisman, A. (1960). Contextual cues in selective listening. *Journal of Experimental Psychology*, *12*, 242-248.

Trevarthen, C. (1980). "Communication and cooperation in early infancy: a description of primary intersubjectivity". In: M. Bullowa (Ed.), *Before speech: The beginning of interpersonal communication*. Cambridge, UK: Cambridge University Press, 321-347.

VanRullen, R., Carlson, T. & Cavanagh, P. (2007). The blinking spotlight of attention. *Proceedings of the National Academy of Sciences of the United States of America, 104*, 19204-19209.

Wickens, C. (1984). "Processing resources in attention". In: R. Parasuraman and R. P. Davies (Eds), *Varieties of Attenion*. New York, NY: Academic Press, 63-102.

Wittgenstein, L. (1958). *Philosophical investigations*. (G. E. M. Anscombe, Trans.). New York: Macmillan.

Yantis, S. & Johnson, D. N. (1990). Mechanisms of attention priority. *Journal of Experimental Psychology: Human Perception and Performance, 16*, 812–825.

Zlatev, J., Persson, T. & Gärdenfors, P. (2005). Bodily mimesis as the "missing link" in human cognitive evolution. *Lund Cognitive Studies (121)*, 1–45.

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Chapter 7

EMOTIONS, ATTENTION AND BLENDING

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"In reality, the other is not shut up inside my perspective of the world, because this perspective itself has no definite limits, because it slips spontaneously into the other's, and because both are brought together in one single world in which we all participate as anonymous subjects of perception."

Merleau-Ponty (1989, p. 353)

ABSTRACT

In this chapter we understand that emotions and attention play a constitutive, fundamental role in human interactional experiences and, thereby, in the process of meaning production. We make sense of experiences in the physical and social world with a body in movement. We live in a body in which we perceive, we pay attention, and we experience emotions to produce meaning in diverse semiotic situations. The enunciative process is one of the ways by which human beings construct meaning by sharing attention, given that, at the core of language, is the attunement to others. Emotions are biophysiological and psychosocial (re)actions of human beings in a cultural and physical environment, triggered by stimuli that assume a determined value to this subject. From a systemic and functional perspective, the basic features to understand the phenomenon of emotions are: the relevance value of the environment to the organism; the motivational force that produces a state of readiness for action; the entire body engagement in the action and the claiming of priority to control behavior and experience (Frijda and Scherer, 2009). In this chapter, we assume that these criteria can be parallel with the system that constitutes The Greater Attention System, as proposed by Oakley (2009). As a way of describing this parallel, we analyze some specific rhetorical situations. With this

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in mind, we consider some principles of Blending Theory (P. A. Brandt, 2004) by analyzing a fictive travel phenomenon. The main goal of this chapter is, precisely, to systematize a discussion that allows us to understand that emotion, as well as attention, are at the heart of meaning construction and that these kinds of human experiences are structured by the same functional and systemic criteria.

1. INTRODUCTION

The question "What are emotions?" is explicitly marked in the history of Western Philosophy. From Plato to Descartes, through Aristotle's Theory of Emotions and relevant reflections by Thomas Aquinas, Kant and Nietzsche, many works aimed to answer this seemingly simple question.

The word emotion derives from the Latin *emovere*, which means to set in motion, to move (Cunha, 1982). We signify our experiences in the physical and social world with a moving body, that is, we live in a body and through it we perceive, move, *experience emotions* and *feel* in order to signify. Adopting this perspective means to support the thesis that emotions are at the core of the process by which our embodied mind produces meaning (M. Johnson, 2007).

From a biological perspective, emotions may be defined as neural, chemical and behavioral responses to several kinds of stimuli that usually have a positive or negative value for each one of us. These values are part of the homeostasis process that keeps our body working in balance. Nonconscious states such as homeostasis play an important role in the configuration of our values. That which becomes significant to us and how this takes place depends, fundamentally, on the monitoring of our corporal states while we act and experience the world (M. Johnson, 2007, pp.56-57). Scholars at work in different fields of knowledge enable us to observe important convergences concerning the definition of emotions (Frijda, 2008; M. Johnson, 2007; Scherer, 2013). Among these convergences, we think that emotions may be understood as an action simultaneously bio-physiological and psychosocial of human in his or her environment, triggered by stimuli that assume a certain value for this subject, in a given interactional situation.

Frijda and Scherer (2009)[1] systematize these convergences in a functional approach, outlining that emotions:

a) arise when something relevant takes place in the organism and this is directly related with the organism's needs, objectives, values and general well-being. The relevance value is ascribed by the organism through an evaluation of events in accordance with certain criteria, in particular by its novelty or surprise, its intrinsic pleasure or displeasure and its consistency with the motivation in question;
b) prepare the organism to respond to important life events and, thus, are a strong motivational force that elicits states of readiness for action;
c) engage the whole organism in the preparatory synchronization of the somatic-visceral and motor systems and, thus, involve several of the organism's components and subsystems; and, finally,

[1] Frijda and Scherer (2009) apud Scherer (2013, p. 110).

d) reclaim, not always successfully, the priority of the control of actions involved in the organism's behavior and experience.

From this perspective, we may define an emotion as an episode characterized by an emergent pattern of synchronization among several components which prepares adaptative responses to relevant events, such as those defined in the four precedent criteria (Scherer, 2005; 2013).

There are numerous concrete examples of emotions that can be seen in everyday life, in which we synchronize the aforemented four criteria. Let us suppose, for instance, that you are standing in the cashier queue at your favorite bookshop, ready to pay for a book you have wanted for a long time. Suddenly, you are pushed from behind by another customer and fall over the child in front of you, injuring her (*something relevant happened*). Even though you were not responsible for the push that made the child tumble, the child's mother gives you a disapproving look, which immediately elicits in you different and simultaneous emotional reactions; you get angry at whoever had pushed you over, worried about the injured child and, in case you believe you could have avoided the push, you feel guilty and upset, deciding to apologize to the child's mother (*readiness for action*). After electing the book on the shelf as the object of your attention, you began to experience a set of emotions (contentment, satisfaction, happiness) which we generally call "well-being." In view of the unexpected episode, the focus of your attention changes drastically. Your initial sense of well-being typical of most euphoric emotional states is replaced by the discomfort typical of dysphoric emotional states (shame, irritation, frustration), that can arise by flushing, tachycardia, sweat, and so on (*engagement of the whole organism in the synchronization of the somatic-visceral and motor systems).*

In agreement with Frijda and Scherer (2009) and Scherer (2005), we understand that, systemically and functionally, emotions are structured based on: the relevance value of the environment to the organism; the motivational force generating readiness to act; the engagement of the "whole" organism in the action; and the search for the actions' control. As we will see further along, these elements may be considered in a framework for the explanation and description of the role of emotions in the meaning production process.

Furthermore, adopting the same approaches as M. Johnson (2007), Frijda and Scherer (2009) and Scherer (2005, 2013) enables us to consider that the human emotional experience involves actions that stem from some patterns. These patterns emerge from the synchronization of the body's organic systems (the visual, auditive, circulatory, respiratory, digestive and limbic systems) implicated in the cognitive functions (sensation, perception, attention, memory) and, in turn, in the semiotic intersubjective experiences, instantiated in different languages (verbal, visual, musical, mathematical, etc.).

Emotions are, thus, implicated in the process of meaning production. Meaning production presupposes multisystemic movements on the part of an embodied mind. The embodied mind, in turn, acts ascribing value to its relationships with the environment (Zlatev, 2003)[2]. The tendency to establish the systemic body equilibrium (homeostatic) takes place in psychobiogical processes that are connected to the intersubjective relationships that we establish socioculturally, including attentional and emotional relationships.

[2] For Zlatev (2003), meaning is the relationship between the organism and the environment determined by the value that the first attributes to the latter, a definition described by the formula S = V(O, E).

2. PERCEPTION, ATTENTION AND EMOTIONS

Consensus among a diverse range of scholars and researchers from different disciplines places attention at the heart of human cognitive capacities (cf. Tomasello, 1999, 2003, 2009; Oakley, 2009; Marchetti, 2010, 2012). All human activities involve the activation of the attention system. The capacity for attention presupposes the systematic activation of our neurophysiological, motor and psycho-cognitive nature. When we focus our attention on an object (be it material, psychic or phenomenological), we simultaneously activate neuronal groups in several parts of the brain and mobilize parts of the body that are, more or less explicitly, implicated in the act of paying attention, perceiving, conceptualizing and feeling. The capacity of paying attention ensures survival.

Sensory-perceptual - and, thus, synesthetic experiences - of human beings seem to organize themselves in accordance with a certain architecture that includes different forms of perception organized by the parameters of attention and emotional experiences[3]. The pragmatic experiences of symbolic communication presuppose that these different forms of perception are always shared and actualized in the "here-and-now" of human interaction. Our perception of a concrete object, a phenomenon or an action, always takes place in a situation that is also perceived by others. Our perception is intersubjectively and gestalticaly configured.

Under a phenomenological perspective, Gallagher and Zahavi (2008, p. 101) remind us that we always perceive an object within a given context. Our experience with the perceptual objects that surround us does not exhaust itself in their appearance. Our perception of these objects is always partial. In fact, each object with which we interact daily has coexistent potential profiles, even if they are inaccessible. The perception of the other, who always appears and "inundates" my perception, even if inaccessible to me, is also manifested by (and in) absent profiles**.** This means that all objects with which we interact, in the physical as well as in the abstract world, are referenced intersubjectively. Human beings are born and raised by others who already act and perceive the world and are in the world. Our sense of reality and of the things we perceive depends on this. Whether empirically present or not, the other is always present in the experience of my perception, of my emotions and my attention. From a bio-physiological perspective, the attention experience implies a distributed series of neuron populations which interact mutually with other populations during the performance of perceptual, motor and conceptual tasks. Paying attention entails a neurophysiological and psycho-emotional cost. Our survival depends on the energy we invest in the act of paying attention. And, to pay attention, the human being necessarily evaluates. Evaluation is a fundamental component of human existence, implied in our attentional experiences and, as we have seen in the first section, also in our emotional experiences. For the Chilean biologist Humberto Maturana (2002, p.19), "the human peculiarity is not in the manipulation but in language and its intertwining with emotioning". We live as we share, intersubjectively, our existing. We live in the same measure that, in the relationship with the other, whom we recognize as an intentional subject like ourselves, we emote, perceive and pay attention. Language, the capacity to communicate symbolically, evolutionary allow human beings to

[3] Exteroception (sight, hearing, smell, touch, taste); proprioception (spatial orientation perception and that of the posture and movements of our own bodies) and interoception (sensations such as pain, pleasure, hunger, thirst, desire; feelings such as love, hate, anger). See Oakley (2009, p. 125).

have social experiences and create cultural artifacts which, in different *processes of semiosis,* emerge from our capacity to experience and share emotion, perception and attention.

In the field of Cognitive Linguistics, we have studies that corroborate the assumption that human beings operate, with and in the world around them, with attention at the center of their action. According to Oakley,

> language marks an apotheosis of the human propensity to convert an object of attention into an intention and then convert that intention into an object of someone else's attention. It ensures a continuous dialectical interplay of attention and intention, a dialectic initiated between two or more people and only later, with time and practice, becoming internalized and "autopoetic".
>
> (Oakley, 2009, p. 126)

The attention we direct toward a certain environment, object or even idea (as a function of the relevance we attribute to this environment, object or idea) requires that we concentrate on a set of characteristic elements to the exclusion of others, which constitute that which (or who), triggered by an emotion, turns out to be the object of our attention. To put it differently, this implies a motivational force that generates the action of identifying and selecting a given set of characteristic elements and, also, within the same set, the exclusion of others. The elements of our attention are, thus, emotionally and perceptually enhanced. Our bodies respond to the changes in the states of these elements (objects, people, phenomena). Aspects of these objects to which we do not direct conscious attention are partially suppressed. At a given moment, our consciousness focuses on a small subgroup from the large number of stimuli that impact our perceptual system. This is how we can understand the operation of attentional selectivity. In this action, our organism is systematically engaged and acts in such a way as to try to control this and other actions which are vital to our species, among which is the harmonization of our attention/emotion with the other**.**

Based on the results of research undertaken in the field of the Neurophysiology of Attention and of the Cognitive Psychology to propose what he terms "The Greater Attentional System", Oakley (2009) postulates that the complexity of the attentional experience can be described by means of three systems (Signal System, Selection System and Interpersonal System), and by each of these systems is instituted on the basis of different elements or mechanisms of attention (alerting, orienting, detecting, sustaining, controlling, sharing, harmonizing, and directing attention). According to Oakley, the activation of the constitutive elements/ mechanisms of the three systems is fundamentally implicated in the production and understanding of different usages of symbolic language. Thus, The Greater Attention System is implicated in the very act of the language use and in the semiotic process of meaning production.

In consonance with the studies described up to this point, we can consider that emotional and attentional human experiences are constituted simultaneously by our sensory-perceptual experiences (which are essentially subjective and synesthetic) and by the sharing of these experiences under the form of symbolic language with intentional subjects like ourselves (a fundamentally intersubjective experience). Grounded in this perspective, emotions, as well as attention, are at the heart of the process of meaning production and these kinds of human experience are structured by the same functional and systemic criteria.

In this chapter, we assume that the criteria that define emotion (see section 1) can be parallel with the system that constitutes The Greater Attention System, as proposed by Oakley (2009). Our goal is to demonstrate, in principle, that attention and emotion are appositional facets of meaning construction: one does not happen without the other. In other words, we intend to provide a preliminary model of emotional engagement that relates systematically to the elements of The Greater Attention System.

As we have seen, our emotional experiences (anger, happiness, love/desire, fear) are systemically and functionally structured, according to the value we attribute to an object in a given situation. Emotional experiences prepare human beings to respond to life events. They are strong motivational force that elicits states of readiness for action, while human beings share attention intersubjectively.

From this moment on, we intend to describe and relate the components that structure emotions to the elemental capacities of The Greater Attention System. Let us resume for a moment the example of the bookshop from the previous section. In that context, it is perfectly possible that the mother would react as in the dialogue below:

– Mom: Are you nuts?
– You: Sorry, it was not my fault.

Before we go through an analysis of the example, it is worthy to remember that the *relevance value,* one of the elements of emotion, is ascribed by the interactants through an evaluation of events in accordance with certain criteria, in particular by its novelty or surprise, its intrinsic pleasure or displeasure and its consistency with the motivation in question.

In the bookshop dialogic context, we can conclude that the relevance value implied in the scene could be described in terms of: i) the mother's sensitivity toward the safety and comfort of her son; ii) her conscious recognition he had been injured; iii) and that she must attend to this situation above all else. According to The Greater Attention System model, in this situation, as is always the case, the interlocutors (the mother and you) are *alerting* to the environment stimuli and sensible to their intensity. Alerting refers to the process of maintaining a general readiness to process novel items, and it is a biophysiological state (Oakley, 2009, p.27). A relevance element (the fall of the child) is *detected* so that it affects the alerting system of the participants of this scene. This novel action changes the emotional and attentional state of the mother and her interlocutor, face the intensity of stimuli. In this case specifically, the interactants are *sharing* the space with other subjects that, at first, are not necessarily implicated in the problematic situation. In Oakley's terms, "sharing attention can be described as the peripheral awareness of another" (Oakley, 2009, p. 34). The mother's reaction (questioning you aggressively) reveals her sensitivity to your intentional state toward a common attentional object (the fall of her child). At this moment, both of you are explicitly *harmonizing* attention.

All social events and situations elicit emotions in order to alert and orient the individual. Orienting is a spatial, temporal, and cultural disposition to attend based on cultural frames of reference (Oakley, 2009, p.37). In this social event example, the cultural frame of reference is a commercial transaction, in which the injury action is an unexpected one. This particular unexpected event is the relevant selected element of the frame that evoked different emotions. This emotional experience has a powerful *motivational force* that elicits states of readiness for action. In order to act, we *orient* our attention by detecting particular relevant kinds of

information over other kinds of information that are less relevant for us. The motivational force that orients the aggressive mother's questioning ("*Are you nuts?*") can be identified in basic emotions[4] such as anger, fear, disgust.

Emotions, as you recall, reclaim, not always successfully, the priority of the control of actions involved in the organism's behavior and experience. In our example, the *action control* is perceptible in the act of both the mother and you adjusting the zoom lens of your attention from a larger scenario (the queue in the bookshop to pay for the items that had been bought) to the incident itself, by concentrating cognitive resources to attend to it (*sustaining*). In addition, aiming at *controlling* the actions inherent in the situation, the mother alternates the focus of her attention between two different, heterogeneous tasks: helping her child and insulting (you). You, in turn, switch your attention between understanding the nature of the incident (caused by another person) and your embarrassment before the child's mother.

Regarding the attention and emotional experiences, the whole organism is biophysically and socio-psychologically involved. The possible blushing, the high pitch of her voice and the aggressive tone may be understood, in its turn, as the *engagement of the entire organism* in the mother's (re)action as a consequence of the action threatening her son.

As elements that structure emotions, the relevance value lines up with the alerting, detecting, sharing and harmonizing systems; the motivational force, in turn, lines up with orienting, and, finally, the action control lines up with sustaining, controlling and directing.

Table 1, adapted from Oakley (2009, p. 37), outlines the parallelism we propose.

To consider that human beings are constituted, bio-psychosocially, on the basis of experiences of an interpersonal and intersubjective nature means to assume that our existence is founded on an indissoluble relationship with the other and that this relationship is actualized on the basis of the sharing of our perceptual, emotional and attentional experiences.

To a greater or lesser degree, this sharing takes place in a compulsory manner, that is, in the process of human interaction we do not have the option of sharing or not sharing our sensory-perceptual, attentional and emotional experiences. In social interaction and, particularly, in linguistic-discursive interaction, this sharing necessarily occurs.

Emotional and attentional experiences are implicated in the process of linguistic-discursive interaction. In the following section, we aim to demonstrate how these experiences are implied in the blending process, which is a basic, fundamental cognitive operation of the meaning construction process (P. A. Brandt, 2004; Oakley, 2009).

3. EMOTIONS, ATTENTION AND BLENDING

Throughout the discussion in this chapter, our aim is to corroborate the thesis that, in the specific context of a discursive interaction, we share perceptual, attentional and emotional experiences as we interact.

As Benveniste (1989) put it, the enunciation process brings about language subjects (I-you) who, in the here-and-now of discourse, manifest themselves dynamically in different enunciation instances.

[4] See Oakley (2009, p. 59).

Table 1. Emotional elements x Attentional elements

Emotional elements / Attentional elements	Relevance value Arise when something relevant takes place in the organism and this is directly related with the organism's needs, objectives, values and general well-being	Motivational force Elicits states of readiness for action	Action control Reclaim, not always successfully, the priority of the control of actions involved in the organism's behavior and experience	
Signal System	Alerting Sensitivity to the *intensity* of stimuli	Orienting Spatial, temporal, and cultural disposition to attend; based on cultural frames of reference		
Selection System	Detecting Conscious recognition of something as relevant to the performance of a task; identification of a task		Sustaining Concentration of mental resources on something; the feeling of narrowing the aperture on "zoom lens" of attention	Controlling *Switching* attention between two heterogeneous tasks; *oscillating* between two aspects of a single object or task
Interpersonal System	Sharing Sensitivity to the presence of other beings as self-propelled, "mechanical" agents without attending to them as intentional Agents Harmonizing Sensitivity to the intentional states of other agents toward a common object of interest (i.e., joint attention); the feeling that the other is attending to the same thing as you; refracting attention occurs when one person establishes attention to something else by following another person's gaze; reflecting attention occurs when one agent makes this other person's gaze the object of attention, a kind of surveillance			Directing The ability to manipulate the attention of other agents; the feeling of being manipulated by some other agent or agency

Joint attention, that is, the sensitivity to the intentional states of other agents looking for a common interest, is a determinative element of the enunciation process and, therefore, of meaning construction. Cognitively, we live in the here-and-now as we attend to the there-and-then, by an imaginative mental simulation. This kind of simulation is at the basis of rhetorical practices, which exploit present audience beliefs to induce new beliefs in the audience.

In different rhetorical situations (reading a book, telling and listening to a story, interviewing and being interviewed), we create "scenes", "scenery", dramatically structured, around "agents", "objects", "relationships", "states" and "processes". These "dynamic scenes" are what P. A. Brandt (2004) calls "mental spaces"[5]. The meaning construction process involves, as a rule, an integration network of these "dynamic scenes", from which brand-new meanings emerge. In this theoretical perspective, language is, itself, a source of theatricality. The dialogue - implicated in the production and use of (verbal and nonverbal) language - is inherently theatrical.

In this perspective, mental spaces are dynamic mini-dramas, which depend on schematic resources of interactivity. One important aspect of meaning construction is the fictive act of using representational resources in a pragmatic situation that presupposes attention in the here-and-now to characterize a scene, situation, or facet of a scene or situation from the there-and-then (Oakley, 2009, p.67).

Let's examine the rhetorical situation of an interview. In this analysis, we will focus on the interviewer and interviewee discursive interaction, in which they share emotional and attention experiences, in adjacency pairs of questions and answers. To exemplify the analysis proposed in this chapter, we will exploit the relationship between three elemental capacities of attention (orienting, harmonizing, and directing) and the components of emotion (relevance value, motivational force, and action control).

The text in focus is a section of a dialogue in which a journalist interviews Alex Atala, an important Brazilian *chef de cuisine*, for the weekly magazine *Time Out São Paulo*. Atala is considered the mastermind behind D.O.M. restaurant, elected number four in the San Pellegrino World's 50 Best Restaurants awards in April, 2012. His uniqueness is due to his ability to make *haut cuisine* with genuine Brazilian regional ingredients. The prize is the element that motivates the interview.

In this dialogic situation, the opening question directs Atala's attention to the meaning of the award. In his answer, in turn, Atala states that his initial expectation was that his restaurant would fall in the rankings. The use of a metaphor to describe the meaning of the prize, in this context, reveals the chef's surprise and pride.

> **What does winning fourth place in the World's Best Restaurants awards mean to you?**
>
> It's a dream I never dreamed of – I never imagined I'd reach this point. I went to London thinking we were going to fall in the rankings.
>
> D.O.M.'s Alex Atala: interview. Time Out São Paulo. Available at: http://www.timeout.com.br/sao-paulo/en/restaurants/features/274/alex-atala-interview - Accessed March 8th, 2014.

As a way of attributing *relevance value* for the prize, the chef means it by the metaphor "a dream never dreamed of". Sharing with the interviewer a specific cultural frame of

[5] Concept originally proposed and developed at Mental Spaces and Conceptual Integration Theory, by Faucconier (1994, 1997) and Fauconnier and M. Turner (2002).

reference (the rankings of a prize and its value), Atala experiences a *motivational force* that *orients* his own attention and action. At the moment of the interview (here-and-now), Atala *directs* the interviewer's attention to a previous moment (there-and-then), in which he did not imagine that he would win the prize. This discursive movement, marked by the verbal tense switch (present-past), is a trial of *action control*. By this movement, Atala (here-and-now) directs the interviewer attention to another time/space (there-and-then) in order to justify his surprise, based on his unexpectation. As a consequence of an evaluation of the real circunstance (the fourth place), his surprise, as the interview develops, turns out to be pride. Pride is an emotion that, as we will see, calibrates great part of the interview.

People show surprise when there are violations of expected events (e.g. fall in the rankings). Surprise is a "primary or basic emotion", that is, people's first, gut-level emotional responses to situations (e.g. fourth place in the rankings). Pride, on the other hand, is the consequence of a successful evaluation of a specific action (unexpected award). In this sense, it is a secondary and social complex emotion, which presupposes a self-appraisal in the "looking glass" provided by others' responses (the group of judges) to a person's behaviors or actions. Sociology of emotions studies point to the fact that individuals act in accordance with expectation states and cultural beliefs and that those in higher-ranking positions experience positive emotions such as happiness and pride, while those in lower-ranking positions experience negative emotions like anger and fear (Stets and J. H. Turner, 2008, pp. 32-35).

As the interview develops, in the turn-taking between interviewer and interviewee, pride and happines are emotions explicitly disclosed.

> **From what I've been hearing and reading since the announcement of the prize, it seems that people here in Brazil feel extremely *proud* of you.**
>
> It makes me happy. This recognition, this opening up – seeing people becoming emotionally engaged is wonderful. But for me, it's the same fight it has always been. I already felt this way – I'm stubborn, and I've always wanted to fight for this.

At this moment in the interview, we can notice that the prior referential element "prize" instigates a sense of being "proud". Then, we can say that the emotional experience of *pride* frames the selection of a new referential element: "proud". In another moment in the interview, the chef proposes a fictive travel through Brazil by its flavors. Fictive action[6] is one important aspect of conceptualization. By this kind of act, we use representational resources commonly associated with attention in the here-and-now to characterize a scene or a situation from the there-and-then by a threatrical, virtual interplay. To answer the question *"Is there any flavor in particular that says 'Brazil'?"* Atala stages a fictive travel by a metonymic cognitive operation. Let's see.

> **Is there any flavor in particular that says 'Brazil'?**
>
> That's really hard. Brazil is a continental country, so you find lots of flavors that represent particular regions of Brazil. But you could say Amazônia with tucupi, chicole do Pará, pimenta de cheiro – you *just close your eyes and you feel like you're there*. Or pequi fruit from the savannah. In Bahia, it has to be the dendê palm oil. If it's chimarrão

[6] For further information, see Pascual (2002), and L. Brandt. (2013).

> [maté tea] and beef, then it's a barbecue – that's the flavor of the south of Brazil. Cheese bread with coffee or cornbread: Minas Gerais.
>
> You can *travel the whole of Brazil through its flavors*, and that's something incredibly clear: that culture is expressed and can be exported through these ingredients.

In the interview, upon assuming the perspective of a physical and cultural distancing regarding 'Brazil' and its regional uniqueness, the interviewer defines the country in terms of 'a whole indivisible into parts' which, metonymically, cannot be associated with any particular flavor. The interviewee, in turn, engages in a discursive movement that aims at directing the interviewer's attention to the possibility, and indeed the necessity, of categorizing the same object of attention (Brazil's flavors) under another metonymical perspective. This rhetorical dynamic is critical for the meaning construction.

At this moment in the interview, the chef refuses the journalist's request, but with politeness and, following the Grice's maxims of quality, quantity and manner, justifies his refusal. From Atala's point of view, it's hard to categorize the whole of Brazil under a unique flavor. According to the chef, the flavors of each region metonymically represent the region itself, and not Brazil as a whole. This is, indeed, a cultural frame. Given that Brazil is "a continental country", under influence of a diversity of cultures, ethnicities, religions, and, cuisines, Brazilian people recognize themselves as a mosaic of all of these variables. The uniqueness of Brazil cannot be expressed or represented by a particular flavor, but by the variety of them.

As we can see in this third excerpt, Atala reveals to be an advocate of Brazilian regional cuisine. In his answer, he establishes a metonymic relationship between flavor and region. In his words, "you find lots of flavors that represent particular regions of Brazil". He tells us that the only way to get acquainted with Brazilian cuisine is to get to know flavors and ingredients from different regions of Brazil. This relationship, flavor and region, is culturally framed, as Atala details by uttering, for instance: "you could say Amazônia with tucupi, chicole do Pará, pimenta de cheiro". This is a form of fictive interaction, in which the flavor itself "speaks" and "names" the region. Spices and foodstuffs are therefore rigid designators of a region. In this sense, the Brazilian chef creates a fictive scenario in which he proposes us to "travel the whole of Brazil through its flavors". The scene constructed by Atala involves a projected ego that moves itself about in the discursively delimited space. In this fictive travel (there-and-then), we can identify the participants (Atala and the journalist), the scenario (the regions of Brazil), the situation as it pertains to the current discourse situation (here-and-now). Thus, in this dialogic situation, while the journalist *directs* Atala's attention to find a unique flavor that represents Brazil, the chef *directs* the journalist attention to a fictive travel around the regions of Brazil. At the interlocutors attentional experience, the capacity of *directing* attention presupposes the emotional component of *action control*. We have to keep in mind that, as the discourse flows, the question of the interviewer (Is there any flavor in particular that says 'Brazil'?) stages as a topic a new referential element: a particular flavor representing Brazil. And we cannot forget that this topic is presented in a dynamic of emotional experiences in that happiness and pride are elemental emotions. Pride is an important parameter for the discursive strategy used by Atala to answer the interviewer:

> "That's *really hard*. Brazil is a *continental country*, so you find *lots of flavors* that represent particular regions of Brazil".

All the highlighted nominal phrases are composed by modifiers of intensity which conspire to create an effect wherein the interviewer is to imagine the vastness and cultural heterogeneity of the country as manifest in the variety of flavors. The nominal phrases modifiers (really, continental, lots of) reveal the chef's intention to increase the status of Brazilian cuisine (its flavors) and, therefore, his own status as a chef. This predicative structure reveals an attempt of action control. This is a discursive strategy used by the chef in other moments of the interview. For example:

> **Speaking of Brazilian cuisine, what is it that distinguishes it from other cuisines?**
>
> Well, the raw materials are just *amazing*, don't you think? The country is distinguished by the *quality* and *potential* of its products. And there are some *incredible* ingredients here that people can only understand if they come to Brazil.

Based on recent research about self-conscious emotions (pride, shame, guilt, embarrassment), we can find results that describe different functions for pride. Among them, one function is that "the experience of pride reinforces prosocial and achievement-oriented behaviors and informs the individual that he or she has done something to *increase* his or her status and group acceptance" (Tracy, R. W. Robins and Tangney, 2007, p.278).

Pride is a *relevance element* for the chef to highlight the variety and complexity of Brazilian cuisine and, therefore, to elect the way the referential element (Brazilian flavor) will be presented (a fictive travel). At this moment of the interview, the chef and the journalist attentional and intentional states have to be *harmonized* with imagined travelers (just close your eyes and you feel like you're there), their virtual tour through the space that allows us the experience of tasting different flavors that represent each region of Brazil (pequi fruit, dendê palm oil, chimarrão, cheese bread). As we have shown in the previous section, the attentional capacity of *harmonizing*, i.e., sensitivity to the intentional states of other agents toward a common object of interest, is directly related to the emotional component of *relevance value.* In Oakley's terms, harmonizing attention capacity occurs whenever we feel that the other is using language as a means of calibrating each other conscious experiences, in such way that each one knows the other to be attending to a common object. In the excerpt in analysis, from an interpersonal system perspective, the capacity to harmonize attention ensures that the participants are attending to the same scene: the fictive travel, (there-and-then) at the same time (here-and-know).

In sum, based on the whole set of emotions eventually experienced during the interview, we can state that the relevance elements implied in the discursive process (as we described before) can be understood in the following terms:

i. the *relevance value*, as we have seen, is shared by the interlocutors through an evaluation of events in accordance with certain criteria, in particular by its novelty or surprise, its intrinsic pleasure or displeasure and its consistency with the motivation in question. The prize is the surprise, the novel element that motivates the interview. There is a cause-effect relationship between the prize and Brazilian haut cuisine made by Atala. The common object of interest (the prize and Brazilian cuisine) acquires a relevant value to the interlocutors – *harmonizing.*

ii. the *motivational force* implied in this interactional situation is oriented by cultural frames of reference, among which are the 'interview' and "*haut cuisine"* frames. In this discursive situation, interviewer and interviewee share these frames of reference from different cognitive and discursive perspectives. This rhetoric strategy implies spatial, temporal, and cultural disposition to attend (e. g., the succession of questions and answers that characterizes the situation of an interview) - *orienting*;

iii. the search for *action control* can be seen as both interlocutors: *mutually manipulate their attention*, in a process of meaning construction which implies the evocation and comprehension of different metonymic resources – *directing.*

In this chapter we start with the presupposition that meaning construction implies a basic cognitive operation named conceptual blending (Fauconnier & M. Turner, 2002; P. A. Brandt, 2004). Our challenge now is to depict a potential relationship between attention, emotions, and blending. We intend to demonstrate how the theoretical model of conceptual integration proposed by P. A. Brandt (2004) allows for the comprehension and description of the process of meaning production, so as to integrate the attentional and emotional dimensions that constitute this process.

The theoretical model proposed by P. A. Brandt presupposes that the conceptual integration process is always set up from a concrete interactional situation, in which and from which a base semiotic space is established. This *Base Space* is to be understood as the space in which the intelorcutors share patterns of attention for the co-construction of reference and of meaning. This is the space that corresponds to the here-and-now of the discourse, and is, therefore, the space in which the interlocutors, aiming at the co-construction of the reference, position themselves in relation to their own enunciation. In the semiotic base space, aspects which simultaneously structure the emotional and attentional experiences allow one to evoke and share those elements of the object of attention that become relevant for the interlocutors. For instance, in the bookshop situation, the mother and the other customer standing in line share a base space, a common reference to the here-end-now, even though they do not share the same perspective on that here-and-now. To put it differently, in the act of attending intersubjectively to concrete or abstract objects, perceived as a gestalt, the interlocutors share elements of these objects that acquire status of *relevance* in the interaction process. The semiotic base space, in turn, simultaneously establishes and integrates two mental spaces: a reference space and a presentation space.

From the cognitive perspective proposed by P. A. Brandt, the *Reference Space* is the space in which referential elements are identified and that, for that discursive scenery, are considered prominent. This is the space where one identifies something that (or WHAT) is the object of attention of the interlocutors. On the other hand, the *Presentation Space* is the space in which the interlocutors share intentional attention in the way the referential content is presented and is discursively constructed. This is the space of predication, of figurativeness, of metaphor. In this space we process knowledge relative to the way in which the referencing process is being instituted.

The process of meaning construction underlying a markedly metaphoric discursive scenario presupposes a mapping between elements identified in the spaces of reference and presentation. Conceptual integration, the cognitive operation implied in this mapping, allows human beings to create always new and deeply dynamic blend spaces, virtual spaces.

Blend Spaces are, thus, the spaces in which conceptual integration effectively takes place. From these spaces facets of meaning emerge, always new and different from those identified in the spaces of reference and presentation. As stated by L. Brandt and P. A. Brandt (2005, p. 227), the virtual spaces must be considered "spaces of momentaneous fictions that generate durable inferences". These inferences, in turn, are activated in a way that they are always new and unleash implications of a semantic-pragmatic character relative to the semiotic base space, from which new conceptual integration networks will be established.

Figure 1 presents the theoretical model here described in a diagram.

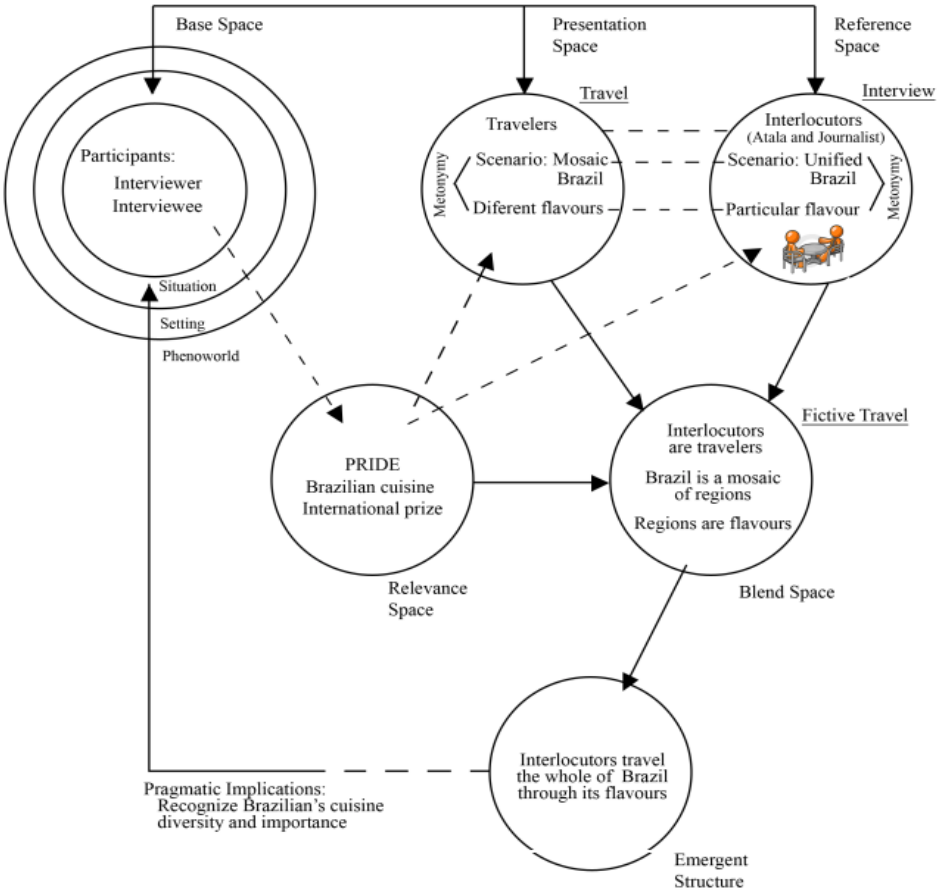

Figure 1. "Brazil's Flavor(s)" Conceptual Integration Network.

The conceptual integration network represented in this diagram is grounded on a *semiotic base space* in which the interactional situation participants play different roles (interviewer-interviewee) and share an interview's script.[7]. In this base semiotic space, the interlocutors undertake and alternate between several different actions, monitoring their (inter) personal attention, and their discursive performance, creating different strategies (gestural, prosodic, lexical and semantic). These strategies are developed to attain interactional goals, actualizing the script of an interview, by taking turns.

[7] This situation could also include readers of the interview, but this is not our focus.

At this process of interaction, the emotional and attentional experiences are fundamentally implied. At the meaning construction, these experiences assume the role of calibrating the blending process, as elements of reference space and presentation space are integrated at the Blend space. In terms of the dynamic of emotional experience at the interview in analysis, *pride* acquires a status of *relevance.*

In the base space in which the interview is structured, the relationship established between I-you, here-and-now, constructed from deictic and anaphorical assignments (interviewer-interviewee), raises salient elements of the interview discourse scenario. In the interview situation, by the question "*Is there any flavor in particular that says 'Brazil'?*", the interviewer enables the construction of a new mental space, the *reference space,* in which he suggests an association of Brazil with a single flavor.

In the here-and-now of the interaction, a facet of a metonymic relation (the association of Brazil with a flavor in particular) is rejected by the interviewee. In response, he proposes a multivalent metonymic relationship between Brazilian's flavors and regions. With this movement, elements of the reference space are projected to counterparts in the *presentation space.*

Therefore, the interlocutors project their ego as travelers, a unified Brazil scenario is projected as a mosaic of Brazilian regions scenario, and a particular flavor is projected as a variety of flavors. Then, at the *blend space,* interlocutors are travelers, Brazil is a mosaic of regions, and regions are flavors. This projection, as we have seen, enables the interlocutors to create a fictive travel: *"You can travel the whole of Brazil through its flavors".*

From this blend, it follows an *emergent structure* from which it is possible to experience the diversity of Brazil by sampling its many flavors, such that the diner in, say, São Paulo, can "tour" a whole continent by sampling the menu. As a pragmatic implication, the conceptual integration process can elicit the recognition of Brazilian's cuisine diversity and importance. This effect entails the recursive (re)configuration of the semiotic base space, at the here-and-now of the interview, from which new conceptual integration networks will be dynamically established.

In this analysis, in particular, we have focused on the interview interaction, but it is also possible to make a similar analysis from the reader's point of view, as the discursive movements of the interview also directs the reader's attention, but this is a point for other discussion.

In this section, through the analysis of a discursive situation, we intended to reveal the way in which emotional and attentional experiences, systemically and functionally structured in similar ways, must be considered in the process of meaning construction; they are constitutive of experiences and are based on the blending process.

CONCLUSION

In this chapter, we assumed that emotions and attention play a constitutive role in human interactional experiences and, therefore, in the process of meaning production. Human beings make sense of experiences in the physical and social world with a body in movement. We live in a body in which we perceive, we pay attention, and we emote; it is the perceiving,

attending, and emoting organism that produces meaning in diverse and disparate semiotic situations.

Emotions are bio-physiological and psychosocial (re)actions of human beings in a cultural and physical environment, triggered by stimuli that assume a determined value to this subject, in a given pragmatic situation. The basic features to understand the phenomenon of emotions are: relevance value of the environment to the organism, its motivational force and its search for action control.

The elemental attention capacities, that is, alerting, orienting, detecting, sustaining, controlling, sharing, harmonizing and directing can be associated to the criteria that structure emotions. In order to illustrate the parallelism established between emotional and attentional experiences, we have chosen to analyze a fragment of an interview marked by a specific rhetorical strategy: a fictive travel. A variety of others could be chosen, among a myriad of possibilities that arouses in actual language.

Our aim is simply to provide preliminary theoretical reflection for integrating three strands of cognitive research into emotion, attention, and meaning construction.

We recognize that, although emotions and attention are subjects historically studied in different areas of research, studies allowing to associate results from the scientific study of these different areas can and must be assumed as a challenge within the current agenda of language studies. This is the agenda to which we would like to contribute.

REFERENCES

Benveniste, E. (1989). [1974] Problemas de Linguística Geral II. Tran. by E. Guimarães et al. Campinas: Pontes.

Brandt, P. A. (2004). Spaces, Domains and Meaning**:** essays in cognitive semiotics. Bern: Peter Lang.

Brandt, L. and Brandt, P. A. (2005). Making Sense of a Blend. Aarhus: Center for Semiotic Research. Retrieved 17 Aug. 2013 from: www.hum.au.dk/semiotics.

Brandt, L. (2013). The comunicative mind: a linguistic exploration of conceptual integration and meaning construction. Newcastle upon Tyne: Cambridge Scholars.

Cunha, G. A. da. (1982). Dicionário Etimológico Nova Fronteira Da Língua Portuguesa. São Paulo: Nova Fronteira.

Fauconnier, G. (l994). Mental spaces. Cambrigde: Cambridge Univerty Press.

Fauconnier, G. (1997). Mappings in Thought and Language. Cambridge University Press.

Fauconnier, G. and Turner, M. (2002). The Way We Think: conceptual blending and he mind's hidden complexities. New York: Basic Books.

Frijda, N. (2008). "The psychologist's point of view". In: M. Lewis, J. Haviland-Jones and L. Barett (Eds.), The Handbook of Emotions. 3rd ed. NewYork: The Guilford Press, 68-87.

Fridja, N. and Scherer, K. (2009). "Emotion definition (psychological perspectives)". In: D. Sander and K. Scherer (Eds.), Oxford Companion to Emotion and the Affective Sciences. Oxford: Oxford University Press, 142-143.

Gallagher, S. and Zahavi, D. (2008). The Phenomenological Mind – An Introduction to Philosophy of Mind and Cognitive Science**.** London/New York: Routledge.

Johnson, M. (2007). The Meaning of the Body: A Esthetics Of Human Understanding. The University of Chicago Press.

Marchetti, G.. (2010). Consciousness, Attention and Meaning**.** New York: Nova Science Publishers, Inc.

Marchetti, G. (2012). Against the view that consciousness and attention are fully dissociable. *Frontiers in Psychology*, 3, 1-14. doi: 10.3389/ fpsyg.2012.00036.

Maturana, H. (2002). Emoções e Linguagem na Educação e na Política. Belo Horizonte: Editora da UFMG.

Merleau-Ponty, M. (1989). Phenomenology of Perception. Translated by C. Smith. London: Routledge.

Oakley, T. (2009). From Attention to Meaning: Explorations is semiotics, linguistics, and rhetoric. European Semiotics Series, Volume 8. Bern: Peter Lang Verlag.

Pascual, E. (2002). Imaginary Trialogues: Conceptual Blending and Fictive Interaction in Criminal Courts. Utrecht: LOT.

Scherer, K. R. (2005). What are emotions? And how can they be measured? *Social Science Information,* 44, 695–729.

Scherer, K. R. (2013). "Emotion in action, interaction, music and speech." In: M. A. Arbib (Ed.), Language, Music, and the Brain: a Mysterious Relationship. Massachussets: The MIT Press.

Stets, J. E. and Turner, J. H. (2008) "The Sociology of Emotions". In: M. Michael, J. Haviland-Jones and L. Barett (Eds.), The Handbook of Emotions, 3rd ed. NewYork: The Guilford Press, 32-46.

Tomasello, M. (1999). The Cultural Origins of Human Cognition, Harvard University Press.

Tomasello, M. (2003). Constructing a Language - A Usage-Based Theory of Language Acquisition, Harvard University Press.

Tomasello, M. (2009). Why We Cooperate? Cambridge: The MIT Press.

Tracy, J. L., Robins, R. W., Richard, W. and Tangney, J. P. (2007). The Self-Conscious Emotions: Theory and Research, The Guilford Press.

Zlatev, J. (2003). Meaning = Life (+ Culture). An outline of a unified biocultural theory of meaning. In: *Evolution of Communication*, 4/2, 253-296.

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Chapter 8

HOW ATTENTION DETERMINES MEANING: A COGNITIVE-SEMANTIC STUDY OF THE STEADY-STATE CAUSATIVES *REMAIN*, *STAY*, *CONTINUE*, *KEEP*, *STILL*, *ON*

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ABSTRACT

Rooted in Leonard Talmy's Cognitive Semantics, this chapter will demonstrate the fundamental impact and differential potential of 'Linguistic Attention' in meaning selection and construction, outlining a link-up of *The Attention System of Language* (Talmy, forthcoming) and another major schematic system, Force Dynamics. The overall objective of this chapter is three-fold: illustrating a theoretical framework, presenting a case study, and eventually sketching a research agenda.

First, I will offer some thoughts on how the cognitive systems Force Dynamics and Attention integrate in a "unified account of conceptual structure in language" (Talmy, 2000, 1, p. 467).

Second, based on the general principle of conceptual alternativity in language, a cross-venue comparison of *keep*, *still*, *on*, three force-dynamically specified event structuring closed-class items, and *remain*, *stay*, *continue*, three open-class competitors, will document the discriminating potential of Talmy's developing model of attention in language: In differentially allocating attention across meaning components and meaning sectors, two principal semantic Subdomains, Componential properties of the morpheme and Frame properties of the morpheme, are seen to capture systematic differences in salience between particular semantic components of a morpheme's meaning and between a morpheme's core meaning and its various associated meaning components, testifying to how speakers' choices and hearers' utterance interpretations are essentially guided by distinctive attention patterns.

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Third, contextualizing the items under scrutiny through authentic samples, the analysis provides a glimpse of how specialized attentional effects in linguistic alternatives selectively contribute to differentially perceive, represent, and frame reality. Such attention-based import gives rise to what I refer to as lexical items' attentional profiles, i.e., their potential to differentially respond to contextual options and constraints.

The suggestion advanced in the following may help resolve some notorious queries concerning the semantic description and/or the discourse-specific characterization of (not only) the items at issue, offering a more plausible and consistent explanation with reference to a 'cognitive space' that is defined by the interaction of two cognitive systems, language and attention: Linguistic choices from the alternatives available in a language system to represent a specific concept prove to be fundamentally motivated, if not substantially determined, by attentional parameters that may account for functional variation in language. And the consistency of the results from such cognitive-semantic investigation into attentional determinants of linguistic entities appears to support the idea that (general) attention, 'mediated' through its language-specific subsystem, is suitable to identify significant properties inbuilt in lexicalized items as some kind of 'black box,' which may, however, now be spelled out as a differentiated set of specified mechanisms.

1. INTRODUCTION

Acknowledging the fundamental insight that attention, as an essentially cognitive process, is not only "fundamental in determining what, how, and why we mean," but also that the conceptual complexes of symbolic units "convey the condensed instructions for the attentional operations one has to perform in order to consciously experience what is expressed through and by them," this volume is informed by the conviction that "[l]anguage, by addressing and guiding attention in specific ways, helps to select, amplify, and support certain semantic components and concepts, and construct and communicate knowledge" (from editors' invitation). In line with this basic orientation, the present chapter embarks on a demonstration of how principles of general attention, mediated through a schematic system in language sensitive to attention effects, provide for a linguistic repertoire of fundamental and systematic structuring devices. It is Leonard Talmy's developing 'Linguistic Attention' that accounts for a wide range and multifaceted set of attention-based cognitive effects operative in language which have largely been neglected in their principled and far-reaching implications in linguistics, thus recognizing the fundamental and systematic impact of general attention on how the human mind conceptualizes reality.

The bottom line of my argument in this chapter is to demonstrate the pervasiveness, or even ubiquity, of attention in framing 'linguistic' reality: Proceeding from a very basic attention-sensitive alternative representation of one and the same physical real-world event as either autonomous or 'caused,' I will trace the attentional specifications inbuilt in causative (and related) patterns and, accordingly, in their respective linguistic representations, taking the event of rolling golf balls as a case in point, against its two visual representations to convey the differential attentional implications (which, in passing, provides another evidence for the significant overlap of language and vision repeatedly emphasized by Talmy).

The impact of attention on the meaning constitution of lexical items and their context selection most decisively and intriguingly manifests itself, I argue, at the interface of what is traditionally referred to as the notorious semantic-pragmatic 'divide': To expose the potential

of Talmy's framework, I have selected six (near-synonymous) competitors from different lexical categories in English as showcases – *continue*, *remain*, *stay*, *keep*, *still*, and *on*. Probing into a fairly fine-grained analysis of attentional effects that targets both these items' internal semantic componentiality and the critical division between what may be referred as their semantic core and (increasingly less defining) associated meaning sectors like presupposition or context, my case study may well reveal how such meaning- and usage-sensitive differences of lexical items become feasible in alternatively foregrounded and backgrounded components of their conceptual complex(es), which will ultimately determine speakers'/writers' preferences of one competitor over (an)other(s). Against the observation that the pervasiveness of linguistic entities' responsiveness to attentional specifications has gone unnoticed and even escaped semanticists for such a long time, the exposition to follow may not fail to confirm the potential of attention in explaining conceptual alternativity: As a general principle, attention becomes feasible in systematically and complexly structured semantic configurations, which I propose to call *attentional profiles* (cf. M. Lampert, 2009) and which will emerge as major determinants of form-meaning associations, referential contents, and contextual implications; and such inbuilt attentional bias underlying lexical items and their constructional patterns motivates the very existence of lexical competition, or linguistic alternativity for that matter.

With language being one major substantive system of cognition (besides perception, motor organization, and culture), Leonard Talmy (2000, 1, p. 7) distinguishes five major higher-level schematic systems that, in turn, function as fundamental categories of conceptual content such as spatial, temporal, and causal domains; these organized domains are themselves implemented as cognitive systems and "constitute the fundamental conceptual structuring system of language": Configurational Structure, Perspective (Point), (Distribution of) Attention, Force Dynamics, and Cognitive State are all relatively independent but, at the same time, systematically link up. While Configurational Structure "comprehends all the respects in which closed-class schemas represent structure for space or time or other conceptual domains often in virtually geometric patterns," like (spatial and temporal) prepositions, thus "establish[ing] the basic delineations by which a scene or event being referred to is structured," (Deployment of) Perspective specifies those schemas in a language that direct an addressee where to place their "'mental eyes' to look out at the structured scene or event" (Talmy, 2011, p. 627f), constructing a vantage point from which to view the configuration of components co-present in space and time of the reference scene. (Distribution of) Attention, directs an addressee's "attention differentially over the structured scene from the established perspective point" (Talmy, 2011, p. 630): The components in their configuration in space and time viewed from a particular perspective point, all outputs of selectional and perspectival, i.e., essentially attentional, specification, are now selectively (non-)attended to, "set[ting] up regions with different degrees of salience, arrange these regions into different patterns, and map these patterns in one or another way over the components of the structured scene" (Talmy, 2011, p. 630). Force Dynamics, in contrast, categorically differing from these "basically pictorial" schematic systems (Talmy, 2000, 1, p. 467), draws on kinesthetics, another major cognitive domain, which likewise has not been recognized as a fundamental concept structuring category in language; conceived as a generalization over the notion of causation, Force Dynamics houses systematic patterns in which component entities in a configuration are specified for the forces they exert on another entity or having force exerted on them by another entity. Explicitly addressing "[t]he

provision for alternatives of foregrounding" in force-dynamic specifications, Talmy (2000, 1, p. 429) observes that apart from allowing to treat "not only constructions with the affecting entity (the Antagonist) as subject[, Force Dynamics] also brings in on a par constructions with the affected entity (Agonist) as subject and even as the only-mentioned participant, as with intransitive *keep*."

Against this background, I will zero in only on the link-up of two systems, Attention and Force Dynamics: Attention is seen to display its massive potential as a general 'external' organizational system, independently operating in language and accounting for a multitude of attentional effects, apart from distinctive system-internal attentional specifications already 'in place,' like those inbuilt in the force-dynamically specified linguistic items selected for investigation. From such perspective, the meaning potentials of *continue*, *remain*, *stay*, *keep*, *still*, and *on* may be conceived as manifestations of multiple cross-domain interactions whose attentional characteristics, I argue, result from the interface of the substantive and operational systems linking-up and allowing, in a very systematic and principled way, to effectively discriminate between each individual item's meaning(s) and usage.

It is especially these differences in the attentional profiles of lexical items that both invoke and account for the fundamental principle of conceptual alternativity in language (e.g., Talmy, 2000). The concrete selection of the items submitted to analysis in this chapter[1] rests on another observation regarding its systematic and generalizing potential – that both closed-class and open-class representatives incorporate force-dynamic patterns and "bring many of these together into systematic relationships" (Talmy, 2000, 1, p. 409).

In view of Linguistic Attention's encompassiveness and complexity, as well as Talmy's own extended comments on and intriguing analyses of the wide range of linguistic phenomena involved, I can only hope to illustrate the principles of a cross-venue comparison to provide an initial idea of what a final account would have to take into consideration. Paying respect to this volume's focus, I will confine my presentation to two principal Subdomains of Linguistic Attention: Componential properties of the morpheme and Frame properties of the morpheme are of major significance for morphemes in isolation, and they appear especially apt to cover alleged differences in the semantics of lexical items, irrespective of their particular meaning 'type,' whether lexical or grammatical.

Following an exposition of the basic line of argument in section 2, a very concise assessment and sketchy contextualization of Linguistic Attention with respect to general attention will introduce the analytical devices selected for the case study in section 3 and a similarly basic outline of the relevant component concepts of Force Dynamics in section 4; the remainder of the chapter will showcase the system's particulars: Section 5, expanding on a precursor study (M. and G. Lampert, 2013, chapter 6.1), will offer a fairly in-depth analysis of the six sample items, assigning them their individual attentional profiles, and section 6 will eventually be devoted to the final comparative analysis, with a selective glance at further specialized comparative attention effects hosted in Domain A of Linguistic Attention[2], giving

[1] The selection of the four verbs may be motivated with reference to, e.g., Huddleston and Pullum's (2002, p. 263f) set of "depictive predicative complements," the copular verbs *continue*, *keep*, *remain*, and *stay*, while *still* and *on* are included on account of Talmy's analysis, see footnote 4.

[2] In its current version, the model details three broad Domains, Attentional properties of an individual morpheme (A), Attentional properties of a morpheme combination (B), and Attentional effects of one entity on another (C), each comprising several Subdomains and Areas, i.e., individual attentional devices in language directly relating to cognitive processing, to the effect that any (semantic) component or (surface) constituent of a given linguistic representation is increased or decreased in its (relative) attentional weight.

an impression of the power of Talmy's integrative and integrating approach, which is then briefly evaluated in the concluding section 7.

2. AN ILLUSTRATION

As examples (1) through (6) may not fail to reveal, the prime targets of my analysis – *remain*, *stay*, *continue*, *keep*, *still*, and *on* – at least considerably overlap in their referential contents (or may even be regarded as approximate synonyms[3]). In view of the explanatory potential of the approach, I have further constrained referential variability – all items under investigation depict forceful interactions in a particular physical real-world event, golf balls rolling (or not rolling) in the attempt to find their intended destination, the hole/cup on the putting green[4]:

1. All land falls to the left when playing the hole making your approach shot to the green almost impossible, hit too straight and your ball will slide down the slope giving a tricky pitch/chip back, hit too far right and your ball will **remain** above the hole leaving a treacherous downhill shot….only one thing for it….hit the perfect shot…!!
2. On the 18th hole, I hit a solid 6 iron 8 feet away from the hole. However, I slightly misread my putt and the ball **stayed** on the edge of the hole. I hit my ball right on my line and was sure it would drop, but it didn't.
3. The ball **continued** to roll up the green and then slowly dropped and went right in the hole.
4. But the ball **kept** rolling and rolling and ended up in the hole for a sweet birdie.
5. Montgomerie knew he had pushed the putt as soon as he struck it, and he walked toward the hole as the ball was **still** rolling.
6. The crowd around the St Andrew's loop loved it when the ball rolled **on** to the green and, two putts later, disappeared.

The bold-faced items reasonably all represent major instantiations of Force Dynamics, a semantic category pertaining to forceful interactions between entities copresent in space and time (see section 3); and while *remain*, *stay*, *continue* are considered members of the lexical or open-class subsystem, and *still* as well as *on* of the grammatical or closed-class subsystems

[3] Another competitor, *persist*, being on a steady decline (see *Corpus of Historical American English*, *COHA*), is only attested in the relevant golf context before the 1930s, and infrequently so, as it associates a (strong) connotation of stubbornness, likely to be assigned to animate subjects; see, e.g., the following (of few) sample(s) from the *Los Angeles Herald*, Volume XXVIII, Number 301, 28 July 1901: *Maud's success was due to his ability to cope with the sand on the course, in which the ball persisted in imbedding itself after a stroke*. And *maintain* is ruled out as an exclusively transitive verb, referring to intrinsic properties of the ball only – its speed, direction, and the like: *For this test-drive, American champion Walker remarked how even with off-centre hits, the ball maintained the speed and distance like it was hit on-centre*. For the constructional specifics of the four verbs, see section 5.

[4] All examples in this chapter are retrieved from the World Wide Web, attested in golf magazines and forums, or sports commentaries; they are used to defend, detail, and corroborate, by contextualization, Talmy's (2000, 1, p. 417) introspective analysis, whose original sample sentences – *The ball kept rolling*/*The ball was still rolling*/*The ball rolled on despite the still grass* – ultimately prompted the golf context as a sensible scenario for illustration.

of language[5], "the force-dynamic word" *keep* may be conceived as an honorary closed-class item (Talmy, 2000, 1, p. 417).

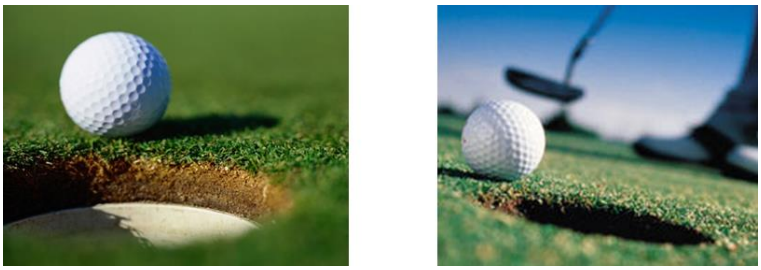

Figure 1. Attentionally discriminate static representations of the same real-world motion event.

To introduce the gist of my line of argument, the two visual representations depicting basically the same real-world event – a golf ball on the edge of a hole – may serve as an illustration (Figure 1).

Both pictures – static representations of a real-world motion event – display a configuration of entities in (physical) space[6] that are responsive to attentional parameters and in fact reflect fundamental salience differences – a figure (i.e., a perceptually[7] foregrounded entity), namely, the golf ball located at one point on the green (i.e., the reference frame against which the other entities are perceived) in the immediate neighborhood of a ground (i.e., a more backgrounded reference entity[8]), viz, the cup, which most onlookers familiar with western culture will understand as the ball's ultimate destination; and they will know from world knowledge that the ball's present stationariness is due to the representational constraints of (static) pictures.

At the same time, each picture may be taken as a possible visual interpretation of two discriminately distinct linguistic representations of a real-world scenario that capture a categorical difference in conceptualization – instances of conceptual alternativity in language which, I will argue, directly follow from different attentional pattern(ing)s in the first place: While the left picture would arguably represent a snapshot from the final phase of (7), the right picture is likely to accommodate the above examples (1) through (6).

7. The ball rolled to the green 253 yards, and sank gracefully into the cup for a 2.

To explain: In all cases, an entity, the ball, moves in space (e.g., the precisely specified distance of *253 yards*) for a certain amount of time (whose specification would presuppose an animated motion picture or a video); the ball remains in this motive state to arrive at its intended destination (involving an appeal to agency), that is, another entity, identified as *cup* in (7) and *hole* in (1) through (5), but not made overt and left to be inferred in (6), where the

[5] For this fundamental division see section 3.2.

[6] For reasons of space limits, I will not expand on the attention effects inherited from Configurational Structure (e.g., singling-out bounded entities like the ball and the cup) and Perspective (e.g., the vantage point from which the figure is perceived, including the agent metonymically represented by the putter and the golfer's foot). All of these, of course, have their own attentional specifications that would need to be accounted for in a more comprehensive analysis.

[7] For the cognitive generalization of this gestalt-theoretical concept, cf. Talmy (1975).

[8] See Talmy (2000, 1, pp. 312ff).

ball 'just' disappears (this non-mention may sensibly generate an additional cognitive effect of heightened surprise). In both scenarios, and in their respective verbalizations, then, certain entities are overtly manifest (the ball, its destination, or the green), while optional components of the configuration are subject to the fundamental all-or-none principle of attentional windowing and gapping (i.e., presence and absence), with the ensuing effect of heightened and lowered salience: The source of the motion, the golfer, is implied in the verbal constituent *hit* in (1) and overtly represented as *I* in (2), while it is particularized in (5), *Montgomerie*, but left unspecified in the remaining examples; or the pre-penultimate medial phases of the ball's movement are largely gapped, except in (1) through (3), surfacing as *approach shot*, *slide down*, *putt*, *dropped*, etc.

To briefly and selectively address some further aspects relevant to the argument vis-à-vis linguistic alternatives: (7) 'says' that the ball has arrived at its destination 'autonomously,' without any force acting upon it, out of itself – that is, the motion in space and time is conceptualized as following from some intrinsic disposition left unspecified. And both the intransitive motion verb *sank* and the manner adverb *gracefully* act as non-dedicated triggers in the immediate environment[9] that would in fact support, or even require, such an autonomous reading; aspects like these are covered by Talmy's (forthcoming) Subdomain Cb, Non-dedicated causal triggers, specifying contextual devices for their attention-directing effects. In contrast, the scenario depicted in the right-hand picture is likely to invoke a categorically different conceptualization of the real-world event, consonant with the representation of the referent scene expressed in the bold-faced items in (1) through (6): Both the lower part of the golf club and the golfer's foot indicate the 'source' responsible for the ball's extended motion; more specifically, the 'instrument' and the body part metonymically, i.e., backgroundedly, represent the action chain initiated by a sentient agent[10], the golfer.

To generalize some observations with respect to this first attentional link-up: The organized domains of space, time, and causation undergo the fundamental processes of activation and attenuation, that is, they highlight some selected portions from all the information available at any one moment, while, at the same time, they disregard other co-present portions of the referent scene. These processes, in turn, involve attention-sensitive operations like delimiting the respective portion out of a continuum as a bounded entity in space and time, then assemble it into a particular (perspectivized) arrangement vis-à-vis other entities in a shared physical environment where the entities find themselves in a specific relation with each other, 'ready' for interaction in the presence of a dynamic momentum. Such selection, unavoidable on principle (cf., e.g., Talmy, 2007, p. 287f) and a major design feature of language inherited from general cognition, is systematically and recursively subject to (re-)adjustments and (re-)allocations by various 'external' attentional mechanisms identified and characterized in the Areas of Linguistic Attention (see next section).

What is especially intriguing in the right-hand picture is the overt representation of the momentum, or 'cause,' for the ball to move in the first place, intimating, at the same time,

[9] I follow Talmy's (forthcoming) terminological suggestion to limit *environment* to "the overtly manifested discourse and physical spatiotemporal surround, while context can also include more implicit or abstract phenomena such as the overall subject matter of a discourse, the models of the discourse content cumulatively constructed by the participants in the course of their interchange, the participants' background knowledge, and their mutual knowledge of each other."

[10] See Talmy's (2000, 1, pp. 271ff) conceptual and linguistic analysis of agentive causation and, exemplified for the present golf scenario, M. and G. Lampert (2013), chapter 7.

that it is not especially salient for the observer; this notion of backgroundedness is not only effected by the spatial configuration – perspectivized as a component relegated to the back of the picture – and its metonymic depiction, but also by the blurry representation of the club and the foot, which is suggestive of lowered significance and indexed via a reduction in distinctness and acuity. And it is exactly this difference in perceptual impact, I argue, that straightforwardly illustrates the function of *remain*, *stayed*, *continued*, *kept*, *still*, and *on* in (1) through (6): All the items 'instruct' the addressee to reconstitute an event representation in which some external cause, or force, has acted upon the ball, though it remains in the background of attention. In this context, a brief comment on the contextual cues is in order: While (1) identifies the intricacies of the terrain as the penultimate cause for the high probability of the ball not to find its destination but *remain above the hole*, challenging the player's performance (*almost impossible*), and (2) spots the golfer's misreading of the green to the same undesired effect – viz, the ball did not drop, (3) depicts a successful, indeed 'smooth' outcome, which may superficially be taken as an autonomous event (cf. *slowly dropped and went right in the hole*) without specifying the 'cause,' which is, however, appealed to via *continue*; see section 5.6. Note that the repetition of *rolling and rolling* in (4) only adds a sense of emphasis, to be understood as an affective implication of surprise perhaps, which is again supported by the satellite *up* (here probably rather not invoking a real-world force but a psychological force instigating an emotional state); likewise in (5), *he had pushed the putt* indicates that it is the golfer's failure to control the ball's movement that caused the ball not to find its intended destination, explicitly verbalizing the unexpected result through force-dynamically specified *still*, whereas (6), similar to (3), invokes a non-autonomous event via the satellite *on*, indicating some external cause; see sections 5 and 6 for more details.

What may well have become evident in the course of this sketch is that attention crucially and multiply affects conceptual content in language, just as Talmy (2006, p. 543) proposes – adding to such fundamental categories like space, time, event, and causation, "the basic ideational and affective categories attributed to cognitive agents, such as attention and perspective, volition and intention, and expectation and affect."

3. THE ATTENTION SYSTEM OF LANGUAGE[11]

This section will introduce the basic conceptual import of Talmy's operational system of attention as it presents itself in its current version: Linguistic Attention is not just a replica of general attention but manifests a highly differentiated language-specific inventory of individual mechanisms that capture particular attention effects inbuilt in lexical items and allow, in a very systematic and principled way, to differentiate between competing forms. Briefly characterizing the system with respect to general attention (section 3.1) and the attention-related upshot of a basic division in language, the open-class and closed-class subsystems (section 3.2), I will address some fundamental principles of the attention system's organization (section 3.3) and then zero in on the specialized factors selected for a more

[11] As always, I am very grateful to Len Talmy for the privilege of granting me access to a very substantial current draft version of this forthcoming book *The Attention System of Language*. Cambridge, MA: MIT Press. All quotes to this as yet unformatted text thus lack page numbers.

detailed analysis of *remain*, *stayed*, *continued*, *kept*, *still*, and *on*, scrutinizing their attentional effects for the two Subdomains from Domain A, Attentional properties of the morpheme, which appear particularly suited for the cross-venue comparison of the items under investigation.

3.1. Linking up Language with (General) Attention

It is beyond question a truism – attention is no less than ubiquitous in (human) cognition[12]: As a general and fundamental cognitive principle, it has unequivocally been conceived as a major vital processing mechanism and one of the most basic abilities of all biological species, including humans, that directly follows from an organism's survival instinct to select relevant targets from the wealth of information provided by its environment – be it concrete objects or information for the immediate need to survive, like finding food or warning signals in the animal kingdom, or more artificial objects and information that safeguard survival in a culturally sophisticated and highly literate community in human societies, which, to this end, have come to essentially rely on linguistic as much as on para- or extralinguistic modes of communication.

In fact, the very first sentence from the preface of the most recent state-of-the-art handbook (of more than 700 pages and over 100 articles), summarizing the results of research on the neurobiology of attention, addresses the central issues and critical concepts of any investigation on attention: "Key to the survival of many biological organisms is their ability to selectively focus neural processing resources onto the most relevant subsets of all available sensory inputs." (Itti et al. 2005, p. xxi) In the consensus view of its 'native' disciplines – cognitive psychology and the neurosciences – attention, only constrained, as it were, by the limited processing resources of the brain, essentially proves a selectional device: In the face of simultaneously available options, an 'attentive organism' will privilege, consciously or subconsciously, those that appear immediately significant in a given circumstance to the disadvantage of their alternatives.

And as a general cognitive capacity humans are endowed with, attention is inherited from evolution, involving both bottom-up (stimulus-driven) and top-down processes (guided by expectations, motivation, and knowledge structures); it is a supremely flexible and adaptive principle tuned in to different (categories of) inputs, including today the arts, economy, education, and the all-pervasive world of the media.

Attention undisputedly, even undisputably, underlies any cognitive (sub-)systems available to humans, including language, to selectively and efficiently interact with the world. That is, language itself has evolved critical mechanisms "directing the interlocutor to make particular focal adjustments … as he or she creates a mental representation of the meaning packaged in the incoming message" (Taube-Schiff and Segalowitz 2005, p. 508). Given both such ubiquity and relevance of attention for language, there is a highly deplorable state of research on attention and/in language, so that, still in 2013, Ardi Roelofs[13], currently one of the few psycholinguists specializing on attention in language, feels entitled to state:

[12] The following sketch draws on M. Lampert (2009, pp. 4ff); see also M. and G. Lampert (2013), chapter 3.
[13] http://www.nici.kun.nl/~ardiroel/home.htm#research (access date 12/16/14).

> Attention and language are among the most intensively researched abilities in the cognitive neurosciences, but the relation between these abilities has largely been neglected. However, understanding this relation is of great theoretical and practical importance. To the extent that attention determines language performance, psycholinguistic models that only address language processes are incomplete.

To date (a) few linguistic attempts have yielded only a very fragmentary view of how attention and language link up[14] – not least due to their adherence to simplistic and parsimonious dichotomies like topic and focus, given and new, theme and rheme, foregrounding and backgrounding[15]. And if attention has now finally begun to surface noticeably in linguistic, or, rather, in semiotics-related research (e.g., Oakley 2009, Stockwell 2009, Marchetti 2010), the underlying conceptualizations still remain too global, vague, or abstract to render them a serious basis for substantially differentiated concrete linguistic analyses.

This situation, however, has fundamentally changed – provided a cognitive semantics perspective qualifies as a viable approach. Grounded in a system of "particular linguistic mechanisms" (Talmy 2007, p. 264) that selectively and differentially distributes attention over the components of a referent scene, an impressively encompassive and intriguingly fine-grained flexible factor model is at least partially accessible: Talmy's attention system of language, emerging since the 1980s as a central component in his Overlapping Systems Model of Cognitive Organization, is sensibly the first

> developing … systematic framework within which to place all such prior findings – together with a number of new findings – about linguistic attention. In fact, [it] is perhaps the first to recognize that the linguistic phenomena across this whole range do all pertain to the same single cognitive system of attention.

Inheriting its characteristics from general cognition, Linguistic Attention recognizes both a significant overlap, though no coextension, of language with other cognitive systems (especially vision) and system-specific particularities. And to illustrate just one such basic shared attentional principle, "greater magnitude along a cognitive parameter tends to attract attention to the entity manifesting it," and this effect translates into language, e.g., as "stronger stress on a linguistic constituent," while in visual perception it corresponds to, say, "a large size or bright color of a viewed object" (Talmy 2007, p. 266).

3.2. Attentional Effects in Linguistic Subsystems: Closed-Class and Open-Class

Given the ubiquitous function of attention in human cognition, including language, basic principles and mechanisms of attention may be expected to have their reflexes in the

[14] Note that Ceccato's (and team) early recognition of both the relevance for and relation between attention and language has largely gone unnoticed in the English dominated scientific community.

[15] These concepts have been mainly introduced to postulate or support yet another language 'module' or 'level' beside or beyond syntax, which has then been variously termed *information structure*, *information packaging*, *focus structure*, or *accessibility*; see Chiarcos et al.'s (2011) collection on salience (biased toward a formalist point of view).

representational formats of conveying information via language as well. Again under the operation of a general organizing principle, such attention-based differences become feasible in the principal formal division of two broad representational categories: Exhibiting critical attention-sensitive properties, any linguistic item instantiates one of two constitutive "universal complementary subsystems" of language, the open-class lexical subsystem (including roots of nouns, verbs, and adjectives, collocations or "lexical complexes," but not roots of adverbs) and the closed-class grammatical subsystem (including all other types of linguistic representations, which are considered to be "quite generally, 'grammatical'," Talmy 2000, 1, p. 23).

And, significantly, these two subsystems consistently associate various distinct attention-sensitive cognitive effects: While open-class (lexical) items represent conceptual content, that is, notions not "referentially constrained" in a principled sense and allowing for the elaboration of individual particularities, "open-class categories in general confer greater salience than closed-class categories" (Talmy forthcoming) and convey a rich array of particularities that appeal to distinctness, clarity, and acuity in the representation of the entities' properties, which, in turn, correspond to high levels of reference activation regularly accompanied by the cognitive effects of significance (see M. and G. Lampert 2013, pp. 39f for such general attentional principles). By contrast, closed-class (grammatical) items represent conceptual structure, whose referential content relies on schematic representation with the ensuing effects of "meldedness, vagueness, and ordinariness" (Talmy 2007, p. 265): The closed-class subsystem typically comprises a restricted and, at the same time, privileged set of grammatically specified notions, which share the common characteristic of reference attenuation following from their specific attentional distribution, systematically giving rise to the cognitive effects of abstraction, schematization, and idealization: "The initial attentional proposal, then, is that a concept tends to be more salient when expressed in an open-class form than when expressed in a closed-class form" (Talmy forthcoming).

3.3. Basic Delineations of Linguistic Attention

Facing the fundamental insight that not all aspects of the linguistic material to be conveyed in a given discourse can (and in fact are supposed to) be uniformly and simultaneously attended to, Linguistic Attention is designed to account for attentional variability and diversity via a relatively closed and perhaps universally available inventory of about a hundred basic attention factors so far identified. These mechanisms are defined and explicated to individually combine and integrate into a comprehensive and highly flexible system of attention-sensitive patterns whose linguistic manifestations provide speakers/writers with an inventory of alternatives to differentially direct hearers'/readers' attention; and hearers/readers, largely on the basis of the speaker's/writer's selection, will accordingly allocate their attention in particular patterns over the linguistic material to differentially yet variably respond to the informational and communicative demands at any given moment in a discourse, functionally and flexibly adapting to their limited cognitive processing resources.

This specifically designed extensive operational schematic system in language "assigns different degrees of salience to the parts of an expression or of its reference or of the context" (Talmy 2007, p. 264), paying respect for the extent to which language is amenable to

attention and its range of potential targets: affecting a linguistic item's form, its conceptual content, or its linguistic and non-linguistic context.

The hierarchically organized mechanisms of Linguistic Attention fall into Domains, Subdomains, Areas, and Subareas/Factors, i.e., individual attentional devices in language that directly relate to cognitive processing, to the effect that any (semantic) component or (surface) constituent of a given linguistic representation is increased or decreased in its (relative) attentional weight. And the target entities whose attentional level is being set feature some dozen types, such as the shape of morpheme, the concept associated with this shape, a set of concepts related to a morpheme, a particular sense of a polysemous morpheme, the meaning of the whole of a composition etc.

In this chapter, I will, however, be exclusively concerned with the second dimension, attentional effects on an item's conceptual content. Before detailing the mechanisms selected for demonstration in section 3.4, I will outline both some basic commonalities and differential characteristics relevant for the comparative analyses to follow: As for the major critical parameters as well as the foundational theoretical and explanatory constructs of Linguistic Attention, it is essential to emphasize that Talmy (2012, revised handout) conceives of attention and consciousness as being "at core … both the same essential phenomenon," with differences "only in relatively more superficial properties." Notably, an(y) individual attention factor targets an *obtent*, "a current or potential content of consciousness" whose potential(ity) is determined by the activation state of "a particular neural ensemble [that] would yield this content if the ensemble were active and its activity were in consciousness"; and a content obtent is then specified for its degree of salience in a psychological process of reference activation (see M. and G. Lampert 2013, pp. 34ff for some details on the functional adaptiveness of the model and its principled compatibility with current views in neuroscience).

Linguistic Attention hosts two types of comparative factors: Same-venue comparative factors address "salience differences between different linguistic entities that occur together in the same venue," say, the differential attentional strengths of semantic components co-present in one sense, e.g., 'cause' vs. 'temporality,' of all the particular morphemes under scrutiny, while cross-venue comparative factors target their relative salience across two venues, the (approximate) identity in meaning of, e.g., *remain* and *stay*, weighing them in terms of differences in attentional strengths.

It is particularly these cross-venue comparative factors that specify variations of salience in language and thus account for alternativity in language: A linguistic entity (or a set of linguistic entities) inheres the potential to regularly and differentially increase or decrease attention on its referential content in comparison with a(ny of its) competitor(s) that for speakers/writers provide(s) options for formulations to accommodate the degrees of the respective concept's salience and allow for differentially directing hearers'/readers' distribution of attention. And on the hearers'/readers' end, given their knowledge of the alternatives available for representing an obtent's salience, the speaker's/writer's selected formulation enables hearers/readers to gauge the relevance of the specific selection in terms of their attentional import (see Talmy forthcoming).

The factors are formulated as a contrast between greater and lesser attention, rather than in terms of a single ranking along an absolute scale; that is, each factor will raise or lower attention on an obtent, which in turn represents one out of three degrees of dividedness – gradient, dichotomous, or hierarchical. Though amenable to analytical scrutiny individually,

the basic factors critically interact in processes of competition, win, and override, whose results become feasible in a lexical item's particular attentional profile (see section 6.3 for some notes).

3.4. Components and Sectors of Meaning and Their Attentional Effects: The Core and Associated Meanings of Morphemes in Isolation

For space limitations, I will unfortunately have to completely disregard, from the three broad Domains Linguistic Attention elaborated so far, Domains B, Attentional properties of a morpheme combination, and C, Attentional effects of one entity on another, which cover combinatorial and contextual effects in a remarkable degree of granularity, but confine my exposition of the model to only a selective illustration of Domain A, Attentional properties of an individual morpheme.

As noted above, I will summarize the attention effects of Subdomain Aa, Symbolic properties of the morpheme, which focuses on the shape-concept association of simplex morphemes and emphasizes the superiority of meaning over any other aspect, and I will briefly address Subdomain Ab, Formal properties of the morpheme, targeting differences in salience that result from non-semantic properties of a morpheme like its lexical category or its state of morphological autonomy. Likewise I gloss over Subdomain Ae, Polysemic properties of a morpheme, i.e., attentional effects that arise from "the different senses within the polysemous range … under a single morphemic shape" (Talmy forthcoming) such as the morpheme's size of the polysemous range and the particular senses' ensuing weighting; also I will have to ignore both Phonological properties and Field properties.

Instead, I will especially concentrate on the discriminating factors of two (successive and interrelated) Subdomains, Componential properties of the morpheme (Ac) and Frame properties of the morpheme (Ad), which, I believe, are especially apt to document Linguistic Attention's potential and its degree of differentiatedness, eventually approximating the cognitively more realistic models found in the cognitive sciences.

Subdomain Ac, Componential properties of the morpheme, identifies "the relative salience of a concept constituting the whole of a morpheme's core meaning against just part of it" with related attention-sensitive effects that set "the semantic components considered as an ensemble as against individually" and "some individual components as against others" (Talmy forthcoming), accounting, in a systematic way, for the various inbuilt attentional specifications previously mentioned. Its first mechanism, Area Ac1, A component's share of a morpheme's full meaning, addressing relevant cross-venue comparative properties, captures salience difference of the same concept in different morphemes: A concept(ual complex) constituting "the sole and entire core meaning of a morpheme, tends to be more foregrounded," but when "conflated together with other concepts in a morpheme's meaning so that it represents a smaller share of this total meaning, it tends to be more backgrounded" (Talmy forthcoming). And the differentiation of, e.g., the causative into a configuration of four interdependent and definitional components (see next section) invokes Area Ac3, Weighting across the components of a morpheme's meaning: It associates a hierarchically comparative same-venue factor which "holds that within a morpheme's meaning, one semantic component can be more salient than a second, the second component can be more

salient than a third, and so on," with "all of a morpheme's semantic components present[ing] themselves for comparison at once" (Talmy forthcoming).

Subdomain Ad, Frame properties of the morpheme, in contrast, accounts, "at the broadest granularity [between] its core meaning and its associated meaning" (Talmy forthcoming), for a basic difference in salience between the (more) central semantic import of a morpheme (in isolation) and its various associated sectors meanings. According to this analysis, a morpheme's plenary (or full) meaning as a conceptual complex or schema is susceptible to a division into several different, hierarchically organized sectors of meaning, though with fuzzy boundaries and gradient crossovers: By a set of cross-venue comparative factors, the core meaning covers the direct and "chief referential import" immediately associated with the morpheme's shape – the central concern for a speaker's/writer's selection of the respective item; the associated meaning(s), by contrast, encompassing successively more peripheral domains of meaning, "extend out indefinitely with ever further conceptual associations that elaborate on the core meaning and are largely thematically related to it," including concepts "not intrinsically related to its core meaning, that is, thematically independent of it" (Talmy forthcoming). Additional to the general effect by reference activation, increasing the salience of the morpheme's plenary meaning as a whole, this attentional gradient introduces a "comparative ranking of strengths," with "the core meaning outweigh[ing] the associated meaning in salience within this overall activation," i.e., "[i]f a morpheme is considered by itself, then its core meaning is in the foreground of attention, while the associated meaning is in … the midground of attention, if not in the attentional background" (Talmy forthcoming).

Typically, then, a conceptual complex represented by a morpheme will comprise non-autonomous components, "intrinsically relative with respect to each other," which may, as "an internally self-entailing complex … logically be considered as single unit entity" and which, given the organization of "our conceptual and attentional systems," are conceived as "portioned out into quasi-independent elements to which heightened attention can be differentially directed" (Talmy forthcoming). This complex of attentional effects, first, covers – from a coarse-grained same-venue comparative perspective – differences in attention between a morpheme's core meaning and the totality of any associated meanings, designated as Area Ad1, The core meaning and the associated meaning of a morpheme. And five successively comparative attentional mechanisms account for cross-venue salience differences within a morpheme's associated meaning, unequivocally privileging, however, the core meaning's salience over any of the associated meaning sectors: The first Subarea targets attention differentials between the core and the co-entailment of a morpheme's meaning, that is, "the larger conceptual whole that the core meaning is necessarily part of"; and in contrast to the relative essentialness of this co-entailment sector for a morpheme's meaning, the presupposition sector, captures "the conceptual underpinning or infrastructure of the core meaning," characteristically less vital for the entire conceptual complex, involving presupposed concepts like "assumptions, beliefs, and further ideational material, sometimes extensive, that must be in place for the core meaning to have its particular conceptual content" and that typically reside in "the midground or the background of attention" (Talmy forthcoming). Progressing further down the necessity/optionality and the salience hierarchies, the augment sector "comprises concepts that elaborate on or add to the core meaning, but that can be incidental to it," and it captures the attentional mechanism of conceptual complexes that "are considered augmentive to the core meaning" (Talmy forthcoming), qualifying as

more optional accompaniments and adding related concepts that are largely incidental and may accordingly be dropped or replaced by alternatives.

The disposition sector will be disregarded in favor of this chapter's decisive 'semantic' objective: It covers "the aspects of a morpheme's meaning that arise from its grammatical properties," i.e., a morpheme's formal internal and external grammatical attributes and their corresponding semantic characteristics, which typically remain in the background of attention with only "some low level of awareness" (Talmy forthcoming).

The final sector targets "any speaker attitude or register pertaining to the core meaning that is lexicalized in a morpheme" (Talmy forthcoming), addressing salience differences between the core meaning and the contextual sector that derive from an isolated morpheme's potential to respond to external effects of stance and affect: It is the "semantic components pertaining to the speaker's attitude or to the speech situation"[16] that account for "concepts solely external to the core content, ones that relate to it but that do not affect its intrinsic character"; and as a significant and distinctive characteristic of the contextual sector, such components "can rival and in some cases perhaps even exceed the core content in salience" (Talmy forthcoming). Accordingly, morphemes may share the same core meaning but differ in having divergent contextual sectors.

These sectors, then, progress, first, "along a parameter of necessity to the core meaning, from the most indispensable to the most optional" and, second, by some criterion of thematic relatedness "along a parameter of relevance to the core meaning … from the most pertinent to the most incidental," with "thematic independence start[ing] up within the disposition sector and [being] in full reign over the contextual sector" (Talmy forthcoming). The division thus entails significant consequences for a morpheme's attentional profile: All the comparative factors result in a successive decrease of attentional import on the concept represented by the morphemic shape, with one possible exception, though, that components of the contextual sector might outweigh the core meaning's salience due to affective value.

Following this cursory outline of the most discriminating attention devices regarding the specific analyses of the six sample items in section 5, the organizing domain under consideration will be introduced, paying due respect for its inherent attentional characteristics.

4. FORCE DYNAMICS: A GENERALIZATION OVER THE CAUSATIVE AND ITS ATTENTIONAL IMPLICATIONS

To give a sense of Talmy's novel semantic category Force Dynamics, a re-analysis of causation in language, I will briefly sketch the system's basic delineations, along with their inbuilt attentional properties (which would certainly require a more elaborated study to be spelled out), in view of the six items' differential attentional analyses, all lexicalized to invoke a force-dynamically specified representation of an event.

Apart from the attention-sensitive specifications deriving from the interaction of attention and the domains of space and time (mentioned in section 2) further effects add up to the

[16] Talmy (forthcoming) proposes to reanalyze speaker's attitude as a backgrounded speaker role, thus accommodating the concept of register, i.e., the contextual sector also accommodates speaker stance targeted at "the core meaning itself."

items' attentional profiles that are due to the operation of attention on a schematic system that maps out "how entities interact with respect to force" (Talmy 2000, 1, p. 409). From the two co-present participants in a force-dynamic configuration, the Agonist, "singled out for focal attention," is specified for its (relative) attentional status and for its physical impact, i.e., "the salient issue [being] whether this entity is able to manifest its force tendency or … is overcome" by a second entity, the Antagonist, which is "considered for the effect it has on the first, effectively overcoming it or not" (Talmy 2000, 1, p. 413).

Attention as a fundamental explanatory construct is immediately invoked via the definitional attributes *single out*, *focal*, *salient*: All address the most basic concepts of general attention, namely, selection, concentration, attraction due to physical stimulus qualities – well-known since the seminal study of William James (1950/1890); and these opposing forces are specified for a particular effect, entailing that other aspects are disregarded, and even the 'ranking' of first and second entity presupposes a difference in attention. In addition, the two entities, Agonist and Antagonist, are sensitive to further parameters always co-present in any force dynamics configuration: Each entity "is taken to exert a force by virtue of having an intrinsic tendency toward manifesting it … either toward motion or toward rest, toward action or inaction"; the forces themselves, which may be constant or temporary, are assigned values for their relative strengths, hence "the entity that is able to manifest its tendency at the expense of the other is stronger," and "according to their relative strengths, the opposing forces yield a resultant, an overt occurrence" (Talmy 2000, 1, p. 414).

In Linguistic Attention, such difference in salience is now captured by two same-venue, hierarchically comparative factors from the componential Subdomain Ac, the above mentioned Component's share of a morpheme's full meaning and its corresponding weight-related mechanism, Weighting across the components of a morpheme's meaning – both accounting for the differential attentional effects of a conceptual complex with their ensuing weight-associated cognitive effects, like meldedness, vagueness, and ordinariness.

Force Dynamics itself, then, is re-analyzed as an attention-sensitive configuration, split up into its individual component entities: In light of Subdomain Ad's specification, the Agonist will outscore the Antagonist in salience, since the former invariably represents the core component whose 'fate' is at issue, while the latter, regularly a backgrounded participant, is relegated to the co-entailment sector as an associated, though non-incidental, meaning component. To introduce the four basic force-dynamic patterns, Talmy's (2000, 1, p. 416) original sample sentences are renumbered as (8):

(8)

a. The ball kept rolling because of the wind blowing on it.
b. The shed kept standing despite the gale wind blowing on it.
c. The ball kept rolling despite the stiff grass.
d. The log kept lying on the incline because of the ridge there.

Keep [VP]-*ing*[17], the "key force-dynamic word" (Talmy 2000, 1, p. 423; see section 5.1), conceptualizes a real-world event in terms of steady-state oppositions, where the intrinsic force tendency of the Agonist either prevails (8b, c) or is overcome by a stronger Antagonist

[17] This is Talmy's (2000, 1, pp. 422f) own notation.

(8a, d) and the Agonist manifests its force tendency either toward rest (8a, b) or toward motion (8c, d). To detail: (8a) features an Agonist, the ball, with an intrinsic tendency toward rest that is overcome by a stronger Antagonist, the wind, and is kept in motion due to the wind's power – one of the two causative *because*-patterns. The Agonist's stronger intrinsic force tendency toward rest prevails in (8b) over an opposing (weaker) Antagonist, instantiating the 'despite' category, which also underlies the hindrance pattern in (8c), now with the stronger Agonist's intrinsic tendency toward motion impacting against a (weaker) Antagonist, the grass. And (8d) illustrates the pattern of extended causation of rest, with the Agonist's tendency toward motion, the log on an incline, being effectively blocked by the stronger Antagonist, the ridge, hence the piece of wood remains in its place.

In the remainder of this chapter, I will suggest, in sections 5.1 through 5.6, an attentional profile for each individual sample item, illustrated in the physical domain of the golf scenario, and then sketch the gist of a comparative attention analysis in section 6.

5. THE ATTENTIONAL PROFILES OF STEADY-STATE FORCE-DYNAMIC PATTERNS

On the precondition that this analysis is confined to attentional effects of morphemes in isolation, with contextual factors almost entirely being neglected, I will first propose a core meaning for the six items under scrutiny, which will serve as the basis for any discussion of further particular(ized) meaning components, weighted against each other and assigned to a sector of associated meanings that arguably captures the concrete distribution of attention over these components[18]. This core meaning includes three components, which partially serve to differentiate between the items:

- All items refer to some process or activity, in which an Agonist and an Antagonist engage in a force opposition of variable strengths, yielding a steady-state overt resultant for the Agonist, the entity whose resultant state is at issue and invariably particularized in the main verb of the local clause;
- *Keep* [VP]-*ing*, *still*, and *on* accommodate all four steady-state force-dynamic patterns (detailed in the previous section), with the variants to be contextually specified;
- *Stay* and *remain* yield an overt resultant of extended rest, particularizing the two patterns of stability of rest or extended causation of rest, while *continue* selects the opposing particularization, the Agonist's overt resultant of extended causation of motion, with either its intrinsic force tendency toward motion prevailing against a weaker Antagonist or its tendency toward rest being overcome by a stronger Antagonist.

[18] For all semantic explications in this chapter, the respective definitions offered in the following dictionaries have been checked: *Merriam-Webster Online*, *OED Online*, *Oxford Dictionaries Online*, *The American Heritage Dictionary of the English Language*, and *Collins Cobuild Advanced Dictionary*; the entries notably all lack any appeal to force(s) for the target senses as well as a reference to differences in salience of the particularized semantic components.

Accordingly, the following core meaning is suggested for force-dynamically specified *keep*, *still*, *on*, *stay*, *remain*, and *continue* in construction with their verbal complements:

> Some attentionally privileged entity, the Agonist in a force-dynamic configuration, engages in a force opposition that yields an overt steady-state resultant.

With reference to Areas Ac1 and Ac3, targeting differences in salience of lexical items' core components, two principled theoretical options suggest themselves: First, the components Agonist and Antagonist, their variable strengths, and a steady-state overt resultant appear to be definitional for the items' gestalt meaning[19], exhibiting, as the previous section has documented, an internal salience weighting of the four interdependent components in the force-dynamic configuration along the following suggested hierarchy: The Agonist would be accredited highest salience as the entity whose fate is at issue and whose overt resultant is regularly assessed; the force tendency's overt occurrence and the invariable steady-state resultant would occupy second rank on account of their discriminating function as a co-defining property of causativity (as, for instance, against modality) and between two fundamental categories of causation (onset vs. steady-state) respectively, while relative strength and the Antagonist, again on a par, represent less salient coentailed components, relegated to an associated meaning sector for their general optionality in terms of overt (same-clause) expression. A second analysis would discriminate between both the second- and third-ranked components, an alternative that would have to be backed up by a substantial empirical study with a close focus on non-dedicated triggers in the items' environment.

Recognizing its special status as "[p]erhaps the single form most indicative of the presence of force dynamics" (Talmy 2000, 1, p. 417), *keep* is expected to most unambiguously represent the core meaning stipulated above. Note that, for the 'semantic' reason addressed above, I will largely disregard another attention-sensitive property of morphemes in isolation that Linguistic Attention systematically accounts for: Though several mechanisms address constructional properties of morphemes, thus acknowledging their environmental potential and regularly allow for any item's constructional analysis, only one particular force-dynamically specified construction (except for *continue*) will be taken into consideration, namely *keep* V-*ing*, *still* V-*ing*, V(-*ing*) *on*, *remain* V-*ing*, *stay* V-*ing*, and *continue* V-*ing*/*to* V.

5.1. The Plenary Meaning of *Keep* [VP]-*Ing*

From the several constructions that feature the verb's morphemic shape (see M. Lampert, in preparation), *keep* [VP]-*ing* may reasonably be conceived as the best example of evoking the schematic system of Force Dynamics as a whole[20] – in fact, *keep*, whose "very frequency and basicness suggest for it a status as an 'honorary' auxiliary" (Talmy 2000, 1, p. 417), is

[19] Having scrutinized more contexts and regarding the inclusion of open-class items, I would, in partial deviation from M. and G. Lampert (2013, p. 200), now opt for a less strong claim, assigning 'beyond a default value' as a presupposed component to an associated meaning sector; see below for details.

[20] It is of note, again, that any appeal to an external force's impact is virtually absent as a semantic component in the definitions of *keep* (as well as in those of its competitors) in current dictionaries. The attentional implications of such prototype effects are captured in Areas Ag1, Semantically associated morphemes (and concepts), and Ag2, Weighting among semantically associated morphemes.

especially versatile to accommodate all four basic steady-state force-dynamic patterns; such flexibility (or undeterminedness, for that matter) well accords with the predictions of the closed-class subsystem's preference for schematic structure and accredits *keep* the status as the category's keyword. As briefly noted in section 3.2, such conceptual structurality involves predictable attention-sensitive cognitive effects for the referential contents conveyed by the (candidate) closed-class items: They regularly exhibit attention-attenuating effects of meldedness, vagueness, and ordinariness, thus representing the respective conceptual complex schematically and abstracting away from particulars – quite in contrast to open-class items' attention-activating distinctness, clarity, and acuity, with various specifications reflecting more particularized patterns (see Talmy 2000, 1, pp. 426f and below).

Apart from and additional to their suggested internal weighting by Area Ac3, the definitional component concepts of Force Dynamics' gestalt core meaning give rise to associated meaning components: The (steady-state) overt resultant denoted by the verb (phrase), e.g., *the ball kept/continued rolling*, readily invokes a further semantic component, framed as 'beyond a default value' and is assigned to *keep*'s presupposition sector; as conceptual underpinnings of the core meaning, like assumptions or beliefs, such concepts "must [however] be in place for the core meaning to have its particular conceptual content" but typically reside in "the midground or the background of attention" (Talmy forthcoming). These associated meanings, in turn, connect to variable augments like, in the present case, 'contrary to expectation' or 'deviating from a norm,' and, as a contextual effect, an affective impression of, e.g., surprise is seen to emerge (as many examples indeed suggest). Needless to state (again) that the proposal advanced would of course require, and in fact awaits, more thorough contextual analyses of substantial corpus data and/or experimental validation, which may be expected to yield information about how to differentially and plausibly specify this semantic component's implicational impact. I would not, however, consider 'contrary to expectation' as an incidental meaning component but rather an encyclopedic quality elaborating on the core meaning, due to its systematic associatedness with all force-dynamically specified items under scrutiny; hence the context sector appears to be ruled out as a potential candidate sector on account of assigning its semantic components a more independent 'lexical' status (see section 3).

To offer, as a case in point, the above example from a typical golf scenario, reprinted here:

4. But the ball kept rolling and rolling and ended up in the hole for a sweet birdie.

Keep 'says' that an Antagonist's force would effectively overcome the Agonist's, that is, the ball's, intrinsic force tendency toward rest[21]. And the net resultant of this force interaction is contrary to the Agonist's expected or default (intrinsic) tendency, according to which any physical object would eventually end up stationary; *keep* thus indicates that the ball's continuous motion results from an external force impinging on the Agonist (i.e, the

[21] The Antagonist itself represents an intricate conceptual complex extending out into the augment sector and involving an agentive-causal event chain (conceived as) instigated by the golfer: As an (external) augment, *keep* may, based on the western cultural concept of causality, cover reference to any potential process that leads to the event – involving multiple causal subevents like agencies, authorities, and institutions engaged in planning, constructing, and maintaining of a golf course as well as the (natural and artifactual) conditions and specifics of the terrain or weather conditions; see M. and G. Lampert (2013, pp. 236ff) for some details.

Antagonist), which, as an obligatory co-entailed component, however, remains unspecified in the immediate context. Provided the contextual sector is relevant for *keep* at all as a (putative) closed-class item, any contextual implication would rest on connotational associations related to the contrary-to-expectation meaning – whether positive or negative depends on non-dedicated contextual triggers: In (4), for instance, *end up* indicates the successful completion of the putt, and *sweet birdie* refers to the desirable result of one stroke under par on that hole, while *but* and *rolling and rolling* may certainly express a welcome surprise, in contrast, e.g., to (5), which depicts the opposite unwelcome scenario, though probably likewise unexpected on account of the top golf professional Montgomerie; see next section.

5.2. The Plenary Meaning of Force-Dynamically Specified *Still*

Apart from re-conceptualizing an event as non-autonomous and sharing the critical force-dynamic characteristics with *keep*, the adverbial particle *still*, itself an undisputed closed-class item, appears to particularize the temporality of steady-state force-dynamic patterns.

Against the attentional analysis suggested for *keep* (assuming equal salience of the force-dynamic components 'overt occurrence of a resultant' and 'steady state,' i.e., leaving these core participants unweighted), *still* would, while sharing with *keep* its core components, differentially highlight the temporal aspect of steady state over the overtness of the resultant. Concomitantly, the greater attention accorded to the steady-state component of *still*'s core meaning (covered by Factor Ac3) would find its semantic correlate in the presupposition sector of the item's associated meaning: Activating the time dimension of an event that extends beyond a default value inalienably moves this semantic component toward the midground of attention.

To illustrate: Example (5) features several supportive environmental cues for the event's (now undesirable) temporal extension beyond an expected default value, as expressed in *pushed the putt* (i.e., the putt fails to find its intended destination); the relevant temporal meaning component is entailed in the non-dedicated trigger sequence *walked toward the hole*, with the (spatial) preposition *toward* contributing its temporal implication (for a fairly detailed analysis see M. and G. Lampert 2013, pp. 245ff):

5. Montgomerie knew he had pushed the putt as soon as he struck it, and he walked toward the hole as the ball was still rolling.

5.3. The Plenary Meaning of Force-Dynamically Specified *on*

The verb satellite *on*, while sharing the proposed core force-dynamic components with *keep* and *still*, in contradistinction to *still*, now (re-)directs some attention to the spatial dimension, based on the directive meaning of the homophonous spatial preposition *on* and activating the concept of an event's forward directionality. Like its temporal counterpart in *still*, this spatial facet of *on*'s associated meaning is proposed to be housed in the presupposition sector and, by virtue of this stipulation, moves to the midground of attention. The forwardly directed movement associated with *on* again is conceptualized to extend beyond a default value and thus, in turn, incorporates a further associated meaning component

'contrary to expectation' and/or 'surprise' in the augment and contextual sectors, which is then subject to affective evaluation.

As before, non-dedicated triggers in the context support such proposition for (6), foregrounding the event's locatedness in space: The forward-directional presupposition is corroborated by *to the green*, and open-class *disappear* (i.e., absence from a visible locus) significantly includes a spatial component in its presumed core meaning, contributing to a spatial conceptualization of the event.

6. The crowd around the St Andrew's loop loved it when the ball rolled on to the green and, two putts later, disappeared.

As an interim conclusion, it may be noted that all three (candidate) closed-class items analyzed so far concur on the same core meaning but weigh the force-dynamic core components differently, and they contrast in their presupposition sectors – a finding which may well be supportive of the general claim of attention as meaning, as such attentional differences relate to (if not correlate with) the respective competitor's semantic profile and usage constraints. The exact interaction between the various attentional mechanisms of the associated meaning sectors would be subject to an in-depth analysis of the contextual Domain C of Linguistic Attention; the following examples from the World Wide Web (with the respective items in boldface) illustrate the three items' readiness to cooccur; note, though, that (11) and (12) are only attested in blogs, and in fact very infrequently so:

9. Tiger later posted on his website that he had made such mistakes and the ball **still keeps** rolling like the shot on #16 at Augusta.
10. i made a thin shot using 4 iron about 200 yds away and the ball **still** rolled **on** to the green. [original spelling]
11. I managed to get past the bunker and on the green … and the ball **kept** rolling **on** to the other side.
12. Although you do notice a difference, when putting it to 1 the ball **still keeps on** rolling considerably long, especially when the surface is just not horizontal.

The subsequent sections on the open-class verbs *remain*, *stay*, and *continue* will now further elaborate on the particularization issue.

5.4. The Plenary Meaning of (Force-Dynamically Specified[22]) *Remain*

The intransitive open-class verb *remain* appears to be specifically lexicalized to refer to steady states of rest: *Remain* thus features a particularized force-dynamic pattern with an overt resultant of rest, brought about either by virtue of an Agonist's intrinsic force tendency toward rest prevailing against a weaker Antagonist (instantiating the 'despite' category) or because of an Agonist's intrinsic force tendency toward motion overcome by a stronger Antagonist (and representing extended causation of rest); in either case, an overt steady-state

[22] The parentheses in this and the subsequent section headings indicate the relevant meaning, excluding other senses of the polysemous open-class items.

resultant of the Agonist's stationariness would ensue, which, in turn, acts as a constraint on collocation, as (13) through (16) below document: *motionless*, *in the bunker*, *sitting on the tee*, *at rest*[23].

This analysis, then, suggests a different core meaning: Unlike the three (candidate) closed-class items, *remain* only accommodates the two force-dynamic steady-state patterns of rest, capitalizing on the configuration's stationariness; and this shift in attention appears not just a matter of differentially highlighting the same component (in Area Ac3) as with *still* and *on* before, but a more 'palpable' difference in semantic import, definitional for the verb's felicitous usage. *Remain* thus conforms to the assumption that open-class items convey more conceptual substance, in contrast to closed-class items' preference for representing conceptual structure schematically and thus being more versatile.

(13) through (16) adjust both spatial and temporal steady states, and the environment features non-dedicated cues invoking an undesired connotational stance, which is triggered by a concurrent associated meaning component in the contextual sector; see, e.g., *a treacherous downhill shot* in (1), *unfortunately* in (13), or the precursor sequence of (14): *I … swung so badly, catching the ball thin and sending it careering into the bank in front of me*.

13. Mind clearly back on the podium collecting his recent Commonwealth team fencing silver, Mikey flashed at one tee shot as though an opponent with his epee, unfortunately the ball remained motionless in its exact position on the tee peg.
14. The ball remained in the bunker and I was faced with a similar shot again.
15. The ball remained sitting on the tee.
16. USGA Ruling: If the ball remained at rest for a few seconds, you play it from where it ended up after rolling closer to the hole.

It should be added that though attestations are found incorporating the motion verb *roll*, they predominantly refer to metaphorical or fictive motion: *Thankfully the cameras remained rolling and their actions are caught on tape. After that last descent, the route remained rolling*[24]. And only one single example from the golf scenario features *remain* in present tense:

17. By the second hole, we decided that the women would separate into their own group, due to the seriousness of the men's play. We (the girls) enjoyed making up our own rules such as; if your ball remains rolling on the green after a putt, any teammate can 'guide' it into the hole with their foot.

In effect, the context of the hypothetical event of defining a rule does not highlight any of the two organizing domains, quite in contrast targeting the ball's unaltered condition and

[23] *Remain stuck* yields more than 300 hits for the golf context; on an informal cursory search outside the golf scenario, the *Corpus of Contemporary American English* (*COCA*) predominantly returns stative verbs like *sitting* or *standing* as collocates, while prototypical motion verbs are only attested in extremely low frequencies.

[24] Whether these occurrences with a concrete physical reference, e.g., *Once they got the car moving, it remained rolling easily enough*., are 'simply' instances of deviant usage or indicators of linguistic change awaits thorough research; if this latter option proved valid, *remain* would adopt the unspecified pattern observed for *keep*, and the meaning of stationariness would then have to be considered an augment, which can readily be dropped.

abstracting away from the event's physicality: (17) highlights the abiding state of a (rolling) ball, accommodating the present tense in its non-temporal reference.

5.5. The Plenary Meaning of (Force-Dynamically Specified) *Stay*

As both intransitive open-class verbs allow for an Agonist's force tendency toward rest only, indiscriminately particularizing the force-dynamic configuration in terms of steady-state stationariness, *stay* and *remain* appear likely to be considered synonyms. Differing, however, from its more formal competitor *remain* in the contextual sector of its associated meaning, *stay* prefers more colloquial registers, but like *remain*, in the golf context, *stay* specifies the Agonist for its locatedness, see (2) or (18) through (20); while, in contrast to *remain*, foregrounding the spatial domain, *stay* also readily accommodates temporal augments, as in (20).

18. The ball stayed on the front of the green, leaving a difficult putt from 45 feet.
19. Bajkowski tried, pitching down from the back left rough, but the ball stayed wide.
20. The ball stayed up in the black sky almost thirty seconds.

Similar to *remain*, a moderate selectional tendency for physical motion events is manifest in the (random) examples (21), from kayaking, and (22), from cycling, as well as in the metaphorical extensions (23) and (24):

21. The water was warm and I stayed rolling close to shore with frequent breaks to spend time with them.
22. Once he got rolling he stayed rolling. In the mountains it is different.
23. Nice ride in from Meyerland to Downtown today, a little bit of a backup on 59 north, but traffic stayed rolling.
24. The cameras stayed rolling all night while the crowd danced to the band's energetic set of originals and a few funky covers.

Again, the entire WWW does not return the collocation *stayed rolling* in the golf context, but one single attestation for the present tense has been retrieved – an expert query about the relationship between length of putt and speed of the ball, similar in its non-situatedness to the previous *remain*-example; and it may be notable for exactly modeling the unequivocalness of objects' real-world physics:

25. Assuming the ball stays rolling at 100 in./sec., on the 3% sloped marble, the ball would travel sideways 15" before it broke 0.84" to the low side of the start line. But the ball doesn't remain at the same velocity on grass, since it is steadily declining in speed.

5.6. The Plenary Meaning of (Force-Dynamically Specified) *Continue*

Regarding its particularization, intransitive open-class *continue* adjusts, as a semantic and register complement to formal *remain*, the (two basic) steady-state pattern(s) of an Agonist's prevailing force tendency toward motion in space to the suggested core semantics, thus emphasizing the (time-based) component of dynamicity: *Stay*/*remain* and *continue*, then, emerge as attention-sensitive counterparts, highlighting the domains of (force-dynamic) stationariness and dynamicity respectively.

To illustrate again the golf context, intransitive *continue* features an Agonist that instigates a steady overt resultant of motion[25]:

26. The ball continued rolling right up the hill, onto the green and didn't stop until it settled in the back fringe.
27. She made such a great stroke that the ball continued rolling on her line and into the cup!
28. Fans loved the water-walking ball, but soon they realized the ball was not done rolling. The ball continued to roll up the green and then slowly dropped and went right in the hole.
29. Lee Westwood on the ninth, it would be a phenomenal putt for par. A gentle push from the Englishman, or so it seems, but the ball continues to roll and roll... and roll. And roll.

6. ATTENTION FOR CONTRAST(S)

It is beyond question that contrast is a fundamental principle in both sensing/perception and understanding/cognition – a vital precondition of any cognitive 'activity'; and in perception it is definitional for stimulus salience, hence at the heart of attention: Contrast, then, critically renders attention an intrinsically comparative concept that is likewise foundational in the organization of Linguistic Attention (see section 3). In the following, I will focus on one type of attention-based contrast, Linguistic Attention's proper perspective of cross-venue comparison, arguing for the 'semantics' of the lexical items under investigation as essentially attention-driven.

Elaborating on Talmy's (2000, 1, p. 417) suggestion of *keep*'s 'keyword' status, whose unequivocalness in representing the force-dynamic configuration makes it especially apt to serve as foil of comparison, not only for "the adverbial particle *still* and the verb satellite *on*," but also, I propose, for *remain*, *stay*, and *continue*; as repeatedly noted, scrutinizing the cross-venue comparative mechanisms of Linguistic Attention's Domain A, I will disregard the

[25] The collocation *continue stationary* is only attested before 1900, while *continue in place*, which is, however, irrelevant in the present context for its non-verbal complement, is found in high frequencies, cf.: *The ban on gay leaders will continue in place.*, *The Scheme will continue in place until such time as the Scheme is revised or replaced.*, *Based on preliminary reports, my understanding is that the Kyoto agreement will continue in place, though minus Japan, Russia, New Zealand, and Canada, and that the parties are committed negotiating a new treaty by 2015*. Note that the two admissible complementation options *continue* [VP]-*ing*/*to* [VP] represent constructional variants whose attention effects would, among others, be covered by the disposition sector, disregarded in this analysis.

constructional aspect addressed in Area Aa2, the disposition sector of Area Ad1 as well as internal and external augments in Area Ag1(f) and Ag2, and only briefly comment, in section 6.2, on some more obvious (formal) differences to give a sense of the intricate interaction of various attention factors that would have to be accounted for even in the limited morpheme-in-isolation analysis. A brief joint attention analysis of the force-dynamically specified items under investigation now offers a summary account of only the discriminating mechanisms from Domain A.

6.1. Toward a Cross-Venue Comparison of Force-Dynamically Specified Morphemes

Proceeding from the premise of a significant overlap in their core meaning(s), a first division by a formal criterion into open-class vs. closed-class, based on the distinction between conceptual content and conceptual structure, targets the difference(s) in attentional import in terms of (type of) categorial specification: Subdomain Ab, Formal properties of the morpheme, distinguishing between the competitors by a cross-venue comparative factor, accounts for an attention-sensitive property, specifying salience degrees "in accordance with the lexical category of the morpheme representing the concept" (Talmy forthcoming). Such differences would suggest an attentional cline for the lexical items at hand, with an alternative owing to the most sensible and/or preferred categorization of the force-dynamic keyword: If *keep* was conceived as an open-class lexical item, it would occupy a position at the higher end of the attention scale on a par with *remain*, *stay*, and *continue*, while *still* and *on*, qualifying as closed-class morphemes, show reduced values in attentional strength in this respect. A further cline along lexical categories would see *keep*, *remain*, *stay*, and *continue* indiscriminate (due to their status as verbs), outscoring the adverb *still* and the satellite *on* in salience. They would have to be relegated to second and third place in this comparison, though such provisional attentional hierarchy privileging verbs over adverbs, and adverbs over satellites (and prepositions) is, as yet, not borne out by evidence, awaiting empirical investigation. If this suggestion proves sensible, no difference in salience is viable among the four verbs; in light, however, of *keep*'s special status as an 'honorary' auxiliary, the verb category may perhaps require a more differentiated scaling by which verbs are to be attentionally distinguished in terms of their status as main, auxiliary, and, in the present case, candidate auxiliary verbs. And vying for the alternative closed-class option, *keep* would not attentionally be distinct from *still* and *on* as to their closed-class status as such.

By the analysis in section 5, Subdomain Ac, specifying attention-related effects due to Componential properties of the morpheme, would then set the open-class verbs against the closed-class items, including *keep*, with each component concept representing a smaller share of the morpheme's full meaning, and hence being subject to attenuation: *Remain*, *stay*, and *continue* capitalize on the rest or motion component respectively, while disallowing the other, hence particularize the force tendency, to the effect that each of the force-dynamic components turns out to be more salient (by Area Ac1), whereas the conceptual complex of all four steady-state resultant patterns constitutes the whole of the closed-class items' meaning, decreasing each component's salience against the gestalt, though with differential weighting in *still* and *on*. In general, however, indiscriminately lesser attention is conferred to

every single force-dynamic component concept, privileging the morpheme's full meaning over its parts, and the gestalt over all its individual semantic components.

Area Ad1, The core meaning and the associated meaning of a morpheme, has been found the major discriminating 'site,' accounting for differences in the six items' salience that, at the broadest level of granularity, contrasts the "chief referential import, and the main concern of a speaker in using the morpheme or of a listener in hearing it" (Talmy forthcoming) with the more peripheral associated meaning.

The cross-venue analysis of the morphemes' core and associated meaning sectors has suggested itself as especially predictive for how attention proves foundational to inform a valid, and in fact superior, semantic explication (not only) of the items under investigation[26]: This very Subarea of Linguistic Attention provides for the attentional mechanisms to distinguish between the lexical items by their individual attentional profiles, ultimately testifying to the significance of conceptual alternativity in language and motivating, if not justifying, their co-existence as lexicalized patterns in the English lexicon in the first place. These attentional effects determine speakers'/writers' choices, preferring one out of several competitors whose core meanings significantly overlap, and hearers'/readers' utterance interpretations appear likewise guided by the alternatives' attentional effects, differentially foregrounding components of their respective associated meanings.

In light of the line of argument promoted in section 5, the six items share a large proportion of core components: They all accommodate steady-state force-dynamic patterns and include an obligatory though non-overt, i.e., backgrounded, Antagonist as a co-entailed component in their associated meaning(s).

And while the specific force-dynamic pattern incorporates a semantic core component of dynamism, realized in the steady-state pattern as an entity's prevailing force tendency with an implication of effectiveness beyond a default value, such extension of the time interval during which the conceptual complex associated with a verb is seen to be valid has been proposed to be connected to the core as a presupposition. In a second, now tripartite, division, *keep*, *still*, and *on* (accommodating extensions in both space and time, though with different frequencies of occurrence and contextual preferences) critically separate from the other competitors, whereas *continue* adjusts steady-state resultants of motion, and *remain* as well as *stay* involve an extension into steady-state resultants of stationariness.

Finally, salience differences between the core and the contextual sectors follow from the items' different degrees of formality, accounting for "any speaker attitude or register pertaining to the core meaning that is lexicalized in a morpheme" and adding "concepts solely external to the core content, ones that relate to it but that do not affect its intrinsic character" (Talmy forthcoming).

The register aspect referred to indeed turns out to be a viable discriminating factor for the verbs under consideration, as an as yet informal check of the *Corpus of Contemporary American English* (*COCA*) reveals: In the context of motion events, *keep* ranks as the fifth frequent item in colloquial spoken contexts (and fiction), clearly outscoring its competitor *continue* (on rank 45), which tends toward the formal registers, especially with *to*-constructions peaking in the academic register and hardly found in fiction. *Stay* parallels *keep*

[26] It should be added that, in principle, such categorization can not escape its fuzzy and even gradient nature, especially since some critical properties turn out to be even more ambiguous for verbs, let alone for closed-class items with their characteristic schematic meanings.

in its preference for colloquial spoken registers and would accordingly complement its open-class competitor *remain*, which again privileges the more formal written registers. The contextual sector also covers an "unusual attentional feature" of a lexical item, with the potential to "rival and in some cases perhaps even exceed the core content in salience" (Talmy forthcoming): Its specification bears on the items under analysis in terms of affective associations that readily draw on the beyond-a-default value, e.g., a sense of (affective) surprise or (attitudinal) notion of contrary-to-expectation, which, as the illustrations have demonstrated, in response to a particular context, may be more or less desirable.

Here is a summary table of only the discriminating Areas of Linguistic Attention scrutinized in this chapter so far (disregarding the coentailment and augment sectors for their yielding invariable values across all six items):

Table 1. Synopsis of the six items' attentional profiles

Lexical item	Conceptual status	Core meaning	Presupposition sector	Contextual sector
keep	honorary closed class undetermined	Agonist's force tendency accommodates all four steady-state patterns, overt resultant	extension beyond a default value, neutral as to spatial or temporal extension	(positive or negative) surprise colloquial
still	closed-class	Agonist's force tendency accommodates all four steady-state patterns, overt resultant	temporal extension beyond a default value	(positive or negative) surprise
on	closed-class	Agonist's force tendency accommodates all four steady-state patterns, overt resultant	spatial (directional) extension beyond a default value	(positive or negative) surprise
remain	open-class	Agonist's force tendency accommodates steady-state patterns with stationary resultant, overt resultant	extension beyond a default value	(positive or negative) surprise formal
stay	open-class	Agonist's force tendency accommodates steady-state patterns with stationary resultant, overt resultant	extension beyond a default value	(positive or negative) surprise colloquial
continue	open-class	Agonist's force tendency accommodates steady-state patterns with dynamic resultants, overt resultant	extension beyond a default value	(positive or negative) surprise formal

- All six items incorporate the force-dynamic pattern with either a stronger or weaker Agonist and an Antagonist obligatorily backgrounded as a coentailed participant, and they share the same presupposition of an abiding force tendency beyond a default value, based on the dynamic component of steady state.
- All (candidate) closed-class items have this core meaning in common, with *keep*, as the force-dynamic keyword, remaining agnostic of any bias toward the domains of space and time, while *still* and *on*, through their differential weightings, privilege, by measures of frequency and/or prototypicality status, either the temporal or spatial extension in the presupposition sector of the associated meaning, concomitantly assigning it to the midground of attention.

- The three open-class items complementarily particularize the core component of steady state, specifying it with reference to either of the motive tendencies: *Remain* and *stay* are lexicalized for their steady-state force tendency toward rest (extending stationariness), and *continue* for its tendency toward motion (extending dynamicity); differing in their contextual sectors, *remain* tends toward formal registers and *stay* (like *keep* and, probably, *on*) peaks in colloquial contexts.
- The beyond-a-default component is proposed to qualify as a presupposition, while its respective specification is conceptualized as an elaboration of the core meaning, to be assigned to the augment sector; and its positive or negative connotations would be housed in the contextual sector of the morpheme's associated meanings.

And if the attentional profiles outlined above prove sensible, the six items under investigation would exhibit a tendency for symmetric patternings across the organizing domains space (open-class *stay*, closed-class *on*) and time (open-class *continue*, closed-class *still*), with open-class *remain* and candidate closed-class *keep* accommodating both specifications.

Note, however, that all items at issue differ in their constructional specifics (Area Ab1), in their formal values assessed by the dispositional sector of the associated meaning (Ad1-d), and in terms of collocational constraints (covered in Area Ag) – all these aspects had to be disregarded for space limitations; some comments, however, may be in order on the remaining factors of Linguistic Attention's A-Domain.

6.2. More Attention Effects Relating to Morphemes in Isolation

The attention effects briefly addressed in the following would in fact have to be taken into account for an attentional profile of a morpheme in isolation.

As to Area Ae, Polysemic properties of a morpheme, any assessment inalienably follows from the general theoretical proviso of how many senses to assume for a given morpheme, and, not least, if all, or some, or just one of these senses are/is activated on encountering the respective morphemic shape. Regarding the cases in point, it may safely be taken for granted that all six lexical items exhibit a range of polysemy, with the (candidate) closed-class competitors displaying quite extensive ones. It remains entirely an empirical issue, however, which item is to be conceived as 'more' polysemous and, accordingly, which sense(s) would qualify as most, more, less, or least salient.

Subdomain Af, Phonological properties of the morpheme, hosts a gradient, cross-venue comparative factor that readily discriminates between the competitors, yielding differences in salience, first, in their spoken realization – with two sounds in *on*, three in *keep*, four in *stay* (provided a perceivable diphthong is realized) and *still*, six in *remain* (again opting for a diphthongized variant), and seven in *continue* (disregarding a possible schwa)[27].

[27] Though this scale appears to favor *still* at first sight, the tense/long vowel in *keep* overrules the lax/short vowel in *still*, but not in *kept*, while *on* shows different values in this factor, depending on its realization in different accents of English – a tense/long vowel in American English versus a short vowel in English English, probably sharing ranks with *keep* due to the inherent duration of the alveolar nasal as opposed to the plosive's lack of duration; any more precise qualification would have to take recourse to operationalizable measures of acoustic phonetics. And to touch on another discriminating phonetic effect, Subarea Bc1, Stress, from Domain

Regarding their written forms, *continue* will occupy first rank with eight graphemes as against six in *remain*, five in *still*, four in *keep* and *stay*, and two in *on*.

From the final Subdomain of the A-Factors, Area Ag1, Semantically associated morphemes (and their concepts), accounts for (hearer-/reader-causal) attentional effects due to reference activation of semantically related morphemes and their conceptual contents: Any of the six morphemes may activate each other by their shared semantic components and, due to the fact that this common semantic ground proves to be considerable, such mutual activation is expected to occur. Area Ag2, Weighting among semantically associated morphemes, would presuppose the identification of a prototypical force-dynamically specified item out of the alternatives – the most likely candidate being the force-dynamic keyword *keep* on account of its more 'purely' and more flexibly expressing the conceptual complex, with lesser interference of concepts 'external' to the force interaction, and accommodating both force tendencies (toward motion and toward rest). In light of this conjecture, the cognitive phenomena underlying this weighting, most probably, greater salience and likeliness to pop up in memory as well as their amenability to classification, again privilege *keep*, also owing to its lexical frequency weighting identifying it as the set's frequency-of-encounter prototype.

Area Ag3, Collocationally associated morphemes, refers to attentional effects by a morpheme's environment: For *on*, e.g., which frequently occurs in clause-final position or in combination with a succeeding prepositional phrase like *to the green*, *some nine feet*, but also in various other syntactic neighborhoods, such as a coordinated verb phrase, *and dropped into the hole for an eagle*, any statement about the activation of collocates appears problematic, or at least premature due to this item's versatility; and as a satellite to a motion verb, *on* would activate a large selection of verbs such as *roll*, *travel*, *sail* etc. or of adverbs like *in*, *to*, *back*, *down* – testifying to the interdependence of attention effects in terms of, in this case, reinforcement (see next section) and correlating with the meaning component of extended motion in space. Similarly, *still* is found with *is* and *was* preceding it and a motion verb collocate following it, whereas *stay* as well as *remain*, predictively, prefer stative collocates (see sections 5.4 and 5.5); on an informal cursory search outside the golf scenario, the *COCA* predominantly returns position verbs like *sitting* or *standing*, but only in extremely low frequencies prototypical motion verbs, with *stay* overall collocating with even fewer stative [VP]-*ing*, while *continue* now favors -*ing*-collocates with motion verbs (see section 5.6 above).

6.3. A Glimpse at Competition in Steady-State Force-Dynamic Patterns

Working out selected items' attentional profiles will also involve detailing some specialized effects arising from attention factors in combination, to yield patterns of reinforcement, competition, and conflict that significantly contribute to such attentional differential and give a sense of yet another dimension of the explanatory potential of Talmy's approach to attention in language, which in turn is again directly related to conceptual

B, compares, e.g., *keep*/*kept* ***roll****ing* vs. *roll*(*ed*) ***on***, where the boldfaced item is invariantly given prominence by this prosodic feature, while there is the option of functional stress assignment for the speaker in ***still*** *rolling* vs. *still* ***roll****ing*.

alternativity in its representational format in language, i.e., realized as linguistic competitors. Concluding the highly selective account of individual attentional effects and the preliminary comparison, I add some tentative remarks on factor interaction, 'challenging' the attentional values of individual factors following from competition, win, or override. Acknowledging such systematic effects of factor interaction is at the very heart of Linguistic Attention and its conception as a factor model which is critically meant to pay respect for combined attentional effects due to the basic individual mechanisms' variably and multiply interacting; and it is precisely this level of flexibility and modulation that indeed grants Talmy's *Attention System of Language* pride of place among linguistic models of attention, eventually making it compatible with cross-systems conceptions of general cognition.

To remain with just a suggestive exemplification of competing attentional effects involving the major mechanisms covered in this chapter: *Keep* would outscore its open-class competitors in salience on account of incorporating no additional component concepts besides the force-dynamic complex, hence distribute the available portion of attention over fewer component concepts (by Area Ac1), but is itself, as a candidate member of the closed-class system, overridden by the open-class verbs for its decrease in clarity, distinctness, and significance of its associated concepts. More salience is therefore conferred upon these items' particularized patterns of extended stationariness (*remain*, *stay*) or motion (*continue*). That is, the closed-class items do not specify the force tendency of the resultant, whereas the open-class verbs do just that: In *remain* and *stay* any tendency toward motion is overcome (with rest as result) complementing *continue* with motion as result (overcoming any tendency toward rest). Subject to a pending, conclusive, and sufficiently fine-grained semantic analysis, especially regarding the open-class verbs, *continue* as well as *still* would allocate more attention to the temporal domain, while *remain* and *stay*, as well as *on* tend to highlight the stationary patterns of the force-dynamics configuration. *On* in turn foregrounds, due to its association with spatial extension, a forward-oriented motion of the overt resultant, which, as a consequence, incorporates some (remote) appeal to the time dimension. With the same provision, the implications by the contextual meaning component, resulting in connotative overtones, await thorough scrutiny of a notable amount of contextualized authentic data.

CONCLUSION

This sketch of few selected mechanisms, though apparently tentative and largely based on meta-cognition as its principal method of analysis, may nevertheless be suggestive to what decisive extent and general import attention affects, or even determines, the semantics of lexical items. The argumentative exercise in this chapter would, hopefully, also not have failed to demonstrate what a comparative analysis along the lines proposed in Leonard Talmy's Linguistic Attention, in accounting for an item's final relative attentional values, is able to contribute to identifying differences in usage so far poorly understood in linguistics. These differences might then be scrutinized systematically on the basis of a homogenous though intricately complex notional category, attention – finding its reflex in an intriguingly multilayered and critically interactional linguistic system. As predicted – or, at least, suggested – by the general attentional specification of, first, the closed- vs. open-class system and, second, the particulars of the individual items' attentional profiles, the concept of

attention indeed appears to be a vital determinant of language use, discriminating, on various levels, between lexical items and suggesting itself as a major parameter to account for semantic differences across linguistic domains.

Having probed into a fairly constrained lexical domain while, at the same time, attempting to maximally control for variables, this chapter may, in more specific terms, have documented the potential of Talmy's model, but, admittedly, the agenda that will immediately open up proves enormous. Just remaining with the force-dynamic keyword *keep* [VP]-*ing*: To spell out in a (same- and cross-venue) comparative analysis an attentional profile against its lexical competitors (the verbs *remain*, *stay*, *continue* as well as non-verbal alternatives beyond *still* and *on*), by itself indeed poses a major challenge when Talmy's framework is taken seriously. All the factors of the A-Domain would have to be worked off, followed by factoring in the dimension of combinational analysis (Domain B), targeted at constructional specifics and their semantic contribution (including the list of construction types), and finally extending the perspective to also incorporate increasingly wider contexts and their attentional effects (captured in the C-Factors) – not only the location of the Antagonist but also various types of contextual 'matches' (only very cursorily touched upon in this analysis). Ultimately, all these aspects call for a serious comparative study of conceptual alternativity that would certainly, in the final analysis, end up in and indeed afford a book-length treatment. And, I believe, this single (alleged closed-class) 'four-letter word' without any doubt deserves such a degree of 'scientific' attention.

Concluding, I address just one immediate domain of the model's practical application, apart from suggesting itself as a powerful tool in stylistics in general – lexicology. Semantic analyses informed by Talmy's *Attention System of Language* appear especially suited to systematize lexicographical entries by reference to an 'external' framework, probably avoiding the notorious, seemingly inevitable circularity compromising even high-quality dictionaries; and the fine-grainedness of the analytical distinctions detailed in Linguistic Attention, covering successive and hierarchical areas of semantic necessity and optionality, likewise allow for a considerable differential rigor in approaching another pending query in lexical semantics: The attentional mechanisms identified may well promote a controlled analysis of polysemy, and the model as a whole seems well suited to scrutinize the cognitive underpinnings informing register-sensitive selection and explicate the principles that govern preferences in (alleged) synonymy.

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REFERENCES

Ceccato, S. (1969) (ed.). *Corso di linguistica operativa*. Milano: Longanesi.
Ceccato, S. and Zonta, B. (1980). *Linguaggio consapevolezza pensiero*. Milano: Feltrinelli.

Chiarcos, C., et al. (Eds.) (2011). *Salience: Multidisciplinary perspectives on its function in discourse*. Berlin: de Gruyter.

Huddleston, R. and Pullum, G. K. (2002). *The Cambridge Grammar of the English Language*. Cambridge: Cambridge University Press.

Itti, L., et al. (Eds.) (2005). *Neurobiology of Attention*. Amsterdam: Elsevier.

James, W. (1950/1890). *The Principles of Psychology*. New York: Dover Publications.

Lampert, M. (2009). *Attention and Recombinance: A Cognitive-Semantic Investigation into Morphological Compositionality in English*. Frankfurt am Main: Lang.

Lampert, M. (in preparation). Keep — *A Cognitive-Semantic Analysis of a Four-Letter-Word.*

Lampert, M. and Lampert, G. (2013). … the ball seemed to keep rolling … *Linking up Cognitive Systems in Language: Attention and Force Dynamics*. Frankfurt am Main: Lang.

Marchetti, G. (2010). *Consciousness, Attention and Meaning*. Hauppauge, NY: Nova Science Publishers.

Oakley, T. (2009). *From Attention to meaning: Explorations in semiotics, linguistics and rhetoric*. Frankfurt am Main: Lang.

Stockwell, P. (2009). *Texture: A cognitive aesthetics of reading*. Edinburgh: Edinburgh University Press.

Talmy, L. (1975). "Figure and Ground in complex sentences." *Proceedings of the First Annual Meeting of the Berkeley Linguistics Society*. Berkeley: Berkeley Linguistics Society.

Talmy, L. (2000). *Toward a Cognitive Semantics. Volume 1: Concept Structuring Systems*. Cambridge, MA: MIT Press.

Talmy, L. (2006). "Cognitive Linguistics." In: K. Brown (Ed.), *Encyclopedia of language and linguistics*. Vol. 2. Amsterdam: Elsevier, 542–546.

Talmy, L. (2007). "Attention Phenomena." In: D. Geeraerts and H. Cuyckens, (Eds.), *The Oxford Handbook of Cognitive Linguistics*. Oxford: Oxford University Press, 264–293.

Talmy, L. (2011). "Cognitive semantics: an overview." In: C. Maienborn, et al. (Eds.), *Semantics: an international handbook of natural language meaning. Volume 1*. Berlin: de Gruyter, 622–642.

Talmy, L. (2012). *"The Attention System of Language — a report on work in progress".* http://linguistics.buffalo.edu/people/faculty/talmy/talmyweb/Handouts/attention1.pdf (last accessed 10/01/13).

Talmy, L. (Forthcoming). *The Attention System of Language*. Cambridge, MA: MIT Press. [draft from 2010].

Taube-Schiff, M. and Segalowitz, N. (2005). Linguistic Attention Control: Attention-Shifting Governed by Grammaticized Elements of Language. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 31, 508–519.

Online Sources

www.ahdictionary.com.
www.myCOBUILD.com.
www.corpus.byu.edu/coca.
www.corpus.byu.edu/coha.

www.thefreedictionary.com.
www.merriam-webster.com.
www.oed.com.
www.oxforddictionaries.com.

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Chapter 9

ATTENTION! DEATH IS MENTIONED: A COGNITIVE SEMANTIC INVESTIGATION INTO NEWS REPORTS OF DEATH

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ABSTRACT

This chapter employs Talmy's (2000) theory of attentional windowing and critical discourse analysis (CDA) to analyze 83 news reports of the death of Neda Agha-Soltan during the 2009 Iranian election protest. The study examines how systemic structures and properties of language play a role in the portrayal of the event. It utilizes the following cognitive tools: figure-ground organization, types of event-frames, and types of windowing. The discursive analysis showed that news reports of death primarily employed causal chain event-frame to report Neda's death, whereas (open) path event-frame was utilized within the causal chain event-frame to describe (and window) the details of her death and to report her death indirectly. In addition, figure-ground reversal was among the employed strategies to shift and direct attention through foregrounding, on one hand, and backgrounding, on the other hand. Furthermore, Neda's death as an 'agent (or author)-causation' was reduced to 'event-causation' for ideological purposes. In short, (cognitively) news reports of death can be a complicated discourse. The findings have wide application to the field of cognitive semantics and, in particular, to news discourse analysis. Theoretically speaking, foregrounding, gapping, windowing and backgrounding can form the *cognitive ideological square*.

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1. INTRODUCTION

The multi-faceted nature of the concept of *ideology*, along with the long history of critical investigations of this concept, led to its uptake, from the 1980s, as one of the main buzzwords of critical discourse studies (CDS) (more commonly known as critical discourse analysis (CDA)) (van Dijk, 1985; Thompson, 1987; Thompson, 1990; Fairclough, 1992; van Dijk, 1993; Eagleton, 1994; Fairclough, 1995; Fairclough and Wodak, 1997; van Dijk, 1998; Wodak, 2000). CDA, which can be viewed as both a theory and a method (Chouliaraki and Fairclough, 1999, p. 16), "is an interdisciplinary approach to textual study that aims to explicate abuses of power promoted by those texts, by analyzing linguistic/semiotic details in light of the larger social and political contexts in which those texts circulate" (Huckin, Andrus, Clary-Lemon, 2012, p. 107). A wealth of critical studies address and illustrate how ideologies, as *social phenomena*, are constructed socially (e.g., Urban, 1982; Dallyn, 2014; van Dijk, 1998; Carlton, 1990; Poggioli, 1968; Gardiner, 1992) through "symbolic forms of various kinds" (Schroeder, 2007, p. 9). One of these symbolic forms is *discourse* and *language* (c.f., Augoustinos et al., 2006; Billig, 1991; Nafstad et al., 2007; van Dijk, 1998).

On the one hand, discourse and ideology are social phenomena only insofar as "one embeds cognition in social contexts and society" (van Dijk, 1998, p. 10). Hence, ideologies are socially constructed, and "the social construction of ideologies does involve *framing processes*" (Oliver and H. Johnston, 2000, p. 50), which are, as cognitive processes, "sets of ideas [that] can be abstracted from the thought processes of any particular individual" (*ibid.*, p. 50). On the other hand, the very use of language is ideological (Butt, et al., 2004, p. 288). That is, studies demonstrate that a speaker may construct and reconstruct reality through different ideological discourse tools (c.f., Augoustinos et al., 2006; Billig, 1991; Nafstad et al., 2007; van Dijk, 1998). Needless to say, however, reality is sometimes misrepresented. Hence, discourse analysis aims to reveal the way(s) in which reality is (mis)represented in given discourses (Räthzel, 1997, p. 57).

As van Dijk (1995, p. 155) clarifies, different levels of analysis are available, such as social analysis, cognitive analysis, and discourse analysis. Within CDS, ideology is just one cognitive notion amongst many, such as memory, knowledge, and attitude. In addition, Botha (2001, p. 54) argues that ideology "emanates from a person's (group of persons') cognitive system." Hence, the study of ideology should include and employ the valuable theories that examine the relationship between thought (cognitive notion) and social reality (social notion) (Eagleton, 1994, p. 15). Methodologically speaking, C. Hart (forthcoming) argues that the synergy of cognitive linguistics (CL) in CDA has been successful and now "constitutes one of the most productive and pervasive methodological approaches to ideological research." C. Hart and Luckes (2007, p. xi) also believe that, "critical discourse analysis must account for the cognitive realities involved in language use, discourse." C. Hart (2010, p. 6) emphasizes that CDA requires "an approach that takes serious stock of research in contemporary Cognitive science, including Cognitive Linguistics." Both C. Hart (2005) and Chilton (2005) strongly argue that CL can inform CDA, by utilizing CL to reveal some "subtle means by which certain discursive strategies are manifested in text and effected in cognition" (C. Hart, 2010, p. 8). Unfortunately, critical studies of ideology ignore the cognitive dimensions of the process of forming and framing different ideologies, so that many of these studies suffer from "a paucity of appreciation of language cognition" (O'Halloran, 2003, p. 14).

It has been argued that the cognitive analysis of ideological expressions was, until fairly recently, "not a well-known, standard way of looking at text or talk" (van Dijk, 2000, Ms.). This neglect of the cognitive aspect of ideology in favor of analysis of its social aspects, e.g., social practices and social structures, has led to an incomplete overview of ideology that overlooks its complexity as not only a cognitive but also a social phenomenon (van Dijk, 1998, p. 126). Such a gap "is striking, since the successful communication of ideology depends on cognitive processes reproduced in the minds of text consumers" (C. Hart, 2013, p. 270).

Cognitive semantics is just one area of the CL movement (Croft and Cruse, 2004, p. 40). **Cognitive semantics is** "concerned with investigating the relationship between experience, the conceptual system, and the semantic structure encoded by language" (Evans and Green, 2006, p. 48). As Musolff (2008, p. 1) argues, over the past decade a number of studies have examined ideology and discourse "from the combined perspectives of Critical Discourse Analysis (CDA) and Cognitive Semantics." Thus, in contribution to the growing literature on the cognitive study of ideology in general and cognitive semantics in particular, this chapter will adopt Talmy's (2000) framework of *attentional windowing* to systematically infer the ideological characteristics and attentional system of news discourse. Briefly, attentional windowing, according to Talmy (2000, p. 258), refers to the different linguistic forms that can distribute one's attention over a scene by placing "one or more windows of greatest attention over [portions of] the scene, in a process that can be termed the windowing of attention." Examining the relationship between ideology and attention is of great importance, because, as Oliver and H. Johnston (2000, p. 50) explain, "to frame an ideology as an ideology is to call attention to the ideas on their own terms, to the structure of beliefs about society (its social theory), and to its ethical, moral, and political content, to its values and norms." The data in this chapter comprise news discourse, because this is one of the most ideologically determined discourses an analyst may examine to reveal the ideologically loaded nature of its discursive tools. Intrinsically, most studies on the subject of news discourse have been conducted on the assumption that aspects of the world as represented in the news do not reflect the "real" world (Stamou, 2001, p. 653). That is, news may represent various different versions of our reality due to the information selection and transformation processes involved in news production.

While the topics of news reports vary, *death* is perennially one of the most important and critical topics. As Walter, Littlewood, and Pickering (1995, p. 581) argue, "[d]eath, dying, and the dead regularly appear in various informational and entertainment media." In media and news discourse, death appears regularly in a wide range of forms, and its coverage is influenced by a number of factors, such as the specific nature of the mediated information in question and how it is "selected, framed, and presented in a certain conventional form" (Harro-Loit and Ugur, 2011, p. 151). Death, according to Harro-Loit and Ugur (2011, p. 151), provokes personal and public reactions; hence, in our mediated society "we get daily information about the death from the (news) media." They further argue that death is frequently viewed as "failure, loss or error, not as a normal ending to all that lives" (p. 151). However, in exceptional situations, like wartime, protests, and revolutions, death becomes the focus of news reporting, represented as an indispensable part of the incident itself. Hence, news reports of death can be ideologically loaded and are worth investigation.

With this focus on ideology and attention, and within the framework of CL, the present study probes news reports of Neda's death, an Iranian woman who was shot during the 2009

Iranian election protests (for more detail, see section 3). As far as the present researchers are aware, no study has yet been conducted to examine ideology and news reports of death from a cognitive perspective. Thus, the present study fills this gap and aims to address the following questions in relation to news reports on Neda's death:

1. What entities function as Figures and Grounds?
2. What are the most frequently employed event-frames?
3. What portions of the event are windowed/foregrounded or gapped/ backgrounded?
4. How can the details provided about Neda's death reveal the ideology of newspapers and, at the same time, how can such details be interpreted in relation to the ideology?

2. THEORETICAL FOUNDATIONS

2.1. Critical Discourse Analysis and Cognitive Linguistics

Critical Theory (associated with the Frankfurt School, particularly Jürgen Habermas and Michel Foucault) has been adopted by many sociologists in a way that lacks any technical or systematic consideration of language studies or linguistics (e.g., Stuart Hall, Birmingham Contemporary Studies). On the other hand, it has also been drawn upon by scholars whose training and orientation is towards language use (Fowler et al., 1979; Fairclough, 1989; Wodak, 1996; Wodak and M. Meyer, 2001). A guiding theme for this latter group has been the notion that language can be used for self-interested ends by power groups, and one of the scholars who was fundamentally oriented towards the contextual study of language was Foucault.

Foucault's work, as an orientation of Critical Theory, has given rise to at least two tendencies in discourse studies. One tendency has its context in sociology, political science, and to some extent, literary studies, and like Foucault's own work, does not analyze language structurally or make much use of the insights of descriptive linguistics (e.g., M. Shapiro, 1984). Instead, there is an assumption that discourse prominently includes non-linguistic as well as linguistic aspects. Another, contrasting, Foucauldian influence can be found among those whose declared preoccupation is with language per se (e.g., Fairclough, 1989, 1992, 1995, 2003; Wodak, 1996). This second group would accept, however, that discourse, understood as language use, is but one manifestation of social action. In fact, the most important tenet amongst these writers is that language is a form of social action (Fairclough and Wodak, 1997, pp. 278–279).

Within the second linguistically oriented group, several sub-schools can be identified. The two main schools are *critical linguistics* (or the East Anglia school) and *critical discourse analysis*. As Wodak and M. Meyer (2009, p. 1) indicate, "The terms Critical Linguistics (CL) and Critical Discourse Analysis (CDA) are often used interchangeably." Critical linguistics draws its social theory from George Orwell, Mikhail Bakhtin, Habermas, and Foucault, and its linguistic theory initially from Noam Chomsky's early versions of *transformational grammar* (Hodge and Kress, 1979) and later from Halliday's *systemic functional grammar* (Fairclough, 1989, pp. 13–14; Fowler, 1996, p. 11). On the other hand, CDA, most commonly associated with Norman Fairclough, Ruth Wodak, and Teun van Dijk

(c.f., van Dijk, 1993; Fairclough, 1995; Fairclough and Wodak, 1997; Caldas-Coulthard and Coulthard, 1996), is a research enterprise that critically analyzes the relationship between language and society. As such, it constitutes a type of discourse-analytical research that studies the way in which social ideologies, identities, and inequalities are (re)enacted through texts produced in social and political contexts (van Dijk, 2001, p. 352). Chilton (2005, p. 24) explains that CDA can reveal how language users establish ideologies, e.g., exclusionary attitudes etc., through recurrent and selective (non)linguistic features and aspects. Fairclough (1995) identifies three stages of CDA, namely, the description, interpretation, and explanation stages. *Description stage* analysis concerns the text itself. The *interpretation stage* includes "more psychological and cognitivist concerns with how people arrive at interpretations" (Fairclough, 1995, p. 59). At the *explanation stage*, O'Halloran (2003, p. 2) notes that recent developments in CDA have seen a dynamic space created for interdisciplinary work resorting in part to sociocultural analysis in order to account for the significance of texts. CDA has done a fine descriptive job with regard to discourse features in various realms using Halliday's systemic functional grammar. Chilton (2005) nicely explains that in order to be successful in Fairclough's third, explanatory stage, CDA needs to consider some aspects of cognitive and evolutionary psychology, namely *modularity of mind*, *intuitive psychology*, *Machiavellian intelligence*, *intuitive biology*, and *cognitive fluidity* (*ibid.,* pp. 25–29). Hence, according to Chilton *(ibid,* p. 44), the combined framework of cognitive evolutionary psychology and CL can yield insights into human nature and human societies that CDA alone has not provided. The following section reviews Talmy's (2000) attentional windowing, which is an important theoretical framework within cognitive semantics.

2.2. Attentional Windowing

Linguistic expressions refer to entities or describe situations/scenes. These can be relatively concrete objects/events, or they can relate to more subjective experiences, such as feeling remorse, joy, or unrequited love (among many others) (Evans and Green, 2006, p. 192). Language conveys entities and scenes by encoding the language user's *conceptual system*, that is, the system of *cognitive representations* (CRs; a term coined by Talmy (2000)). According to Evans and Green (2006, p. 192), "although the conceptual system is not open to direct investigation, the properties of language allow linguists to reconstruct its properties and build a model of it that… explains the observable properties of language." Talmy (2000) points out that the *conceptual system* (CS) is made up of two systems, namely, the *conceptual content system*, which provides the majority of rich substantive detail and the *conceptual structuring system*, which provides the structural properties of a scene. The conceptual structuring system in Talmy's CS (2000) is based upon a limited number of large-scale *schematic systems*: (1) the *configurational system*, (2) the *perspectival system*, (3) the *attentional system*, and (4) the *force-dynamic system* (for more detail, see section 2.3).

These schematic systems offer the essential organization of the CS through which a wealth of meanings can be encoded and decoded by utilizing closed-class words. Each of these schematic systems provides a structural aspect of the given scene.

It is worth noting that the concept of attention reflected in Talmy's attentional system is very similar to that of Langacker (1987, p. 115), who notes:

> Attention is intrinsically associated with the intensity or energy level of cognitive processes, which translates experientially into greater prominence or salience. Out of the many ongoing cognitive processes that constitute the rich diversity of mental experience at a given time, some are of augmented intensity and stand out from the rest as the *focus of attention*.

The attentional system concept implies that languages can place a portion of a coherent referent situation into the foreground of attention by means of the explicit mention of that portion, while conversely placing the remainder of that situation into the background of attention by omitting mention of it (Talmy, 2000, p. 257). This cognitive process is called *windowing of attention*. The coherent referent situation with respect to which the windowing must take place is the *event-frame*, or generic unitary conceptual category, resulting from the systematic segmentation applied by human cognition to phenomena that occur (Thepkanjana, 2000, p. 260). The relationship between the event-frame and windowing is as follows: the part that is foregrounded through inclusion is *windowed*, while the part that is backgrounded through exclusion is *gapped* (Kim, 2009, p. 51).

Basically, windowing enables one to describe and conceptually reframe an event in different and various ways (Marchetti, 2006, p. 5), that is, different patterns of selected windows can be placed over the scene (Talmy, 2000, p. 258). This latitude results from a state of *conceptual alternativity* (Talmy, 2000; Croft and Cruse, 2004; Evans and Green, 2006). In other words, a sequential referent scene may have the window of strongest attention placed over its beginning, middle, or end—that is, the scene can exhibit *initial*, *medial*, or *final windowing*. On the other hand, some other given portion of the same scene may not be windowed at all. To put it another way, this portion can be "backgrounded by the lack of sentence constituents referring to it, and accordingly here be said to have *initial*, *medial*, or *final gapping*" (Talmy, 2000, p. 237). Based on analysis provided by Talmy (2000) and Kim (2009), such *backgrounding* and *foregrounding* techniques can be a means to direct the hearer's attention, as well as to purposely support the speaker's ideology. Kim (2009, p. 50) explains:

> The process of segmentation of a causal relation is closely related to scope of predication, and is mainly represented by verbal, adjectival or aspectual expressions. An event structure consists of sequences of sub-causal relations along with temporal phases, such as Volition to initiate bodily action, Activity, Force Transfer from an Agent to Patient, Change of location or state, and resultant State.

For example, let us imagine a situation where a little girl is jumping, trying to reach cookies in a glass jar, and the jar falls and breaks. This incident consists of several sub-events or sequences of sub-causal relations: *volition* (the girl's volition to reach the jar), *activity* (jumping), *force transfer* (transferring force from the girl to the jar), *change* (change of state from unbroken to broken jar), and *state* (the resultant state of [the jar's] being broken). Windowing of attention then, which involves choosing which of these sub-events to foreground and which to background, is defined as "a cognitive process of segmenting some of these sub-causal relations out of the whole causal relation, or the entire series of sub-causal relations could be within the window of attention" (Kim, 2009, p. 52).

Regarding focus of attention, Kim (2009, p. 50) explains, "[in] psychology, focus of attention is about what directs the perceptual system, which is a center-periphery pattern in which greater attentional strength is placed in a central region and lesser attentional strength is placed in a surrounding region". However, in linguistics, the primary and/or secondary focus of attention contributes to the selection and determination of human participants in a given situation (*ibid.,* p. 50). That is, the focus of attention refers to the perceptual and/or cognitive prominence of participants and is represented in the selection and arrangement of nominals in a sentence, i.e., it is *participant oriented* (*ibid.,* p. 52). Kim adds that a speaker composing a sentence may choose one of two or three participants in a given scene, such as a Subject-Verb-(Object) form or a Subject-Verb-Indirect Object-(Direct Object) form. In a transitive form, a participant might be chosen as a Subject (or Agent), as the primary focus of attention, and the other participant as an Object (or Patient), as the secondary focus of attention (*ibid,* p. 50). In conclusion, in the sense that language is a means of directing attention, focus of attention demonstrates which participant in an event the speaker plans to direct the hearer's attention towards, while windowing of attention demonstrates the sub-causal relations of the overall causal relation the speaker plans to direct a hearer's attention towards (*ibid.,* p. 52).

2.3. Event-Frames

Croft and Cruse (2004, p. 7) explain one of the fundamental assumptions of CL as follows: *words* denote or symbolize concepts, namely, units of meaning. In contrast, *frames* are means for organizing these concepts (Fillmore, 1985, p. 225). In other words, meanings are described relative to frames or cognitive models. Fillmore (*ibid.,* p. 223) defines frames as specific unified frameworks of knowledge, or coherent schematizations of experience. Talmy (2000, p. 259) points out that in order to be practicable the notion of windowing demands a basis upon which to distinguish between two kinds of material missing from a sentence: one whose referent would be understood as belonging to the represented scene, and another whose referent would be felt as peripheral or incidental.

Thus, Talmy takes for granted that language users conceive certain elements and their interrelations as belonging together as the central identifying core of particular events or event types, whereas other elements, which on other grounds might have seemed to share an equally intimate involvement in the event, are instead conceptualized as peripheral or incidental (*ibid.,* p. 259).

Conceptual elements and interrelationships that in this way are evoked together or co-evoke each other lie within or constitute an event-frame, while elements that are conceived of as incidental, whether evoked weakly or not at all, lie outside it (*ibid.,* p. 259). Talmy (*ibid.*) introduces five generic types of event-frame: *paths*, *causal chains*, *cycles*, *participant interactions*, and *interrelationships*. The following are brief accounts of these types.

2.3.1. Path Windowing

Path windowing is a windowing process that acts over a path event-frame, which is "the so-conceived entirety of a path of motion" (*ibid.,* p. 257). This windowing process can be treated with respect to three different categories of path—*open paths*, *closed paths*, and *fictive paths* (*ibid.,* pp. 265–270).

2.3.1.1. Open path

An *open path* is a path, conceptualized as an entire unity (i.e., having a beginning and an end), that is represented by an object physically in motion over a period of time. Most importantly, the beginning and end points of the path are at *different* locations. To illustrate, we will cite Talmy's (*ibid.*, p. 266) example:

A. The crate that was in the aircraft's cargo bay fell out of the plane through the air into the ocean. [maximal windowing]

Talmy (*ibid.*, p. 266) suggests several factors that have a pivotal role "in the putative cognitive processes by which an open path becomes conceptualized as an event frame—that is, as a unitary event bounded off from surrounding material regarding space, time, or other qualitative dimensions."

2.3.1.2. Closed Path

A *closed path* pertains to the same kind of entity as the open path except that its beginning and end points *coincide* at the same location in space; that is, the path now constitutes a circuit. In this sense, then, this path features *departure*, *away*, and *return* portions.

B. [I need the milk]. Go get it out of the refrigerator (and) bring it here.

2.3.1.3. Fictive Path

The English construction "X BE across Y from Z" directs one's attentional focus along a spatial path. Such a spatial configuration, understood as static through time, can often be conceptualized so as to render it conceptually sequential and to represent a path of fictive motion. The fictive trajectory exhibited by shift in a person's focus of attention over a conceived scene is one such type of fictive motion.

C. My bike is across the street from the bakery.

2.3.2. Causal-Chain Windowing

The sequential causal chain event-frame can have a window of attention placed over its beginning, medial, or end portion. That is, it can have initial, medial, or final windowing. On the other hand, it can have an unwindowed portion, that is, a portion can be backgrounded or gapped. In other words, it can also have initial, medial, or final gapping (Talmy, 1996, 237). The semantic composition of a physical causal chain with an intentional *initiatory agent* can be depicted as follows (Talmy, 2000, p. 272):

Agent's scope of intention
[⟶]
[1] → [2] → [3] → [4] → [5]
Sequence of causally chained sub-events
[1]: Agent's act of volition that activates bodily motion.

[2]: Bodily motion of the agent (particular body part(s) or whole body) that initiates the physical causal chain.

[3]: Intermediate, causally chained sub-events.

[4]: Penultimate sub-event (= immediate cause of final result).

[5]: Final resulting sub-event (= agent's intended goal within scope of intention).

NB:

a. [3] may be absent.
b. [3] may be absent and [2] may coincide with [4].
c. [3] and [4] may be absent and [2] may coincide with [5].

Regarding causative verbs, Talmy (*ibid.*, p. 537) argues that different causation degrees exist. He divides them into three main degrees (semantic causative types): (1) event-causation, e.g., *the window broke*, (2) author-causation (unintended) e.g., *he broke the window by mistake*, and (3) agent-causation (intended), e.g., *he broke the window to annoy you*.

2.3.2.1. Discontinuous Windowing over Agent + Result (+ Immediate Cause)

In most languages, in constructions that refer to causal chains, the entire medial portion of the sequence is gapped, whereas the initiating agent and the final result of a sub-event are windowed (i.e., discontinuous windows are placed on the agent and final result). For example, in "I broke the vase," where the initiating agent is "I" and the final sub-event is "the vase broke," there is no indication of the bodily motions the agent undertook to execute the intention (namely, "bending down and moving my hand to grasp a rock on the ground, straightening up and lifting the rock with my hand, swinging my arm while holding the rock in my hand, and releasing the rock from my hand, thus propelling it forward"), what other intervening causally linked sub-events might have occurred, or what the immediate cause of the final result might have been.

2.3.2.2. Windowing of Causal Chains with Intermediate Cognitive Agents

Subsequent to the activities of an initiating agent, a following causal chain can include additional cognitive entities whose agency is essential for the occurrence of the sequence leading to the final reported result. However, to the extent that material referring to these *intermediary agents* is gapped from a sentence, the intentions, volitional acts, and effects of these agents are attentionally backgrounded, conceptually neglected, and thereby rendered *causally transparen*t, that is, subject to the conception of a causal continuity progressing directly through the agents rather than stopping at each agent and being renewed by a fresh act of intention and volition.

D. I'm going to clean my suit at the drycleaners store on the corner. [Here, no reference is made to the cleansing agent that will be used.]
E. The pharaoh built a pyramid for himself. [Similarly, no reference is made to those who actually built the pyramid.]

2.3.3. Phase Windowing

While a *cycle event-frame* consists of a cyclical event, *phase windowing* can position the window of strongest attention over a particular phase of that cycle. Thus, the cycle has defined initial, medial, and final phases, as well as a base phase that occurs after the final phase and before the initial phase. If the overall event is a motion event and a closed path is present in the cycle, "then the earlier, distinctively labeled portions of a closed path now become its 'departure phase', 'away phase', and 'return phase', while the base phase can be labeled as its home phase" (Talmy, 2000, pp. 279-280).

F. The pen kept falling off the table. [departure-phase windowing]
G. I kept putting the pen back on the table. [return-phase windowing]
H. The pen kept falling off the table and I kept putting it back. [departure-phase windowing plus return-phase windowing]

2.3.4. Participant-Interaction Windowing

Participant-interaction windowing describes a complex situation consisting of two parts: a primary circumstance and participant(s) interacting with that circumstance on (at least) two different occasions. The *participant* here can be a participant in either the expressed referent event or the current speech event. The participant's interaction with the circumstance can be direct, as in observing or considering the circumstance, or indirect, as in asking another participant about the circumstance. Linguistic devices direct an addressee to adopt one of the two participant interaction times as the location of his *temporal perspective point*, and to place around the interaction there an attentional window that could include such elements of the interaction as the activity, the surrounding scene, or the cognitive content of the participant.

2.3.5. Interrelationship Windowing

An *interrelational complex* is a conceptual complex that contains parts not autonomous but intrinsically relative to each other, where the presence of one part necessarily entails the presence of the others. With respect to linguistic expression, such a complex can be conceptually partitioned into parts expressed by syntactically distinct constituents. A language will permit alternative windowings over one or another part of such a complex, with mention of the remaining parts omitted (although their presence is still understood). Such interrelationship windowing alternatives allow the selection of a locus of strongest attention within a complex, or the adoption of a particular perspective on the complex while, given appropriate context, still conveying the complex as a whole.

2.3.5.1. Figure–Ground Interrelationship

The *Figure* is a moving or conceptually movable entity within the scene whose site, path, or orientation is a variable whose particular value is characterized with respect to the *Ground*. The Ground is a stationary reference entity within the scene with respect to which the Figure's site, path, or orientation is characterized. Figure and Ground are components of an event of *Motion* (covering both motion and location) that includes two further components, as shown below:

Event of motion = Figure + Fact-of-Motion + Path + Ground

Broadly speaking, the distinction between Path and Ground often, but not always, coincides with the syntactic division of a sentence into subject and object (Langacker, 1987, p. 231). Talmy (2000, p. 316) introduces some attention-related characteristics of the Figure-Ground asymmetry that determine the relationship between them. He demonstrates that the Figure is of greater concern or relevance (i.e., more salient) than the Ground (which is backgrounded). Furthermore, Talmy (2007, p. 277) indicates that, "the Ground is more familiar and expected, while the Figure is more recently in awareness." Kuang and Wen (2003) added two other characteristics to Talmy's description, namely time length and predictability. That is, Ground lasts longer than Figure, and Ground is more predictable than Figure. Lijun and Fenfen (2013, p. 65) argue that, "[f]igure and ground appear in the perception domain at the same time, however they can't be perceived meanwhile." In Figure–Ground organization (FGO):

> the entity that functions as the Figure of a situation attracts focal attention and is the entity whose characteristics and fate are of concern. The Ground entity is in the periphery of attention and functions as a reference entity used to characterize the Figural properties of concern" (Talmy, 2000, pp. 12-13).

According to Stockwell (2002), foregrounding is not limited to the entity that is positioned as the Figure. Rather, an entity can be foregrounded through different techniques such as "repetition, different naming, new description, original syntax structure, pun, alliteration, rhyme emphasis, metaphor, and so on" (*ibid.*, p. 14).

2.3.5.2. Factual–Counterfactual Interrelationship

According to Talmy (*ibid.*, p. 291), a language could contain a pair of constructions, namely factual and counterfactual, "such that if their overtly expressed materials are positive/ negative counterparts of each other, then both constructions make the same overall statement." Hence, a speaker can broadly construct the same statement by choosing one of the available constructions; however, the speaker will also determine whether to direct greater attention to something that *is* the case or to something that *is not* the case. For example, one can say *it is not cloudy* or *it is sunny*. As each construction entails the other:

> their referents together can be considered to constitute a certain kind of interrelationship event frame, namely a *factuality event frame*, and the directing of heightened attention to one or the other of these referent types can be called *factuality windowing* (*ibid.*, p. 291).

3. CONTEXTUALIZATION OF THE DATA AND DATA COLLECTION

On June 20, 2009, Neda Agha-Soltan (Nedā Āghā-Soltān), a 26-year-old Iranian woman, was killed during the Iranian election protest. What marked her death out from others that occurred was that it was recorded by a cellphone camera and subsequently posted on social media sites.

The image of her last breaths on the streets of Tehran was spread across Facebook, Twitter, and YouTube, and drew (negative) international attention to the government crackdown. It was, as Mahr (2009) commented, the most widely witnessed death in human history. Neda's murder thus neatly illustrates the concern of the current study: news reports of deaths. We do not propose to give a full account of the political situation that resulted in this event. Instead, we shall focus exclusively on the representation of Neda's death in the news.

The data set for analysis comprises news articles reporting the death of Neda Agha-Soltan collected from English-language newspapers. The corpus used in the present study was accessed via the Factiva database[1]. The search term "Neda Agha-Soltan" was used to collect stories that focused on her death and the search yielded 110 articles written in 2009. Excluding duplicates and unrelated articles, the final data set comprised 83 articles in 62 newspapers. These articles were coded using the Factiva software (c.f., Appendix A). Each of the articles used in the study was selected because it both reported Neda's death and provided a description of the video recording. It is worth mentioning here that the data were heterogeneous; that is, they included not only hard news but also editorials and opinion articles. These different types of article are undifferentiated here, and analyzed under the umbrella term "newspaper discourse."

4. RESEARCH METHODOLOGY AND DATA CODING

As noted above, this study examines news reports of the death of Neda Agha-Soltan, who was shot during the 2009 Iranian election protests. This incident was chosen because of its political and ideological importance and because of the wide exposure of the images. Because Neda's death was caught on tape, the movements and actions represented in news reports are highly significant, as the attention given to various details provides evidence for the ideological stance of certain newspapers. To achieve this, excerpts from news reports were extracted and analyzed at the sentential and discourse levels, employing Talmy's (2000) framework, and the results from selected news networks were statistically analyzed.

Talmy's (2000) theoretical framework, rather than his more up-to-date 2007 version, is used in the present study because the former is more easily applicable to empirical analysis, and comprehensively addresses the research questions posed in this study (c.f., Introduction). Hence, by employing Talmy's (2000) framework, this chapter examines the role of attention in framing events and how attention is used to frame and reframe various ideologies. Scrutinizing the semantic and discursive details of the data may disclose the different ways in which attention is directed and diverted ideologically, using varied techniques to represent elements within the data. In addition, analysis may reveal how ideologies can be restructured and events, in turn, reframed cognitively. The presupposition of this analysis is that ideologies can be uncovered by close reading, understanding, and systematic analysis of mental and attentional operations.

[1] Factiva is "a business information and research tool owned by Dow Jones and Company. Factiva aggregates content licensed and free sources . . . [and] provide[s] access to more than 36,000 sources (such as newspapers, journals, magazines, television and radio transcripts, photos, etc.) from almost 200 countries in 28 languages, including more than 600 continuously updated newswires" (Wikipedia).

That is, the application of Talmy's (2000) theory can reveal more about the mental aspect of language structure and hence explain how language is organized cognitively and what attentional operations are assigned to different language structures.

One of the uses of such an analysis is to ascertain the cognitive processes that enable understanding of linguistic aspects such as words, expressions, and, broadly, ideological discourse. Such findings may enable us to both decode and encode ideology in any discourse.

In short, this study aims to contribute to both the fields of CL and CDA by offering an insight into ideology and the cognitive discursive tools through which ideology is constructed. Hopefully, this study will deepen our understanding of the attentional dimension of language and discourse and contribute to the available literature on ideology and cognition (e.g., Alharbi, 2013; Benedetti, 2011; M. Lampert, 2009; Marchetti 2010; Oakley, 2009). To that end, we focused our analysis on:

1. Talmy's (2000) operation of event-frames, namely foregrounding and backgrounding of the participants in the event under examination. Specifically, we tried
   - To identify what entities (and their percentage of usage) were assigned the roles of Figure and Ground;
   - To examine in depth the Figure–Ground organization (FGO) of the different essential entities;
2. The types of event-frame used, and the patterns of windowing of attention over the event (i.e., the death scene). Specifically, we tried to identify:
   - The event-frames employed and their proportions of usage;
   - The patterns of windowing and their percentage of usage namely, initial, medial, or final windowing;
   - The patterns of causation.

This study employed a mixed methodological approach and the data analysis is divided into two sections:

1. Quantitative data analysis: to examine the frequency of Figure and Ground as well as the frequency of different types of event-frame and windowing.
2. Qualitative discourse data analysis: to scrutinize extracts from the data under examination.

5. QUANTITATIVE DATA ANALYSIS

As noted above, the analysis is divided into two sections, presenting quantitative and qualitative analysis, respectively. The two sections below introduce the quantitative analysis of the FGO, the event-frames, and the types of windowing of each event-frame. This statistical section helps to depict and reveal the ideology of the newspapers under analysis by enabling a comparison of the relative number of instances of the different elements employed.

5.1. Figure–Ground Organization

Any news reports, in particular those reporting death, contain specific elements. That is, there are elements readers may expect to find as they read, such as the agent (or Figure), the action, the patient (or Ground), the element, the place, the time, and the manner. Yet, news reporters always select certain elements to *report* and certain elements to *unreport*, and these choices are usually interrelated with their ideology, or the ideology of the news network. In the present study, the data are examined in order to reveal which portions of Neda's death scene were windowed (or foregrounded) and which were gapped (or backgrounded). In so doing, the analysis first presents a statistical overview of the Figure (agent) and Ground (patient). Table (1) illustrates the frequency, by number and percentage, of the most prevalent Figures and Grounds in the data.

From Table 1, it is clear that the most important Figures (F), among many, are *Neda* (32%), *blood* (27%), and the *video/pictures of Neda* (17%). On the other hand, the most frequently employed Grounds (G) are *Neda's body parts (head, eyes, etc.)* (26%) and (the) *Militia/government sniper (or thug)* (29%) (who allegedly shot Neda). The following are some illustrative examples (a detailed analysis is provided in section 7.1):

1. *Neda Agha-Soltan* (F), 27, was shot in the *heart* (G) during clashes between security forces and protesters in Tehran.
2. The grisly *video* (F) of 26-year-old Neda Agha-Soltan dying in a Tehran street, shot down by *a government thug* (G).
3. A faceless police *sniper* (F) has killed Neda Agha Soltan (G)
4. *blood* (F) pouring from her *nose* (G) after she was reportedly shot.

Table 1. Figure-Ground frequency in the data

Terms	Figure		Ground		TOTAL	
	No.	%	No.	%	No.	%
Death	4	6%	0	0%	4	4%
Neda	23	32%	3	9%	26	25%
Blood (theme)	19	27%	0	0%	19	18%
Video/pictures of Neda	12	17%	1	3%	13	12%
Neda's body parts (head, eyes, etc.)	6	8%	9	26%	15	14%
Gunshot	2	3%	0	0%	2	2%
Militia/government sniper (or thug)	2	3%	10	29%	12	11%
Murder	1	1%	0	0%	1	1%
Life	2	3%	0	0%	2	2%
Place of death (e.g., ground/street/etc.)	0	0%	4	11%	4	4%
Bullet	0	0%	4	11%	4	4%
World	0	0%	4	11%	4	4%
TOTAL	71	67%	35	33%	106	

This paper also examines event-frames and windowing to aid understanding of death reports as well as ideology from a cognitive perspective. The following section presents a statistical overview of the different types of event-frame and windowing utilized in the data.

5.2. Event-Frames and Windowing

The data below were analyzed according to Talmy's (2000) theory of attentional windowing to reveal the types of event-frame employed and the portions of the death scene that were windowed and gapped. Table 2 shows the frequency of types of event-frame used in the data.

From the statistical summary in Table 2, it is apparent that the causal chain event-frame is prevalent, comprising 65% of all event-frames employed to describe Neda's death. On the other hand, (open) path event-frames comprise 35% of usages. Tables 3 and 4 present the frequency of different types of windowing employed in each type of event-frame.

It should be noted that the analysis of the data under examination has revealed new types of windowing (i.e., Continuous windowing over action + agent and Inter-final windowing) in addition to the types specified by Talmy (2000) (i.e., Discontinuous windowing over agent + result and Intermediate Cognitive Agents). With reference to the type of windowing used in the causal chain event-frame, Table 3 indicates that "intermediate cognitive agents" constitute 60% of usages, and "discontinuous windowing over agent + result" comprise 18%. By way of contrast, the least frequent types of windowing are "continuous windowing over action + agent" (8%) and "inter-final windowing" (14%). The following are some illustrative examples (further analysis is provided in section 6.1):

1. A faceless police sniper has killed Neda Agha Soltan. [Discontinuous windowing over agent + result]
2. She [Neda] was shot - it seems deliberately - in the chest by a sniper with the Iranian security forces. [Continuous windowing over action + agent]
3. In the video, *a young woman* clad in jeans, white running shoes, and a black T-shirt *collapses to the ground with an apparent chest wound*. [Intermediate Cognitive Agents] (i.e., the intermediary agent is gapped from the sentence)
4. This brave young woman was *shot* and *killed*. [Inter-final windowing]

Table 2. Event-frame frequency

Event-Frame	Number of occurrences	Percentage
Causal chain	62	65%
Path	33	35%

Table 3. Causal chain event-frame

Event-frame	Type of windowing	Number of occurrences	Percentage
Causal chain event-frame	Discontinuous windowing over agent + result	11	18%
	Continuous windowing over action + agent	5	8%
	Intermediate Cognitive Agents	37	60%
	Inter-final windowing	9	14%

Table 4. Path event-frame

Event-frame	Type of windowing	Number of occurrences	Percentage
Open Path	Initial windowing	24	73%
	Medial/penultimate Windowing	1	3%
	Final windowing	8	24%

Regarding the different types of path event-frame, Table 4 shows that the open path was the only type employed in the data. With regard to windowing, initial windowing and final windowing are the most frequently employed types, comprising 73% and 24% respectively. In contrast, medial windowing was utilized just 3% of the time. Below are examples that illustrate the most frequent types of windowing:

1 The blood flows *from* her mouth and nose [Initial windowing = medial + final gapping].
2 She is struck by a bullet, then falls to the ground [Final windowing = initial + medial + gapping]

6. QUALITATIVE DISCOURSE ANALYSIS

In this section, we examine event-frames employed in the data by investigating certain examples in detail. The analysis focuses on the causal chain event-frame for two reasons: firstly, the causal chain event-frame is the dominating event-frame in the data under examination; and secondly, the path event-frame, as a secondary frame, is used within the causal chain event-frame for the purposes of windowing. This explains the differences in frequency and the prevalence of one event-frame over the other.

6.1. Event-Frames and Windowing

Death is always perceived as inherently causative. Hence, causation is the primary framework and approach for understanding such an event. With reference to the causal chain event-frame, Neda's death can be analyzed as consisting of a number of sub-events that form a causal chain event-frame. Table 5[2] provides a detailed description of the stages of Neda's death, as it might be imagined, employing the causal chain event-frame.

It is worth mentioning that a causal chain event-frame may account either for the agent's full intentionality and volition of action, or only for certain sub-events that function in favor of the final result. From Table 3, which shows the different types of windowing of the causal chain event-frame, only portions (or sub-events, to use Talmy's term) of the above description can be traced in the data under examination. The purpose of the analysis here is to highlight the extracts and sub-events that are windowed, and to examine how these sub-events contributed to ideological formation from the perspective of discourse analysis. In this chapter, due to lack of space, only a few examples are analyzed for illustrative purposes.

[2] As adapted from Talmy (200/1:272).

Table 5. Stages of the causal chain event-frame

Stages of the causal chain event-frame	The scene of Neda's death
1. Agent intends to act.	1. The agent (reportedly a sniper) decided to shoot Neda.
2. Agent sets parts of his body, or his whole body, in motion, and thereby initiates the cause of the event.	2. He pointed the gun at Neda. 3. He pulled the trigger. 4. He shot her.
3. Intermediate sub-events that are causally related (optional)	5. The bullet shot through the air.
4. Penultimate sub-event = immediate cause of the final result	6. The bullet hit Neda forcefully. 7. The bullet penetrated Neda's chest. 8. The bullet caused a wound. 9. Neda collapsed to the ground. 10. Neda bled. 11. Blood poured from Neda's nose and mouth. 12. Neda lost consciousness. 13. Neda's head slumped. 14. Neda's eyes went blank.
5. Final resulting sub-event = agent's intended goal	15. Neda died.

Before providing these examples, we will discuss the different types of windowing of the causal chain event-frame that are presented in Table 3, and connect them with the sub-events mentioned in Table 5.

Figure 1 shows a five-segment causal chain, as set out in Table 5, illustrating the different types of windowing. The sequence of the causally chained sub-events of Neda's death is represented via the numbering of stages, from 1 to 5. The first windowing in Figure 1, *continuous windowing over all the stages*, illustrates all stages of Neda's death, as imagined and given in Table 5. The dots represent the beginning and end of the windowing. The large arrows represent the development in time of the whole 5-stage event, whereas the small arrows indicate the sub-events that were windowed in the data (c.f. Table 3).

However, the direction of the final large arrow in this diagram is reversed, because it visually represents "continuous windowing over action + agent," as well as "Figure–Ground reversal" (FGR) (see section 7.1).

The types of windowing are explained below and one example of each type is offered here as an illustration. The order of examples follows the order of types of windowing in Figure 1. The first type is "intermediate cognitive agents."

6.1.1. Intermediate Cognitive Agents

A. In the video, a young woman clad in jeans, white running shoes, and a black T-shirt collapses to the ground with an apparent chest wound, and then loses consciousness as blood pours from her nose and mouth.

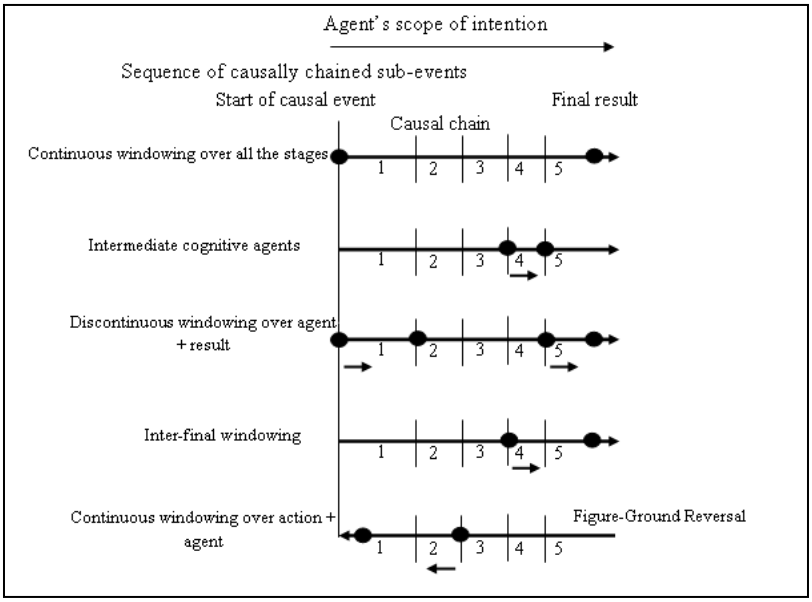


Figure 1. Different types of windowing of causal chain event-frame.

Example (A) describes the scene of Neda's death, as reported by a journalist. Putting Example (A) above in relation to the structure of the causal chain event-frame in Table 5, it is apparent that stages 1, 2, 3, and 5 (the final result) are gapped by omission, while the penultimate stage (Stage 4) is windowed. Talmy (2000, p. 272) explains that "discontinuous" windowing over agent and result is a natural way to describe a causal event, because it answers the two main questions "what happened?" and "who initiated the event?" Thus, the most acceptable manner of describing the causal event is to include at least Stages (1) and (5) (Discontinuous windowing over agent + result); however, this type of windowing comprises only 18% of the data (see Example (B). Intermediate cognitive agents, meanwhile, Example (A) is the most prevalent type of windowing used in the data (60%)). Although this type of windowing might not be the most natural or common manner of describing a causal chain event-frame—in particular a death incident—according to Ungerer and Schmid (1996), Stage 4, which is windowed in this example, is "the most significant aspect in a causal chain event-frame, because it refers to the immediate cause of the final result."

As a causal chain event-frame, Example (A) has a sense of causality; that is, the minor cause and result of this sub-event are windowed through the open path windowing. As Talmy (2009, p. 39) indicates, "The path windowing language applied attentional windowing to particular sub-events within the causal chain." Thus, the path windowing here in Example (A) focuses the attention on one minor sub-event within the causal chain, namely, the collapse of Neda *to the ground*. This *open path* event-frame has a *final* windowing (i.e., final windowing = initial + medial gapping) focusing the attention on *the ground*. That is, this example conveys the concept of *an open path* in which Neda progresses through the phases of standing up in the street, collapsing by falling down through the air, and lying on the ground. In this example, the phrase "with an apparent wound" serves to window Stage 4, the minor cause of her death. In addition, "as blood pours from her nose and mouth" is assigned a Ground interpretation.

It should be mentioned that Talmy (2009, p. 20) extends the concept of Ground through Ground interpretation. Simply put, Ground (G) refers to an entity such as "fall to the *ground*" and "blood pours from her *nose*" in which the words "ground" and "nose" are the Grounds. On the other hand, Ground interpretation occurs when a sub-event can be the Ground of a Figure that is another sub-event. That is, in Example (A) Neda loses consciousness (F) as a result (a minor reason) of the blood pouring from her nose and mouth (G). Hence, this sentence seems to assign a Ground interpretation to the process of the pouring of the blood event (i.e., setting it as a fixed and known reference point, and assigning a Figure interpretation to the losing consciousness event), and thus establishes a temporal (and causative) relation to this. In this discourse, the focus of attention (or greater attention strength) is placed on Neda (1) by making her the Figure; (2) by the lengthy description of her death, (including her physical appearance, e.g., "in jeans, white running shoes, and a black T-shirt"); and (3) the absence of Ground (i.e., the sniper).

Interestingly, the causal chain event-frame "profiles the initial causal event before the force-dynamic change" (Oakley, 2005, p. 452). That is, one would expect the journalist to report that Neda was shot first followed by reporting of the force-dynamic changes such as losing consciousness, blood pouring from nose and mouth, or dying. Yet, in this example, it has been noted that the causal chain event-frame profiles certain sub-events in favor of the final result, and the force-dynamic change in favor of the initial causal event. This result coincides with the fact that "blood" is foregrounded, and hence windowed, rather than the initial cause (i.e., the shooting), which was gapped through omission.

6.1.2. Discontinuous Windowing over the Agent and the Result

The second example below illustrates the second most frequent type of windowing of the causal chain event-frame, namely "discontinuous windowing over the agent and the result."

B. faceless police sniper has killed Neda Agha Soltan.

In Example (B), the windowing places focus on the agent and the result. In other words, by means of the FGO, the journalist places the sniper into the foreground of attention by explicitly mentioning him as the Figure. On the other hand, Neda is backgrounded through being made the Ground. In addition, the result of the sniper's action (an action that is here gapped) is manipulated into focus to become more prominent. That is, the act of shooting Neda is not mentioned. However, an interesting point to highlight here is the cognitive grammatical aspect of the word "sniper" itself, namely the *deverbing* –er, which is generally construed as marking the agent of the process, "snipe" here. Here, sniper instantiates the v + -er (snipe + -er). Part of our understanding of the noun "sniper" is related to our understanding of the verb "snipe." Taylor (2002, p. 425) explains that a participant in cognitive grammar may refer to the other meanings that are constructed and implied by the frame of a given verb. The bound morpheme -er sets up a schema into which the more specific meaning "snipe" is inserted. Accordingly, the derivational morpheme -er implicitly constructs an activity, "snipe" here, as a person performing this activity, the "sniper." In addition, in "sniper" the action assumes that there is another participant (or patient), Neda in this example. Furthermore, the verb "snipe" itself implies that the action of the sniper is intentional; hence, Neda's death was not a mistake.

Moreover, the main verb of Example (B), i.e., "kill," further highlights, and double-mentions, the action of sniping Neda. This is one of the cognitive iterative techniques employed in the data under examination. Hence, the main event was backgrounded and mentioned indirectly through the deverbing -er. As noted earlier, the window over the agent and the result is, according to Talmy (2000, p. 272), the most common type of description of the causal chain event-frame, as it answers the two main questions that readers will raise: what and who? However, as mentioned above, this type of windowing comprises only 18% of the total.

6.1.3. Windowing over the Action and Its Result

The third type of windowing is inter-final windowing, or windowing over the action and its result. We should remind the readers that the present data revealed two new types of windowing of the causal chain event-frame; that is, inter-final windowing and continuous windowing over action + agent. The inter-final windowing, which is the first data-specific type of windowing, is discussed below. The following example is illustrative:

C. This brave young woman was shot and killed.

In Example (C), Neda is manipulated into focus, i.e., foregrounded, through two techniques, namely (1) being the Figure, and (2) the absence of Ground. This is one of those cases in which the passive voice (agentive passive[3]) is used, resulting in FGR. Domaradzki (2007, p. 41) explains that transformation from active to passive constitutes a shift in prominence. In the case of Neda, employing FGR allowed the journalists to (1) call attention to the receiver of the action rather than the performer, that is, foreground Neda and what happened to her; (2) background (or relegate) the sniper, and consequently gap (defocus) the agent and his role by eliminating it altogether, either because he is unimportant or unknown (giving Neda more prominence); (3) window the action; and finally, (4) window the result of the action of the sniper.

6.1.4. Continuous Windowing over Action + Agent

The fourth type of windowing over the causal chain event-frame is "continuous windowing over action + agent." This is the least frequently employed type of windowing in the data and the second data-specific type as noted earlier. The following example is an illustration:

D. She [Neda] was shot - it seems deliberately - in the chest by a sniper with the Iranian security forces.

Example (D) is another example of FGR. FGR allowed the journalist to distribute the readers' attention evenly.

That is, the reversal manipulated Neda into focus, and backgrounded the sniper; yet, with reference to the causal chain event-frame as a whole, the type of windowing windowed the action and agent in reverse. However, the action here *again* received double windowing through the cognitive grammatical aspect of the word "sniper."

[3] "Agentive passive involves with expressed agent and without expressed agent" (Wang, 2010: 946).

In addition, the *deverbing* –er and the main verb of this sentence, "shot," are further redefined by the noun "sniper," and (indirectly) double-mentioned (for more detailed analysis, see Example (C) above).

6.2. Talmy's (2000) Degrees of Causation

Talmy (1976, 2000) argues that there are different degrees of causation: (1) event-causation; (2) author-causation, when the result is not intended; and (3) agent-causation, in which an agent deliberately initiates the action with a certain goal in mind. Tables 3 and 5 and Figure 1 provide a panoramic view of the causation discourse in the present data. Theoretically speaking, the death of Neda could either constitute author-causation, in the case that the sniper did not intend to kill her, or agent-causation, if he did.

In both cases, the agent or author is an important factor in her death, because Neda's death is not an example of event-causation. However, it has been noted that Neda's death was reported primarily as event-causation by placing penultimate windowing over the causal chain event-frame, and secondarily as agent- (or author-) causation, when the sniper was mentioned. Statistically speaking, 60% of the reports reported event-causation, whereas 40% reported agent- (author-) causation (Table 6).

In more detail, through penultimate windowing (intermediate cognitive agents), Neda's death was treated as being caused by the wound and the blood she shed, which are undeniably minor causes. However, these two sub-events would not have occurred if the sniper had not shot Neda. These two sub-events may manipulate this incident to represent Neda's death as fact-causation, because being shot does not necessarily cause death.

It is the blood she shed that caused her death. In addition, this reduction from author-causation to event-causation enabled the journalists to manipulate Neda into focus while reporting her death. In short, from the analysis, it is apparent that "agent-causation" was reduced to "event-causation" most probably for ideological purposes. Thus, news reports of death can be reducible to event-causation. It is possible, however, that, because the sniper did not appear in the video, he was gapped by journalists attempting to report only the contents of the video without adding further detail.

7. FINDING AND DISCUSSION

The present study aimed to contribute to the field of CDA in general, and CL in particular, by applying Talmy's (2000) attentional windowing theory to the area of news discourse, particularly news reports of death.

Table 6. Degrees of causation

Degrees of Causation	Number of occurrences	Percentage
Agent (author) causation	25	40%
Event-causation	37	60%

With regard to CDA, the present study has revealed trends in all newspapers with reference to the different strategies analyzed in the study, namely FGO (reversal); types of event-frame; types of windowing and gapping; and Talmy's (2000) degrees of causation. In this section, the findings of the above analysis are presented and discussed.

7.1. Figure–Ground Organization

Fernandez (2006, p. 101) argues that, traditionally, the subject of death is one that is not discussed in a straightforward fashion. This taboo surrounding mention of death can be accounted for by a number of strategies regarding FGO. A quick look at Table 1 shows a number of findings. Firstly, news reporters avoided use of the word "death," especially as a Figure (usage rate as Figure = 6%). Hence, Neda's death was reported indirectly. This indirectness, and the use of downtoning expressions (that were backgrounded and assigned a Ground interpretation), helped to avoid the use of the word "death." Accordingly, news reporters focused attention on Neda (32%) and the blood she shed (27%), an indicator of her death, without using the words "die" or "death." On the other hand, the word "sniper" was utilized as the Figure only twice (i.e., 3%), whereas Neda was utilized as the Ground three times (9%). This raises an important issue, namely FGR (or use of the passive voice). Undeniably, the case of Neda has a two-dimensional representation, i.e., a person is being shot by someone, or someone is shooting a person. In other words, it is a matter of perception, and perception matters; what was perceived as a Figure (the sniper) has become a Ground, and vice versa. Hence, the sniper is backgrounded while Neda, originally the non-salient party, is manipulated into focus and given prominence through use of the passive voice. The difference between the presence of "Neda" and "the sniper" is statistically significant (Chi-square test, *p*-value = 0.000300185) (see Appendix B). FGR is also revealed through the type of windowing of the causal chain event-frame (for more detail, see Table 3).

FGR reveals part of the attention-grammar interface. Myachykov et al. (2009, p. 5) argue that, "priming a referent leads to preferential assignment of attentional focus." They further argue that a number of studies have demonstrated that an English speaker is more inclined to use the passive voice frame when the attention is directed towards the patient. Grammatically speaking, voice in grammar, according to Quirk (1972, pp. 801-811), enables one to view the same event in two ways without changing the fact one intends to report. In other words, as Domaradzki (2007, p. 41) argues:

> [A]ctive and passive sentences can be characterized as distinct cognitive perspectives from which the speaker chooses to construe the situation (the choice of a perspective being naturally conditioned by what attracts his attention), while the Figure–Ground organization and scanning operations can be said to underlie every linguistic construction.

Items that appear at the beginning of an utterance occupy a salient slot, and thus could trigger structural organization somewhat independently of grammatical status (MacWhinney, 1977). The other two strategies employed to manipulate attention are: absence of Ground in some cases (obvious from the percentage rate the sniper constitutes the Ground) and the longish description and treatment of the Figure in other cases (obvious from the details of

Neda's body parts, for instance). These two strategies cause Neda to stand out more prominently.

Briefly, FGO is an important tool for organizing and manipulating reality to coincide with one's ideology. FGR can shift attention from (what is supposed to be) the Figure to (what is supposed to be) the Ground, i.e., to turn Ground into Figure, and vice versa. FGR indicates that the relationship between Figure and Ground is flexible, and perceptual-oriented. In addition, FGR indicates the flexibility of attention and the process of shifting attention from one thing to another to achieve specific goals.

With reference to the syntactic structure of FGR, it has been noted that the passive voice can visualize and guide the attentional experience of the readers and the attentional operations of shifting attention (i.e., transformational attentional experience).

7.2. Event-Frames and Windowing

As mentioned earlier, to understand news reports of death, one may view death as reflecting Talmy's causal chain event-frame, which was the prominent type of event-frame found in the data. The second prevalent event-frame in the data is the open path event-frame that was employed within the causal chain event-frame to depict Neda's death. Metaphorically speaking, the open path is the most appropriate type of event-frame to describe such details, because, as Talmy (2000, p. 265) argues, the open path "is described by an object physically in motion in the course of a period of time, having a beginning and an end, and whose beginning point and ending point are at different locations in space." In the same vein, the final windowing is metaphorically focused on the final result of the path. Hence, Neda's life was an open path that was described as an object in motion physically that has a beginning point and an end point; these two points were at different locations in space with the focus on the final result—her death. Physically, when Neda was alive, she was at a location in space that was different from that when she died. By utilizing the open path event-frame to describe her blood and her body parts, Neda's life was conceived as a path of motion.

7.3. Attention and Ideology

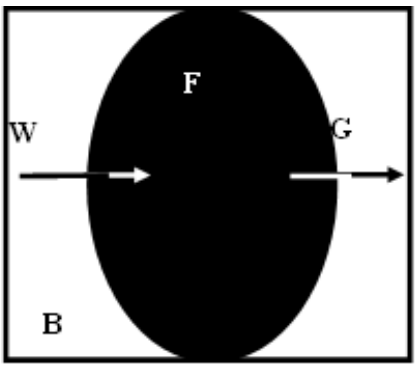
News discourse is highly ideological and hence partial, because it utilizes different techniques. In this sense, news reports of Neda's death are ideologically complex and partial. Journalists may have attempted to conceal the partiality of their reports and descriptions of Neda's death by providing objective description and details to maintain a certain level of impartiality. They manipulated Neda into focus, since she, not the sniper, appeared on the tape, whereas the sniper was gapped by omission from some news reports. From the analysis, it is apparent that news discourse backgrounds an entity in one way, and simultaneously foregrounds it in another way. Hence, what seems to be backgrounded in discourse can be indirectly foregrounded in cognition. In this sense, news discourse analysis is not a straightforward task. To illustrate, some newspapers mentioned the sniper, albeit as a Ground (using different references, see Table 1), perhaps in order to indicate the Iranian government's responsibility for Neda's death.

Utilizing different references and naming are techniques of foregrounding. Another technique of foregrounding is repetition. By repeating certain aspects, such as Figure or even Ground, or certain portions of the event, one indirectly foregrounds these aspects even if they are backgrounded in the discourse. On the other hand, by frequently omitting specific aspects, such aspects are gapped. This corresponds to van Dijk's (1998) ideological square, which comprises four moves: (1) to emphasize the positive about Us and the negative about Them; (2) to de-emphasize the positive about Them and the negative about Us; thus, (3) the negative about Them will be topicalized, hence windowed, whereas (4), the negative about Us will not be topicalized, and hence will be gapped. In the same vein, the cognitive ideological square (see Figure 2) comprises four moves (attentional operations): to (1) foreground and/or (2) window certain desired aspects and sub-events, and (3) background and/or (4) gap certain aspects and sub-events.

Figure 2 is a visual representation of the ideological cognitive square. In brief, the white square is backgrounded, whereas the black oval is foregrounded. The arrows indicate the process of windowing and gapping within the event-frame; the white-headed arrow represents what is windowed and the black-headed arrow represents what is gapped. In this sense, use of the causal chain and path event-frames, as well as the process of foregrounding and backgrounding, enabled journalists to manipulate attention in the following steps: (1) distract or disengage attention from the agent (i.e., the sniper); (2) direct attention towards the patient (i.e., Neda); and (3) redirect reader attention to this newly established focus by providing more details regarding Neda.

CONCLUSION

Attention is a complex system of interrelated cognitive operations. Similarly, as van Dijk (2006, p. 138) notes, "Ideological discourse is not always a direct, coherent, and transparent manifestation of underlying ideologies." Thus, the analysis of attention (or more specifically attentional decoding) and news discourse is not an easy task. In short, it has been noted that causal chain and path windowing work collaboratively and in a complementary manner to manipulate readers' attention.



F = foreground; W = window; B = background; G = gap.

Figure 2. Schematic of the cognitive ideological square.

A number of cognitive strategies were employed, namely (1) FGO, (2) repetitions (of figures), (3) FGR, (4) detailed accounts (e.g., Neda's body parts and physical appearance), (5) windowing the details of her death through open path event-frames, and (6) gapping the sniper (or the Ground) to give more prominence to the Figure, Neda.

Beyond the controversy of Neda's death, the use of Talmy's (2000) attentional windowing to examine the ideological content in discourse is encouraged by the present study, as the results are supported by statistical evaluation and validation of the findings. In addition, the findings are backed up by the linguistics evidence in discourse studies. Hence, CL in general, and Talmy's (2000) attentional windowing in particular, have proven to be fruitful theories to expand our understanding of the ideological nature of discourse, and its discursive strategies. It is worth noting that **this is the first study**, to our knowledge, to apply Talmy's (2000) theory to reveal ideology. More applications of this and other cognitive theories are required in order to prove their pertinence and utility.

APPENDIX

Appendix A: Data set of the study

News network	No of Articles	Factiva Codes
Al Arabiya	2	Document ALARAB0020090623e56m000b5 Document ALARAB0020090623e56m000gq
The Advertiser	2	Document ADVTSR0020090624e56o0000j Document ADVTSR0020090623e56o00063
Agence France Presse	1	Document AFPR000020090623e56n004v3
America	1	Document AMER000020090709e57600002
The Arkansas Democrat Gazette	1	Document AKDG000020090625e56p0000r
Asian News International	1	Document HNASNI0020090623e56n000sf
Associated Press Newswires	2	Document APRS000020090625e56p001w5Document APRS000020090623e56n0005u
Australian Broadcasting Corporation (ABC) News	1	Document ABCNEW0020090702e5720006d
Cox News Service	1	Document COXNS00020090623e56n007pu
Belfast Telegraph	1	Document WBEL000020090816e56q002e8
The Boston Globe	1	Document BSTNGB0020090628e56s0001e
Business Day (South Africa)	1	Document MEWBUD0020090627e56r0000u
Business World	1	Document BSWRLD0020090629e56t00020
The Canadian Press	1	Document CPR0000020090626e56p00065
Canberra Times	1	Document CANBTZ0020090709e57a0001p
Canwest News Service	2	Document CWNS000020090622e56m007y7 Document CWNS000020090622e56m003xt
Charleston Gazette	1	Document CGAZ000020090630e56r0000n
The Christian Science Monitor	1	Document CHSM000020090624e56o0000g
Corpus Christi Caller Times	1	Document XCCC000020090805e56r001nl
The Courier-Mail	1	Document COUMAI0020090623e56o0000s
Daily Camera	1	Document CAMERA0020090624e56p0015t
Daily Mail	1	Document DAIM000020090623e56o00026
The Daily Telegraph	3	Document DT00000020090624e56o0003u Document DT00000020090623e56n00026 Document DT00000020090630e56u0002e
Deseret Morning News	2	Document DN00000020090623e56n0001b Document DN00000020090626e56q00016

Appendix A: (Continued)

News network	No of Articles	Factiva Codes
TODAY (Singapore)	2	Document TDAYSG0020090623e56o00014 Document TDAYSG0020090730e57v0002q
Geelong Advertiser	1	Document GEEADV0020090624e56o0000p
The Globe and Mail	1	Document GLOB000020090624e56o0002v
The Guardian	1	Document GRDN000020091228e5ct000bp
Guardian Unlimited	1	Document GRULTD0020090623e56n000mg
The Hamilton Spectator	1	Document HMSP000020090624e56o0000s
The Independent	1	Document IND0000020090623e56n0002o
The Irish Examiner	1	Document IRISEX0020090624e56o00015
Irish Times	1	Document IRTI000020090627e56r0003b
Manawatu Standard	1	Document TEVEST0020090626e56q0000z
The Mercury	1	Document MERCRY0020090625e56o0000r
New York Post	2	Document NYPO000020090624e56o0000s Document NYPO000020090623e56n0004i
New York Daily News	1	Document NYDN000020090623e56n0000j
The New York Times	6	Document NYTF000020090623e56n0007s Document NYTF000020090623e56n0007q Document NYTF000020090623e56n0006d Document NYTA000020090624e56n0000b Document NYTA000020090624e56n0000m Document NYTA000020090624e56n0000f
New Zealand Herald	1	Document NZHLD00020090623e56o00005
Ottawa Citizen	1	Document OTCT000020090623e56n0000y
The Palm Beach Post	1	Document PMBP000020090715e56n0003s
Pittsburgh Post-Gazette	2	Document PPGZ000020090623e56n0001t Document PPGZ000020090628e56s0003b
Philippine Daily Inquirer	1	Document AIWPHI0020090625e56p0000x
The Providence Journal	1	Document PROV000020090709e57900009
The Sun	1	Document THESUN0020090623e56n000fj
The Sunday Mirror	1	Document SMIRR00020090628e56s0005x
The Sunday Times	1	Document STIMES0020091121e5bm00015
Sunshine Coast Daily	1	Document APNSCD0020090623e56o0012y
Spiegel Online International	1	Document SPION00020090731e57u00004
States News Service	1	Document SNS0000020090915e56q001io
Trend News Agency (Azerbaijan)	1	Document TRENDE0020090623e56n000xd
The Times	1	Document T000000020090729e57t0008y
Times Record News	1	Document XTRN000020090814e56p00038
The Toronto Star	3	Document TOR0000020090624e56o0005i Document TOR0000020090623e56n0001q Document TOR0000020090623e56n0000h
Vancouver Province	1	Document VANPRO0020090623e56n0000x
Vancouver Sun	1	Document VNCS000020090626e56q0000u
Ventura County Star	1	Document VENTCS0020100609e6690001e
The Virginian-Pilot and The Ledger-Star	1	Document NFLK000020090701e56p0008h
The Washington Post	3	Document WP000000020090624e56o0002a Document WP000000020090624e56o0001f Document WP000000020090623e56n00018
The Washington Times	2	Document WATI000020090623e56n0003n Document WATI000020090624e56o0000i
The West Australian	2	Document TWAU000020090624e56p0002l Document TWAU000020090626e56r000ag
Winnipeg Free Press	1	Document WFP0000020090625e56p0000u

Appendix B: Chi test of Neda and sniper as figure and ground

chi sq	18.80362919
Df	3
P	0.000300185

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REFERENCES

Alharbi, A. M. (2012). *Social Representations of 'IAM' in two Australian Newspapers before and after 9/11: A Tri-Semantic Framework*. Unpublished PhD Thesis.

Augoustinos, M., Walker, I. and Donaghue, N. (2006). *Social cognition: An integrated introduction.* London: Sage.

Benedetti, G. (2011). The enigma of language. The meaning of the fundamental linguistic elements. *A possible explanation in terms of cognitive functions: Operational semantics*. NY: Nova Science Publishers.

Billig, M. (1995). *Banal nationalism*. London: Sage.

Billig, M. (1991). *Ideology and opinions*. London: Sage.

Botha, W. (2001). "The deictic foundation of ideology, with reference to African Renaissance." In: R. Dirven, R. Frank and C. Ilie (Eds.), *Language and Ideology: Volume 2: descriptive cognitive approaches.* Philadelphia: Benjamins, 51-76.

Butt, D. G., Lukin, A. and Matthiessen, C. (2004). Grammar–The first covert operation of war. *Discourse and Society*, 15, 267-290.

Caldas-Coulthard, C. R. and Coulthard, M. (1996). *Texts and practices: Readings in critical discourse analysis.* London: Routledge.

Carlton, E. (1990). *War and ideology*. London: Routledge.

Chilton, P. (2005). "Missing links in mainstream CDA: Modules, blends and the critical instinct." In: R. Wodak and P. Chilton (Eds.), *A new agenda in (critical) discourse analysis: Theory, methodology and interdisciplinarity*. Amsterdam: John Benjamins, 19-52.

Chouliaraki, L. and Fairclough, N. (1999). *Discourse in Late Modernity: Rethinking Critical Discourse Analysis*. Edinburgh: Edinburgh University Press.

Croft, W. and Cruse, D. A. (2004). *Cognitive linguistics*. Cambridge: Cambridge University Press.

Dallyn, S. (2014). Naming the ideological reflexively: Contesting organizational norms and practices. *Organization*, 21(2), 244-265. Doi: 10.1177/1350508413475494.

Domaradzki, M. (2007). *Cognitive critique of generative grammar. Lingua ac Communitas*, 17, 39-58.

Eagleton, T. (1994a). "*Introduction.*" In: T. Eagleton (Ed.), Ideology. London: Longman, 1-20.

Evans, V. and Green, M. (2006). *Cognitive linguistics: An introduction*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Fairclough, N. (1989). *Language and power*. London: Longman.

Fairclough, N. (Ed.). (1992). *Critical language awareness*. London: Longman.

Fairclough, N. (1993). Critical discourse analysis and the marketization of public discourse: The universities. *Discourse and Society*, 4(2), 133-168.

Fairclough, N. (1995). *Critical discourse analysis: The critical study of language*. New York: Longman.

Fairclough, N. and Wodak, R. (1997). "Critical discourse analysis: An overview." In: T. A. van Dijk (Ed.), *Discourse and Interaction*. London: Sage, 67-9.

Fairclough, N. (2003). *Analyzing discourse: Textual analysis for social research*. London: Routledge.

Fairclough, N. and Wodak, R. (1997). "Critical discourse analysis." In: T. A. van Dijk (Ed.), *Discourse as Social Interaction*. London: Sage, 258-284.

Fang, L. and Guan, F. (2013). The Realization of figure and background in Li Qingzhao's Poems. *Cross-Cultural Communication*, 9(5), 64-68. Available from: http://cscanada.net/index.php/ccc/article/view/j.ccc. 1923670020130905.2755.

Fernandez, E. C. (2006). The language of death: Euphemism and conceptual metaphorzation in Victorian Obituaries. *SKY Journal of Linguistics*, 19, 101-130.

Fillmore, C. J. (1985). Frames and the semantics of understanding. *Quaderni di Semantica*, 6 (2), 222–254.

Fowler, R. (1996). *Linguistic Criticism*. Oxford: Oxford University Press.

Fowler, R. and Hodge, B. (1979). "Critical linguistics." In: R. Fowler et al. (Eds.), *Language and Control*. London: Routledge, 185-213.

Gardiner, M. (1992). *The dialogics of critique: M.m. Bakhtin and the theory of ideology*. New York: Routledge.

Harro-Loit, H. and Ugur, K. (2011). Representation of death culture in the Estonian Press. *Estonian Journal of Archaeology*, 15(2), 151-170.

Hart, C. (2005). Analysing political discourse: Toward a cognitive approach. *Critical Discourse Studies*, 2(2), 189–201.

Hart, C. (2010). *Critical discourse analysis and cognitive science: New perspectives on immigration discourse*. Basingstoke: Palgrave.

Hart, C. (2011). Force-interactive patterns in immigration discourse: A cognitive linguistic approach to CDA. *Discourse and Society*, 22(3), 269-286.

Hart, C. (2013). Force-interactive patterns in immigration discourse: A cognitive linguistic approach to CDA. *Discourse and Society*, 22(3), 269-286.

Hart, C. (forthcoming). "Cognitive linguistics and critical discourse analysis." In: E. Dabrowska and D. Divjak (Eds.), *Handbook of cognitive linguistics*. Berlin: Mouton De Gruyter.

Hart, C. and Lukeš, D. (2007). "Introduction." In: C. Hart and D. Lukeš (Eds.), *Cognitive linguistics in critical discourse analysis*. Newcastle: Cambridge, (ix-xiii).

Hodge, R. and Kress, G. (1979/1993). *Language as Ideology*. London: Routledge.

Huckin, T., Andrus, J. and Clary-Lemon, J. (2012). Critical discourse analysis and rhetoric and composition. *College Composition and Communication*, 64(1), 107-129.

Ibbotson, P., Elena, L. and Tomasello, M. (2013). The attention-grammar interface: eye-gaze cues structural choice in children and adults. *Cognitive Linguistics*, 24(3), 457-481.

Jones, P. E. (2000). "Cognitive linguistics and the Marxist approach to ideology." In: R. Dirven, R. Frank and C. Ilie (Eds.), *Language and Ideology*: Volume 1: descriptive cognitive approaches. Philadelphia: Benjamins, 227-249.

Kim, Y. (2009). *Event construal and its linguistic encoding towards an extended semantic map model.* University of Oregon, Unpublished PhD dissertation.

Kuang, F. T. and Wen, X. (2003). Realization of figure-ground. *Journal of Foreign Languages*, 4.

Lampert, M. (2009). *Attention and Recombinance: A Cognitive-Semantic Investigation into Morphological Compositionality in English*. Frankfurt am Main: Lang.

Langacker, R. W. (1987). *Foundations of cognitive grammar: Volume I: Theoretical prerequisites.* Stanford: Stanford University Press.

Lijun, F. and Fenfen, G. (2013). The Realization of Figure and Background in Li Qingzhao's Poems. *Cross-Cultural Communication*, 9(5), 64-68. Doi:10.3968/j.ccc.1923670020130905.2755.

MacWhinney, B. (1977). Starting points. *Language*, 53(1), 152–68.

Mahr, K. (8 December 2009). Neda Agha Soltan. *Time*. Retrieved 1 January 2012 from http://content.time.com/time/specials/packages/article/0,28804, 1945379_194701_1944705,00.html.

Marchetti, G. (2006). *A criticism of Leonard Talmy's Cognitive Semantics*. Retrieved 15 February, 2014 from http://www.mind-consciousness-language.com/Criticism %20of% 20Talmy.pdf.

Marchetti, G. (2010). *Consciousness, Attention, and Meaning*. New York: Nova Science Publishers.

Musolff, A. (2008). What can critical metaphor analysis add to the understanding of racist ideology? Recent studies of Hitler's anti-semitic metaphors. *Critical Approaches to Discourse Analysis across Disciplines*, 2(2), 1-10.

Myachykov, A., Garrod, S. and Scheepers, C. (2009). *Attention and syntax in sentence production: A critical review*. Discours, 4.

Nafstad, H. E., Blakar, R. M., Carlquist, E., Phelps, J. M., and Rand-Hendriksen, K. (2007). Ideology and power: The influence of current neo-liberalism in society. *Journal of Community and Applied Social Psychology*, 17(4), 13-327.

Oakley, T. (2005). "Force-dynamic dimensions of rhetorical effect." In: B. Hampe (Ed.), *From Perception to Meaning: Image Schemas in Cognitive Linguistics*. Berlin: Mouton de Gruyter, 443-474.

Oakley, T. (2009). From attention to meaning: Explorations is semiotics, linguistics, and rhetoric. *European Semiotics Series*, Volume 8. Bern: Peter Lang Verlag.

O'Halloran, K. (2003). *Critical discourse analysis and language cognition*. Edinburgh: Edinburgh University Press.

Oliver, P. and Johnston, H. (2000). What a good idea! Frames and ideologies in social movement research. *Mobilization*, 5(1), 37-54.

Poggioli, R. (1968). The Theory of the Avant-Garde. Cambridge, Mass: Harvard University Press.

Quirk, R., Greenbaum, S., Leech, G., and Svartvik, J. (1972). *A grammar of contemporary English*. London: Longman.

Räthzel, N. (1997). "Gender and racism in discourse." In: R. Wodak (Ed.), *Gender and discourse*. London: Sage, 57-81.

Rogers, R. (2004). *An Introduction to Critical Discourse Analysis in Education*. Mahwah, NJ: Lawrence Erlbaum.

Schroeder, C. (2007). *Monastic bodies: Discipline and Salvation in Shenoute of Atripe*. Philadelphia: University of Pennsylvania Press.

Shapiro, M. (Ed.). (1984). *Language and Politics*. Oxford: Blackwell.

Stamou, A. (2001). The representation of non-protesters in a student and teacher protest: A critical discourse analysis of news reporting in a Greek newspaper. *Discourse and Society*, 12, 653–80.

Starck, N. (2004). Writes of passage: A comparative study of newspaper obituary practice in Australia, Britain and the United States. *Unpublished Ph.D. dissertation*. RMIT, Australia.

Stockwell, P. (2002). *Cognitive poetics: An introduction.* London and New York: Routledge.

Talmy, L. (1976). "Semantic Causative Types." In: M. Shibatani, (Ed.), *Syntax and Semantics 6: The Grammar of Causative Constructions.* NY: Academic Press, 43-116.

Talmy, L. (1996). "Fictive Motion in Language and Ception." In: P. Bloom, M. A. Peterson, L. Nadel, and M. F. Garrett, (Eds.), *Language and Space*. Cambridge: MIT Press.

Talmy, L. (2000). *Toward a cognitive semantics Volume I: Concept structuring system.* Cambridge, MA: MIT Press.

Talmy, L. (2007). "Attention Phenomena." In: D. Geeraerts and H. Cuyckens, (Eds.), *The Oxford Handbook of Cognitive Linguistics.* Oxford: Oxford University Press, 264-293.

Talmy, L. (2009). "Concept structuring systems in language." In: M. Tomasello (Ed.), *The new psychology of language: Cognitive and functional approaches to language structure* Volume 2. NJ: Erlbaum, 15-46.

Taylor, J. R. (2002). *Cognitive Grammar*. Oxford: Oxford University Press.

Thepkanjana, K. (2000). "Lexical Causatives in Thai." In: A. Foolen and F. Leek (Eds.), *Constructions in Cognitive Linguistics*. Philadelphia: Benjamins, 259-281.

Thompson, J. B. (1987). Language and ideology: A framework for analysis. *Sociological Review*, 35, 516-536.

Thompson, J. B. (1990). *Ideology and modern culture: Critical social theory in the era of mass communication*. California: Stanford University Press.

Tsur, R. (2000). Metaphor and figure-ground relationship comparisons from poetry, music, and the visual arts. *PSYART: A Hyperlink Journal for the Psychological Study of the Arts, article 000201*.

Ungerer, F. and Schmid, H.-J. (1996). *An Introduction to Cognitive Linguistics*. London: Longman.

Urban, M. E. (1982). *The Ideology of administration: American and Soviet cases*. Albany: State University of New York Press.

Van Dijk, T. A. (1985). "Cognitive situation models in discourse processing. The expression of ethnic situation models in prejudiced stories." In: J. P. Forgas, (Ed.), *Language and social situations*. New York: Springer, 61-79.

Van Dijk, T. A. (1993). "Discourse, Power and Access." In: C. R. Caldas (Ed.), *Studies in critical discourse analysis*. London: Routledge, 84-102.

Van Dijk, T. A. (1995). Ideological Discourse Analysis. *New Courant*, 4, 135-161.

Van Dijk, T. A. (1998). *Ideology: A multidisciplinary approach*. London: Sage.

Van Dijk, T. A. (2000). *Cognitive discourse analysis: An introduction*. On-line Available: http://cf.hum.uva.nl/teun/ and http://www.discourse-in-society.org/

Van Dijk, T. A. (2001). "Critical discourse analysis." In: D. Schiffrin, D. Tannen and H. Hamilton (Eds.), *The handbook of Discourse Analysis*. Malden MA: Blackwell Publishers, 352-371.

Van Dijk, T. A. (2006). Ideology and discourse analysis. *Journal of Political Ideologies*, 11 (2), 115-140.

Walter, T., Jane, L. and Pickering, M. (1995). Death in the news: The public investigation of private emotion. *Sociology*, 29, 579–96.

Wang, Y. (2010). Classification and SLA studies of passive voice. *Journal of Language Teaching and Research*, 1(6), 945-949.

Wodak, R. (1996). *Disorders of discourse*. London: Longman.

Wodak, R. (1997). *Gender and Discourse*. London: Sage.

Wodak, R. (2000). Does sociolinguistics need social theory? New perspectives on critical discourse analysis. *Discurso and Sociedad*, 2(3), 123-147.

Wodak, R. and Meyer, M. (2001). *Methods of critical discourse analysis: Methods of critical*. London: Sage.

Wodak, R. and Meyer, M. (2009). "Critical Discourse Analysis: History, Agenda, Theory, and Methodology." In: R. Wodak and M. Meyer (Eds.), *Methods for Critical Discourse Analysis*. London: Sage, 1-33.

Woolard, K. A. (1992). Language ideology: Issues and approaches. *Pragmatics*, 2(3), 235-249.

Young, E. H. (2011). *Why we're liberal, why we're conservative: A cognitive theory on the origins of ideological thinking*. Available online from http://dspace.sunyconnect.suny.edu/bitstream/handle/1951/52392/000000880.sbu.pdf?sequence=1.

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Chapter 10

ATTENTION AS THE ORIGIN OF MEANING FORMATION

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ABSTRACT

This chapter proposes that meaning is originally based on attention to spatial perception. Much of what we perceive is unattended, but spatial attention is the initial basis of meaningful interpretations of things and events. This hypothesis is illustrated by infant concept formation in the first months of life. From birth attention is attracted to motion through space, and aside from seeing, almost all the first concepts are about motion events, such as something going into a container, or behind another object, or to a goal-directed location. Infants also attend to bodily feelings, but these cannot be meaningfully interpreted until they are blended with spatial representations. Only spatial and auditory information have the structure necessary for imagery, which in turn is the only method preverbal infants have to engage in conceptual thought. That events are usually the initial content of such thought is shown by the fact that infants use events to make their first inferences and that they recall events better than the objects taking part in them. Although during the early months infants do gradually form broad object kind concepts, with the exception of animate things, they pay less attention to objects than to what objects do. Why the greater attention to events than to most objects is not reflected in early word learning is also discussed.

1. INTRODUCTION

This chapter describes how infants first begin to ascribe meaning to what they perceive in the world. Because this early learning sets the stage for later learning, it is useful for both

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psychologists and linguists to understand how meaning formation begins and what it first consists of. Some of what I describe here about meaning formation in infancy is speculative, because only in the last decade has extensive research begun on how infants start to form concepts and what they consist of.

I use the terms meaning and concept roughly as synonyms. Concepts are what we think with, either in the form of images or words. They are abstractions that are initially derived from perception of the world, although of course with experience and the help of language we learn to formulate abstract concepts such as love and truth that have no straightforward perceptual basis. Concepts are, by definition, available to conscious thought[1]. So far as we know, infants in the first year of life have no concepts other than those derived from what they perceive. Basically, their concepts are their interpretations of what is perceived. My main hypothesis in this chapter is that this process of deriving meanings from perception occurs only with attention.

We are born with attentional proclivities. For example, as described in more detail below, infants are overwhelmingly attracted to motion. The result of this attentional pull is that almost all of the first concepts (meanings) infants derive from perceiving the world involve things moving. I assume that the first meanings derived from attended perception are innate. In any case the first interpretations described below are very early, since conceptual activity, such as using meanings to make simple inferences, occurs at least by 2 ½ months of age (Luo and Baillargeon, 2005a).

Needless to say, much perception occurs without attention. We take in and learn an enormous amount of information about the environment; most of it without noticing it, that is, without attending to it. For example, infants learn sequences of common events, such as what happens at bedtime. If the familiar sequence becomes disrupted, infants respond to the difference by attending to the new sequence, but in itself that does not tell us that the infants have a concept of the order of events at bedtime. It is important to realize that although attention may be required for a meaning to be formed, attention can also be paid to something like a disruption of a familiar experience without such a result. Alas, we cannot ask infants what the sequence is, and it is very difficult to test conscious awareness of it. We can do something like show them pictures of the sequence in scrambled order to see if they look longer at it, but again, even if they do that does not tell us that they conceptualize the order. Even as adults, we know lots of things that we cannot bring to mind, i.e., think about when they are not present.

To my knowledge, there are to date only three irrefutable kinds of tests of conceptual knowledge in preverbal infants: tests of inference making, recall of the past, and mental problem solving. Recall of the past is an example of conscious thought, in that something not being perceived comes to awareness. The very early age at which an event can be experienced and then recalled at a later time was shown in a study by Campanella and Rovee-Collier (2005). Three-month-olds were shown a pair of puppets (A and B) a number of times so that they became associated, and then the experimenter modelled an action on A. The infants were then periodically shown A again (without the action) until they were 6 months of age, at which point the infants were given B and allowed to handle it.

[1] In previous work (J. Mandler, 2012) I suggested that concepts could be either implicit or explicit. By this I meant only that although one may not be consciously aware of a concept when making an inference, it is nevertheless available to conscious thought.

A significant number imitated the action that they had not seen in 3 months and had never seen modelled with B. There were already data showing that 6 month olds can recall an observed action after a 24 hr. delay (e.g., Collie and Hayne, 1999), but I believe this is the first demonstration that infants as young as 3 months can process information in recallable (conceptual) form that will last for several months.

Conceptual inferencing has been shown at 2 ½ months. Luo and Baillargeon (2005a) found that infants this age sometimes make false inferences about normal sights. Infants watched an object disappear behind a screen. The screen had an opening in it, but the infants were surprised when the object appeared in the opening. Apparently infants this age have already made the inference that objects which go behind a wall-like occluder shouldn't be seen until they come out from behind it. This inference (behind an occluder means unseen) is an example of a conceptual meaning. Finally, mental problem solving is an ideal way of demonstrating conceptual activity, although it is probably later to begin. It has been shown in terms of planning by 8 month olds (Willatts, 1997), and in terms of generating and testing hypotheses by 9 month olds (Coldren and Colombo, 1994). There are no data that I know of earlier than that.

However, there are only hints that address the role attention played in these experiments. For example, recall data are proof of conceptual activity, and it seems obvious that the infants attended to the actions that were later recalled, but there was no reason to collect data on attention. Similarly, we have no data on attention from the experiments on inferencing. I turn now to a discussion of the most likely hypotheses about the early meanings that infants achieve in relation to attention. I emphasize that in some cases, the attentional data support conceptual meaning even though by itself it does not prove it for the reasons previously discussed. Nevertheless, the accumulation of extensive data on experiences such as containment and occlusion makes conceptual meaning the most likely explanation for the observed changes in attention.

2. ATTENTION TO MOTION

Attention can be shown in several ways, but the most common one in infant research is by preference in what infants look at. Infants attentively follow moving objects from birth (Haith, 1980). In a sense, they have no choice, in that anything that begins to move makes them follow the path of motion, and continue to do so if it repeats. Simion, Regolin, and Buff (2008) found that even at birth infants discriminate biological from inanimate motion, and prefer to look at the former (even though the biological stimulus represented motion of a hen, not a human). This built-in proclivity does not mean they necessarily attend to the objects doing the motion. For example, Bahrick, Gogate, and Ruiz (2002) showed that at 5 months infants are more likely to remember an action than the object used in the action, for example, the stroking action of brushing hair more than the object (a hair brush or a bubble wand) doing the stroking. On the assumption that recall requires attention to information, such a finding indicates that more, or possibly all, attention was paid to the action than to the object doing it. Of course, infants eventually do learn about the details of objects, but it lags behind, because what they attend to about objects moving in space is mainly the path of motion and where it goes.

Although infants are always attracted to motion, nevertheless, some motions are preferred to others. For example, 3-month-olds prefer to look at objects moving contingently with one another (following linked paths) than when moving randomly (Rochat, Morgan, and Carpenter, 1997). Three-month-olds also smile at objects that interact with them in a contingent fashion (Frye, Rawling, Moore, and Myers, 1983), indicating their attentive interest. This interest in contingent interactions can be indefatigable, as in playing peekaboo, a game that delights 4-month-olds beyond most adults' willingness to continue to engage in it.

As early as 3 ½ months, infants distinguish between an object starting to move on its own or moving when another object touches it (Leslie, 1982). Contact between objects is important to understanding animate versus inanimate objects, above and beyond how they move. Animate objects start motion on their own, and inanimate objects do not. Animate objects also interact with other objects from a distance (as in the peekaboo example), whereas inanimate objects do not. Although infants distinguish between animate and inanimate motion from birth, we do not yet know exactly when in the first six months infants combine animate motion with starting motion on its own and interacting with other objects from a distance into a full-blown concept of animal. We do know, however, that a concept of animals as different from inanimate things is operative at least by 6 months of age. Among other things this is shown by attending differentially to a bird after seeing a series of airplanes, even though the stimuli were all highly similar (J. Mandler and McDonough, 1993, 1998).

Infants also know something about locations, although this has been given relatively little study. We do know that by 5 months they pay attention to where objects disappear, as shown by their later being able to find objects they have watched being hidden (Newcombe, Huttenlocher, and Learmonth, 1999). The locus of attention to moving objects is another interesting phenomenon. We know that infants attend to motion when it starts. However, there is evidence that 12-month-olds pay even more attention to what happens when motion ends. Lakusta, Wagner, O'Hearn, and Landau (2007) studied encoding of source and goal in goal paths and found less was remembered about the source than the goal. Even adults pay more attention to paths to a goal than paths from a goal (Lakusta and Landau, 2004). It is possible that the greater attention to the end than the start of motion they found occurs primarily in goal paths than for other kinds of motion. It would not be surprising that we are more interested in achieving a goal and spend more attention on what happens at the end of the goal-path than on how or where it starts. Because only attended information is recallable, however, better recall of the end of a goal path than its start indicates the need to specify the amount of attention paid to something, not just that it was attended.

Goal paths are an important aspect of infant learning. Understanding of goal-directed behaviour has been shown in 5-month-olds (Woodward, 1998). When infants this age see someone repeatedly reach for an object, if the object is moved to a new place they attend and look longer if the person reaches to the old place instead of to the new one. This interpretation of goal-directed behaviour is not restricted to animates; Luo and Baillargeon (2005b) showed that at the same age infants also interpret inanimate objects as goal-directed if they start motion by themselves and show persistent direct paths to an object. Furthermore, 6-month-olds reach the same conclusion if a self-starting box takes repeated paths around a barrier to an object (Csibra, 2008).

These kinds of data indicate that infants have developed a concept of moving to something. There are two kinds of object movement that fit this meaning: 1) self-starting in

conjunction with moving on a direct path to a place or an object, and 2) self-starting in conjunction with moving toward an object or place, but going around an obstacle to get there. Here the paths differ but are linked by their common beginnings and endings. At this young age self-starting matters to conceptualizing something as goal-directed, but by 9 months goal-directed behavior can be ascribed without seeing how the path to the goal starts (Csibra, Biro, Koos, and Brockbank, 1999). Once again, it appears that the start of a goal path is less important than where the path goes and what happens when it stops. The path and goal are more attention-demanding.

Other kinds of motion are also attention-demanding for infants, in particular going into or out of a container and going behind an occluder. My assumption is that the attention-grabbing property of containment and occlusion is due to the disappearance of objects. Occlusion and containment are the two ways that objects disappear when infants are attending to them. Thanks to extensive work by Baillargeon and her colleagues we have a lot of data on young infants' knowledge about these two kinds of object disappearance. In most of these experiments the measure is longer looking at sights that violate already acquired knowledge, usually called showing surprise (defined as heightened attention; e.g., Wang S., Baillargeon, and Brueckner, 2004). These researchers investigated 4-month-olds' response to occlusion and containment of objects too wide to fit either behind a barrier or in a container. They did not use any familiarization or habituation (training) trials, which had been suggested to independently account for similar results. Instead, they only showed test trials, in which appropriately narrow or too wide objects went behind an occluder or into a container. Four-month-olds responded appropriately in both cases, attending longer to the impossible events than to the possible ones. Although, as discussed in the introduction, attention to an unusual sight does not prove conceptual knowledge, this kind of experiment, in conjunction with the inferencing data below, offers strong support for it.

As mentioned in the introduction, infants make inferences about occlusion as early as 2 ½ months, including incorrect ones, such as that you should never see an occluded object (Luo and Baillargeon, 2005a). Learning about windows and doors in a wall-like occluder and when they enable such sights takes a few more weeks (Aguiar and Bailargeon, 1999). By 3 months infants have attentively processed enough containment to know that containers must have an opening if something is to go inside (Hespos and Baillargeon, 2001a). By 4 months they distinguish tight fitting and loose fitting containment (Spelke and Hespos, 2002). As discussed above, they also know that a wide object will not fit into a container. Interestingly, they do not know until 7 ½ months that a taller object won't disappear completely when it is put into a shorter container, even though they understand that height matters in occlusion by 4 months (Hespos and Baillargeon, 2001b). My guess is that the delay in understanding height vis a vis containers would be even longer for liquids, because their "height" is hard to be aware of. I suspect the reason for the height-width discrepancy stems from infants' experience of eating and drinking. Infants can see that very wide things won't go into their (or other) mouths, without being cut or broken up. But from their point of view endless amounts of food and drink go in, not only at one meal but day after day! (Of course they know nothing about intake of food in relation to elimination)[2].

[2] Interestingly, the notion that containers can hold any amount is common in metaphors, such as holding someone in one's heart (for discussion see J. Mandler and Pagán Cánovas, 2014). I note also that even adults are less likely to notice a height than a width discrepancy when seeing containment (Strickland and Scholl, in press).

Another experiment providing evidence that the behavior of infants in many of these containment and occlusion experiments is due to conceptual meaning and not just to seeing something unusual is provided in an experiment by Wang, Baillargeon, and Paterson (2005), in which 9-month-old infants examined either containers or tubes that were identical in appearance except for the bottom on the container. At this age infants have learned that tall objects won't fit into short containers, but do not yet know that about tubes until several months later. Following this examination the infants were shown a tall object being lowered into either short or tall containers or tubes (a bottom being surreptitiously added to the tube). Thus, the events looked the same for both the container and the tube. However, the infants looked reliably longer at the tall object going into the short container than into the tall container, but did not differ in their looking time to the tall object going into the short or tall tube. The most likely way to explain such results is in terms of the conceptual knowledge infants have about containers, knowledge that is still lacking for tubes.

3. CONCEPTUAL MEANING PRIMITIVES

The reader may have noticed that all the examples of infant concepts discussed so far have involved motions of objects through space that young infants attend to, one specific kind of object (container), and spatial locations where objects move to. I summarize them here, putting them into capitals. In the first six months of life. Infants attend to anything that MOVES on PATHS. They are especially attentive to ANIMATE MOTION. They sometimes notice when objects don't MOVE. They attend to the START and END of PATHS. They attend to PATHS that go TO a LOCATION or THING. They attend to LINKED PATHS and whether THINGS CONTACT each other or not. They attend to whether a MOVE is BLOCKED, whether something moves INTO or OUT OF a CONTAINER, and whether the container is OPEN. They attend to when things move BEHIND an occluder and DISAPPEAR (i.e., are no longer SEEN). Of course they also attend when things APPEAR and so are SEEN. CONTAINERS are attended very early. Finally, from birth infants attend to EYES and where they look. These early concepts, that I call primitives because I believe they form the foundations of the conceptual system, are listed in Table 1.

Here are a few comments about these primitives. In the past I wrote about primitives as being the earliest conceptual meanings, naming the mechanism that forms them Perceptual Meaning Analysis (J. Mandler, 2004). However, I did not discuss preferential attention as a major part of this mechanism. Instead, I based my list on evidence for their being conceptual in nature, such as being used for making inferences about unseen things, and their early onset, either innate or learned in the first few months. An obvious conclusion was that, aside from seeing, the early concepts mainly involved motion through space along with a few spatial relations. However, the retionship between attention and early conceptualization is striking and suggests that attention may be a required contributor to the formation of the earliest meanings, and therefore is a fundamental part of Perceptual Meaning Analysis.

As Table 1 makes clear, most of the suggested primitive concepts are about the motion of things and whether or not they can be seen. Motion along paths demands attention from birth, and infants attend to motion beginning and where it ends. As discussed in the last section, infants preferentially attend to animate than inanimate motion from birth. Hence, including

attention as a variable in concept formation indicated I should add ANIMATE MOTION to my previous attempts to specify primitives (J. Mandler, 2008, 2010, 2012)[3]. Even though it is motion that is mainly attended rather than the objects doing the moving, ANIMATE MOTION can be applied to THING. This, of course, is what provides one of the bases for the initial global category of animals as a category of objects, although it apparently takes some months to accomplish.

Table 1. Conceptual Primitives

PATH	±MOVE
START PATH	ANIMATE MOTION
END PATH	BLOCKED MOVE
PATH TO	BEHIND
LINK	DISAPPEAR (-SEEN)
±CONTACT	APPEAR (+SEEN)
THING	EYES
CONTAINER	INTO
OPEN	OUT OF
LOCATION	

N.B.: the symbol ± is used to express that something either does or does not move or contact another object, and is or is not seen.

It is interesting that CONTAINER is the only specified THING in Table 1. Although it is the acts of going in and out of containers that attract attention, attention focused on such events is presumably what leads to the object itself becoming attended (Hespos and Baillargeon, 2001b). Attention to the act of things going into a container has the extra benefit of conceptualizing that containers have an opening. What I am suggesting is that attention to moving objects is innate and as a side effect some object details become attended and conceptualized as well. One would expect details of people to be relatively early, then, given the prominence of attention to the way they move. However, at 3 and 4 months infants still do not uniformly distinguish people from other animals, for example, categorizing pictures of people and horses together (Quinn and Eimas, 1998). Not until 7 months are infants straightforwardly differentiating pictures of people and other animals, although the data suggest that 5 month olds may attend longer to people than to animals (Pauen, 2000).

Since infants also attend to objects disappearing behind occluders, why is occluder not listed in Table 1? Perhaps it should be, but the problem is that anything can be an occluder. They do not have inherent distinguishing characteristics, such as containers do (a bottom, sides, and an opening). Infants do not seem to attend to what occluders look like (probably because almost anything can be one). Furthermore, the data we have in infancy are on screens that are wall-like occluders (not familiar objects like a piece of furniture). My hunch is that what is being measured in these experiments is attended because it is like someone leaving a room, not like one object passing behind another.This might account for the youngest infants'

[3] I discussed the importance of animate motion to early conceptual development in earlier work on conceptual primitives (J. Mandler, 1992; 2004), but it was left behind in more recent writings as I emphasized other aspects (e.g., J. Mandler, 2010, 2012).

surprise when they see an object reappear in a window or door in the wall-like occluder; when people go out of rooms you don't see them until they come back through the door.

EYES, along with things being SEEN or UNSEEN, are primitives as well (see J. Mandler, 2012, for discussion). Infants not only attend to eyes from birth (M. H. Johnson and Morton, 1991), they prefer to look at eyes that look at them than at eyes that are looking elsewhere (Farroni, Casibra, Simion, and M. H. Johnson, 2002). As far as I know there are no data as to when infants first relate eyes to seeing, but presumably it is fairly early for their own eyes. At least they may know that when they shut their own eyes they do not see. So the attention to people's eyes is there from birth but we do not yet know exactly when the meaning is formed that other people's closed eyes cannot see. The idea is there by 12 months, but perhaps not before this age (Brooks and Meltzoff, 2002).

In summary, the primitives listed in Table 1 differ slightly from those I suggested in J. Mandler (2012), in part because I have weighted inclusion in the list in terms of attention. All of the presently proposed primitives are known to attract attention. My assumption is that all of them are innate, or are so closely involved with innate meanings that they are added in the first few months of life. In either case, by divvying up the world into the most important categories, they are an adequate foundation for building a conceptual system[4].

Needless to say, other spatial relations are learned during the course of the first year. For example, infants have been trained to discriminate above and below relations at 3 to 4 months (Quinn, 2003). However, that does not mean they conceptualize the relations; indeed they do not, in the sense that they do not treat above and below as structures independent of the objects used in training until 6 to 7 months, and as far as we know this spatial relation does not particularly attract attention in daily life. The most likely other spatial relations to be attended are UP and DOWN, which given the role that being picked up and put down plays in infant life, may be even earlier than above and below.

4. ATTENTION, STRUCTURE, AND NONSPATIAL MEANINGS

With the exception of eyes and seeing, all of the meanings associated with attention discussed in the previous section involve moving things, paths through space, spatial relations, and object kinds associated with particular types of path, namely, containers and animate things. Needless to say, infants attend to other things as well, such as colors, tastes, smells, and bodily feelings such as force, pain, and fear. However, none of these become conceptualized in the early months, because they lack necessary dimensional structure. All of the primitives consist of at least two dimensions, and this is as important for conceptualization as attention. Before language, conceptual thought operates via imagery, and images are structured representations[5].

[4] The reader may notice the absence of a primitive of AGENCY, which I included in my earliest attempt to formulate the first concepts (J. Mandler, 1992), and is also espoused by Carey (2009) and others. As indicated in my reply to Carey (J. Mandler, 2011) I have also come to doubt that a concept of making something move is achieved in the first six months. I think the onset of causal understanding is an issue still to be decided, but suggest further that an understanding of intentionality (for which there is no evidence in the early months) may be an essential part of a concept of agency.

[5] Visual imagery is the most common type of spatial imagery, but even congenitally blind persons form images of spatial information, based on touch and locomotion (Afonso, Blum, B. F. G. Katz, and Tarroux, 2010).

Bodily feelings, as well as colors, tastes, and smells, lack the perceivable 2- or 3-dimensional structure that space and motion through space have. Without structured input images cannot be formed, so before language bodily feelings have no way to be thought about in their absence[6]. For example, pain is attention demanding, but is experienced one-dimensionally as a little or a lot, and although it can be remembered as constant or throbbing, the feeling itself cannot be imaged when it is not present. Needless to say, a painful experience can be associated with a particular place or procedure so, for example, infants receiving a shot in a doctor's office may cry the next time they go there, but that is not the same as being able to image the pain itself in its absence.

Force can also be felt one-dimensionally as a little or a lot, but again that is insufficient to form an image. Force can be gestured two-dimensionally, but this is something that infants are not capable of until fairly late in the first year, and we have no data on when gesture to represent force begins. I have hypothesized that it begins when infants begin to move themselves around and personally experience blocked motion, suggesting that it may well be 8 to 9 months of age before the internal feeling of force begins to be associated with pushing and pulling events.

Emotions are experienced one-dimensionally as good or bad, but not otherwise differentiated one from another until around age 4 to 5 (Widen and Russell, 2008), and even for adults are extremely difficult to describe. This is one of the reasons for metaphor, to help us express what emotions feel like. What all this means is that infants in the first year are conceptually ignorant of their bodies in spite of the feelings the body produces. I believe this is because bodily experience lacks the structure needed to make it imageable and available for thought.

Auditory information is better off. Sound can go up and down, fast or slow, make jumps and glides; it can be imaged and recalled, and in terms of structure it is space's main rival, although preverbal sound cannot describe events and so must be secondary to spatial representations in that period. Unfortunately, aside from language there has been little research on infant's conceptualization of sounds. We do know they attend to music and recognize tunes (Volkova, Trehub, and Schellenberg, 2006), but we have almost no information as to whether they conceptualize them. In any case, before language begins to be learned, auditory information plays a relatively small role in infants' lives. Spatial information is the overwhelming source of their conceptualizations.

What is needed to conceptualize bodily feelings is to amalgamate them with structured spatial information, a process Pagán Cánovas and I call schematic integration (J. Mandler and Pagán Cánovas, 2014). I will describe this briefly here for understanding force. Young infants have little experience with force, and I believe do not give it much attention until they begin to crawl and meet up with obstacles when doing so. By 6 to 7 months, they begin to bang objects on hard surfaces, but not until 8 to 9 months do they begin to crawl. At some point in this range of ages they begin to struggle to get down from parents' arms. Once they begin to move themselves around they bump into things and try to move them. It is these developments that presumably direct attention to feelings of force, even though they have experienced some forceful feelings since birth.

[6] It has even been persuasively argued that meaning itself necessarily consists of structured material (Garner, 1962). Certainly, structured material (e.g., a categorized list of words) can be brought to mind in a way that unstructured material (e.g., a random list of words) cannot (e.g., G. Mandler, 1967).

In J. Mandler and Pagán Cánovas, we used the example of experiencing force when pushing hard against a heavy object. Infants cannot image the force but can associate the feeling of "umph" as they push with the imagery of motion being blocked. With repeated experience this association allows what we call a schematic integration, in which the feeling of umph becomes blended with, and thus given structure by, the spatial imagery of blocked motion. The forceful feeling remains a secondary part of the structure being built, but can be mildly aroused when imagining the forceful event. In current psychological parlance this phenomenon is known as embodiment.

What I am hypothesizing is that it is their own forceful actions that attract infants' attention to forceful feeling, and it is only when that happens that a schematic integration is formed that enables the feeling of force to become meaningful. It is not as imageable as spatial information, but imaging the spatial aspect of a forceful action can mildly arouse a forceful feeling. That is about the best we can do when we think about force; even with language for most of us it is only barely defined in our minds.

I have used force as an example of one way we make nonspatial or non-auditory information meaningful. Processes similar to this happen for understanding time, which around the world is always understood by blending it with spatial information (e.g., Casasanto, Fotakapoulou, and Boroditsky, 2010; Clark, 1973; Nuñez and Cooperrider, K. 2013). This process may begin in infancy; 9-month-olds are already sensitive to correlations between spatial and temporal lengths (N. Srinivasan and Carey, 2010).

Other kinds of nonspatial information, such as color and emotion, are too unrelated to space for it to be useful in helping to structure them and make them imageable in their absence. We have reached the point where the only help available to think about certain kinds of perception and bodily feelings is language. Both color concepts and emotion concepts are examples of this. Color concepts at first may consist only of labels that point to a particular type of experience (Roberson, Davidoff, I. R. L. Davies, and L. R. Shapiro, 2005), and as mentioned earlier, even with language emotions take years to become conceptualized.

Unfortunately, we have little information about the role that attention plays in achieving these kinds of nonspatial understanding.

5. WHY LANGUAGE ABOUT MOTION IS LATE

Given that motion along paths is paid so much attention in the early months and less attention is paid to objects, why are motion verbs later to learn than nouns? First of all, it is important to note that the presence of verbs in early speech depends on what the language is. In Japanese and Korean, for example, verbs are much more salient than they are in English. They occur at the ends of sentences and nouns are often omitted from sentences. Not surprisingly then, verbs occur more frequently in the one-word stage of language learning in these languages than they do in English (Gopnik and Choi, 1990). Similarly, verbs appear in the first 10 words spoken by Chinese children in contrast to English speakers (Tardif, Fletcher, W. Liang, Zhang, Kaciroti, and Marchman, 2008). Nevertheless, more nouns appear in early speech even in these languages.

The onset of language is often considered to be when children begin to speak, as long as there is indication they know what the words they use refer to. Children typically begin to

produce words around the end of the first year (L. Bloom, Tinker and Margulis, 1994), although in families where sign language is used, production can begin as early as 6 months and on average around 8 months (Folven and Bonvillian, 1991; Meier and Newport, 1990). Perhaps not surprisingly, then, there is evidence that hearing infants also begin to understand spoken words between 6 and 9 months, considerably before they begin to produce them. Bergelson and Swingley (2012) tested understanding of words for body parts and foods by presenting pairs of pictures in which one showed a body part and the other a food item, and measuring how long the infants looked at the appropriate picture upon hearing the label for the item portrayed. As young as 6 months they began to show above chance responding to some of the words used (see also Tincoff and Jusczyk, 2012).

This work was done with nouns, presumably because nouns are more common than verbs in early word production in English (e.g., Nelson, 1973). Recently, however, Bergelson and Swingley (2013) tested comprehension of verbs in this same period using preferential looking at videos of actions like kissing and sleeping. Although only a few verbs were tested, they did not begin to be significantly comprehended until 10 months of age. Although this shows verb comprehension earlier than previous work, it still lags a little behind comprehension of nouns. Why should this be the case?

Part of the answer may lie in the clarity of joint attention of infants and adults to objects compared to motions. Infants need to have an idea of what the adult is looking at when saying a word in order to get an idea of what is being referred to (e.g., Tomasello and Todd, 1983). Adults are more apt to point to objects than to paths or actions, and in any case it may be easier for infants to see that an adult is attending to an object than to what it is doing. Furthermore, when an adult does label an action, actions are often rapid and quickly finished, whereas when an object is labelled, it typically stays there while the child looks back and forth from it to the adult. It should also be noted that many verbs to children are used to ask the child to do something or to talk about completed actions, and so the action being referred to is not present and joint attention between action and word does not occur (Tomasello and Kruger, 1992).

Unfortunately, at this point we do not have enough data on early verb comprehension to know what kind of verbs are easiest for infants to understand, although there is research indicating that deictic path verbs like "go" are produced earlier than manner verbs like "run" (Choi and Bowerman, 1991; Göksun, Hirsh-Pasek, and Golinkoff, 2010), and so may be comprehended earlier as well. Similarly, prepositions in English and verbs in Korean for spatial relations involving containment and support are early in production, again suggesting they are comprehended early as well. In any case, most verbs express only one part of the events that infants attend to. Even if not much attention is paid to the object that is going somewhere or doing something, nevertheless an attended event shows a thing moving through space going somewhere. It could be into a container or to a place, but an event is not as simply expressed as a thing that can be pointed to.

There is a related problem with the literature on this topic that suggests it is often difficult to know what infants' earliest productive vocabulary refers to. Nelson (1985) pointed out that infants may use nouns to refer to activities involving objects rather than the objects themselves. For example, she suggested that the term "ball" might refer to "ball contexts" rather than the ball itself. She concluded that both picture naming and event reference account for most of the earliest object words found in the first 20 or so words of infants' vocabularies (Nelson, 1985). Following this idea up, Nelson, Hampson, and Shaw (1993) found that many

of the nouns that the children produced in the first half of their second year referred to locations (e.g., park, presumably as a destination), actions (e.g., kiss), and events (e.g., party) rather than to objects.

That nouns can refer to actions is mentioned in one of the studies of first words (Kauschke and Hofmeister, 2002). Nevertheless, as is common in the word-learning literature, when they categorized the first words of 32 German children, they reported that no verbs were used at their youngest age (13 months), but the largest category of words was what they called relational words, which was considerably larger than nouns. By relational words, they referred to words for relations between actions or between objects, words for appearance or disappearance, words for the functions of objects (i.e., what they do), words for temporal aspects of actions or events, and locatives. Such words refer to many aspects of the events that infants attend to. Whether they are expressed by verbs or nouns does not matter; what matters is what they mean.

Consider the first "verbs" produced by Tomasello's child (Tomasello, 1992). The four earliest "verbs" were produced at 15 months and consisted of MOVE (asking for something to move out of the way), WHERE-GO (used to express disappearance of something) WHEREDA, used to ask the location of a disappeared object, STUCK (when the child couldn't make something work), and NO, used when something expected wasn't there in a hiding game. By 16 months, GONE appeared (again, expressing disappearance), STAY (in the sense of don't move), BYE (said when leaving a place) MORE and GET-IT (both asking for something to be given to him), DOWN (expressing where something should move, as in asking to be put down), as well as the two regular verbs SWEEP and PLAY. As these examples illustrate, single words can only express part of an event such as an object starting up and moving out of sight, or food being moved from there to here. However, in the given example, several of the words express aspects of events that attract attention: leaving a place, going somewhere, disappearance of an object (going out of sight), and the location to which an object moves. These are words about motion on paths, their beginnings and ending. This is the sense in which BYE is used, as a referral to someone leaving.

Similar data are reported in the first 10 words of any sort spoken by the 8 children studied by Nelson (1973). The age range was from 13 to 15 months. More words were nouns (and the most frequent of these being names like Mommy and Daddy), but the verb-like and location words produced were: BYE, HI, SIT, GO-GO, SEE, SCHOOL, WHERE, HERE, THANK YOU, and NO. It isn't possible from the data provided to know exactly what was being referred to, although BYE and HI presumably refer to something going out of and coming into sight. Most of the others are actual verbs (SIT, SEE, GO-GO) or locatives, presumably referring where things are or have gone. Finally, Benedict (1979) reported that for the 8 infants she studied, over 50% of the first 10 words understood were action words, although action words were considerably lower in production[7].

[7] Tardiff et al. (2008) also gathered information on the first ten words of children in three languages, using very large samples. Surprisingly, in their English-speaking sample, these authors found only BYE and HI of the action-relevant words and locatives reported by Nelson (1973), and Benedict (1979) for English, and by Kauschke and Hofmeister (2002) for German. However, no information about ages of the children or even what the words were referring to (for example VROOM was classified as a sound, but presumably was said while rolling a toy car or the like), making it difficult to know how to assess the relationship between the seemingly very different results.

What these various studies indicate is that great care needs to be taken when making conclusions about what infants mean in the early stages of word production. Just because a noun is used does not mean that an object is being referred to; it may be even more likely that it refers to an event in which an object is taking part. Certainly, the examples discussed above suggest that things moving, going out of sight, disappearing, and reappearing are being focused on in the one word phase of language acquisition. Perhaps we have paid too much attention to linguistics when talking about early language. Here I have been discussing what infants mean by the words they use, not linguistic categories. I am suggesting that infants use words to refer to the aspects of events that draw their attention, presumably using words they have heard and attended, thus likely to be spoken by their caretakers. These are more apt to be nouns than verbs in many languages, although varying by situation (Choi, 2000). But the linguistic category of the words being used does not tell us that that is what was meant. The child hears nouns to refer to games like peekaboo or pattycake, but what the infant pays attention to and understands are the actions involved.

CONCLUSION

What I have tried to show in this chapter is that meaning originates in attention to what is perceived. More specifically, it begins as interpretation of attended spatial information. Bodily feelings can be both perceived and attended, but they are unstructured. Until they become blended with spatial information, or until language describing them is taught, they remain uninterpreted, and so on this definition remain without meaning. Of course babies feel things, but that does not mean they understand them, or can think about them in their absence. That requires imagery (or language), both of which are structured representations. In the sense I am using the word, meanings are concepts.

Infants learn the things associated with pain, how to avoid them, and perhaps even cry when they see them, but that does not imply they have a concept of its meaning and can bring it to mind in its absence. I emphasize this use of the word "meaning" because in my view the word tends to be used in too many ways to make it easily useful. What I have tried to do is to give the word a specific definition, to show how it originates, and what is required for it to be formed. Some may consider the definition too narrow, but it has the advantage of being explicit, and when the term is used with a different meaning it suggests questions that need to be asked as to how the two definitions fit together.

Within the present definition, examination of the infancy literature suggests that attention is required for meanings to be formed. When we look at infants' earliest concepts, it appears that they all concern what the literature tells us are attended by babies either from birth or very shortly thereafter. They involve motion of objects on paths through space and where they go, or the results of that motion, such as disappearance. Objects are understood as what moves, but in the early months most (inanimate) objects do not receive attention to their details because attention is being expended on what the objects are doing. An exception to this general lack of attention to inanimate objects is to containers.

Infants also attend to relations between objects, but once again, this involves how they move or whether they contact each other. For example, infants attend to whether objects come into contact with each other or not; this is the sort of thing noticed about objects rather than

what they look like. Of course infants do learn to tell one object from another on the basis of what they look like, but that does not mean the objects have different meanings; for that, they need to pay attention to what the differences are. Obviously not everything babies attend becomes conceptualized; I am not talking about an identity relation between attention and meaning, only suggesting that attention is a required precursor for meanings to be formed.

The other topic addressed in this paper was how attention affects early word usage. Not surprisingly, how often a word is used when talking to infants is important. Infants hear many more nouns than verbs and this shows up in their early word production. But what they understand by these words – their meaning – does not necessarily match the word form. Infants' first words are often nouns or relational words that refer to actions or locations rather than objects. In the one word stage they can only use single words to verbalize events, such as "ball" to express a throwing game played with Daddy or "school" to express the end of a path where one goes. I did not address the role of attention in language learning itself. Instead I wanted to point out that it is attended events that young infants begin to talk about, using whatever words are available to them. We should not be surprised that infants, like adults, talk about what goes on around them rather than just naming things. It is what goes on around us that demands our attention.

REFERENCES

Afonso, A., Blum, A., Katz, B. F. G., and Tarroux, P. (2010). Structural properties of spatial representations in blind people: Scanning images constructed from haptic exploration or from locomotion in a 3-D audio virtual environment. *Memory and Cognition,* 38, 591-604.

Aguiar, A. and Baillargeon, R. (1999). 2.5-month-old infants' reasoning about when objects should and should not be occluded. *Cognitive Psychology,* 39, 116–157.

Bahrick, L. E., Gogate, L. J. and Ruiz, I. (2002). Attention and memory for faces and actions in infancy: The salience of actions over faces in dynamic events. *Child Development,* 73, 1629–1643.

Benedict, H. (1979). Early lexical development: comprehension and production. *Journal of Child Language,* 6, 183-200.

Bergelson, E. and Swingley, D. (2012). At 6–9 months, human infants know the meanings of many common nouns. *Proceedings of the National Academy of Sciences,* 109, 3253-3258.

Bergelson, E. and Swingley, D. (2013). The acquisition of abstract words by young infants. *Cognition,* 127, 391-397.

Bloom, L., Tinker, E. and Margulis, C. (1994). The words children learn: Evidence against a noun bias in children's vocabularies. *Cognitive Development,* 8, 431-450.

Brooks, R. and Meltzoff, A. N. (2002). The importance of eyes: How infants interpret adult looking behaviour. *Developmental Psychology,* 38, 958–966.

Campanella, J. and Rovee-Colliler, C. (2005). Latent learning and deferred imitation at 3 months. *Infancy,* 7, 243-262.

Carey, S. (2009). *The origin of concepts.* New York: Oxford University Press.

Casasanto, D., Fotakopoulou, O. and Boroditsky, L. (2010). Space and time in the child's mind: Evidence for a cross-dimensional asymmetry. *Cognitive Science*, 34, 387-405.

Choi, S. (2000). Caregiver input in English and Korean: use of nouns and verbs in book-reading and toy-play contexts. *Journal of Child Language*, 27, 69-96.

Choi, S. and Bowerman, M. (1991). Learning to express motion events in English and Korean: The influence of language-specific lexicalization patterns. *Cognition*, 41, 83-121.

Clark, H. H. (1973). "Space, time, semantics, and the child". In: T. E. Moore (Ed.), *Cognitive development and the acquisition of language*. San Diego, CA: Academic Press.

Coldren, J. T. and Colombo, J. (1994). The nature and processes of preverbal learning: Implications from nine-month-old infants' discrimination problem solving. *Monographs of the Society for Research in Child Development*, 59, vii–75.

Collie, R. and Hayne, H. (1999). Deferred imitation by 6- and 9-month-old infants: More evidence for declarative memory. *Developmental Psychobiology*, 35, 83–90.

Csibra, G. (2008). Goal attribution to inanimate agents by 6.5-month-old infants. *Cognition*, 107, 705–717.

Csibra, G., Gergely, G., Bíró, S., Koós, O., and Brockbank, M. (1999). Goal attribution without agency cues: The perception of 'pure reason' in infancy. *Cognition*, 72, 237–267.

Farroni, T., Csibra, G., Simion, F., and Johnson, M. H. (2002). Eye-contact in humans from birth. *Proceedings of the National Academy of Sciences*, 99, 9602–9605.

Folven. R. J. and Bonvillian, J. D. (1991). The transition from nonreferential to referential language in children acquiring American Sign Language. *Developmental Psychology*, 27, 806-816.

Frye, D., Rawling, P., Moore, C., and Myers, I. (1983). Object-person discrimination and communication at 3 and 10 months. *Developmental Psychology*, 19, 303–309.

Garner, W. R. (1962). *Uncertainty and structure as psychological concepts.* New York: Wiley.

Góksun, T., Hirsh-Pasek, K. and Golinkoff, R. M. (2010). Trading spaces: Carving up events for learning language. *Perspectives on Psychological Sciences*, 5, 33-42.

Gopnik, A. and Choi, S. (1990). Do language differences lead to cognitive differences: A cross-linguistic study of semantic and cognitive development. *First Language*, 10, 199-216.

Haith, M. M. (1980). *Rules that babies look by: The organization of newborn visual activity.* Hillsdale, NJ: Erlbaum.

Hespos, S. J. and Baillargeon, R. (2001a). Reasoning about containment events in very young infants. *Cognition*, 78, 207–245.

Hespos, S. J. and Baillargeon, R. (2001b). Infants' knowledge about occlusion and containment events: A surprising discrepancy. *Psychological Science*, 12, 141-147.

Johnson, M. H. and Morton, J. (1991). *Biology and cognitive development: The case of face recognition.* Oxford, England: Blackwell.

Kauschke, C. and Hofmeister, C. (2002). Early lexical development in German: a study on vocabulary growth and vocabulary composition during the second and third year of life. *Journal of Child Language*, 29, 735-757.

Lakusta, L. and Landau, B. (2004). Starting at the end: the importance of goals in spatial language. *Cognition*, 96, 1-33.

Lakusta, L., Wagner, L., O'Hearn, K. and Landau, B. (2007). Conceptual foundations of spatial language: Evidence for a goal bias in infants' language learning and development. *Language Learning and Development,* 3, 179–197.

Leslie, A. M. (1982). The perception of causality in infants. *Perception,* 11, 173–186.

Luo, Y. and Baillargeon, R. (2005a). When the ordinary seems unexpected: Evidence for incremental physical knowledge in young infants. *Cognition,* 95, 297–328.

Luo, Y. and Baillargeon, R. (2005b). Can a self-propelled box have a goal?: Psychological reasoning in 5-month-old infants. *Psychological Science,* 1, 601–608.

Mandler, G. (1967). "Organization and memory". In: K. W. Spence and J. T. Spence (Eds.), *The psychology of learning and motivation: Advances in research and theory.* New York: Academic Press. (Reprinted in G. H. Bower (Ed.), *Human Memory: Basic Processes.* New York: Academic Press, 1977).

Mandler, J. M. (1992). How to build a baby: II. Conceptual primitives. *Psychological Review,* 99, 587-604.

Mandler, J. M. (2004). *The foundations of mind: Origins of conceptual thought.* New York: Oxford University Press.

Mandler, J. M. (2008). On the birth and growth of concepts. *Philosophical Psychology,* 21, 207-230.

Mandler, J. M. (2010). The spatial foundations of the conceptual system. *Language and Cognition,* 2, 21-44.

Mandler, J. M. (2011). A leaner nativist solution to the origin of concepts. *Behavioral and Brain Sciences,* 34, 138-139.

Mandler, J. M. (2012). On the spatial foundations of the conceptual system and its enrichment. *Cognitive Science,* 36, 421-451.

Mandler, J. M. and McDonough, L. (1993). Concept formation in infancy. *Cognitive Development,* 8, 291-318.

Mandler, J. M. and McDonough, L. (1998). On developing a knowledge base in infancy. *Developmental Psychology,* 34, 1274-1288.

Mandler, J. M. and Pagán Cánovas, C. (2014). On defining image schemas. *Language and Cognition, 6, 510-532.*

Meier, R. P. and Newport, E. L. (1990). Out of the hands of babes: On a possible sign advantage in language acquisition. *Language,* 66, 1-23.

Nelson, K. (1973). Structure and strategy in learning to talk. *Monographs of the Society for Research in Child Development,* 38, (1-2, Serial No. 129).

Nelson, K. (1985). *Making sense: The acquisition of shared meaning.* Academic Press: London, England.

Nelson, K., Hampson, J. and Shaw, L. K. (1993). Nouns in early lexicons: evidence, explanations and implications. *Journal of Child Language,* 20, 61-84.

Newcombe, N., Huttenlocher, J. and Learmonth, A. (1999). Infants' encoding of location in continuous space. *Infant Behavior and Development,* 22, 483–510.

Núñez, R., Cooperrider, K., (2013). The tangle of space and time in human cognition. *Trends in Cognitive Sciences,* 17, 220-229.

Pauen, S. (2000). Early differentiation within the animate domain: Are humans something special? *Journal of Experimental Psychology,* 75, 134-151.

Quinn, P. C. (2003). "Concepts are not just for objects: Categorization of spatial relation information by infants". In: D. R. Rakison and L. M. Oakes (Eds.), *Early category and concept development*. New York: Oxford University Press.

Quinn, P. C. and Eimas, P. D. (1998). Evidence for a global categorical representation of humans by young infants. *Journal of Experimental Child Psychology,* 69, 151-174.

Roberson, D., Davidoff, J., Davies, I. R. L., and Shapiro, L. R. (2005). Color categories: Evidence for the cultural relativity hypothesis. *Cognitive Psychology,* 50, 378–411.

Rochat, P., Morgan, R. and Carpenter, M. (1997). Young infants' sensitivity to movement information specifying social causality. *Cognitive Development,* 12, 537–561.

Simion, F., Regolin, L. and Bulf, H. (2008). A predisposition for biological motion in the newborn baby. *Proceedings of the National Academy of Sciences,* 105, 809–813.

Spelke, E. S. and Hespos, S. J. (2002). "Conceptual development in infancy: The case of containment". In: N. L. Stein, P. J. Bauer and M. Rabinowitz (Eds.), *Representation, memory, and development: Essays in honor of Jean Mandler*. Mahwah, NJ: Erlbaum, 225-246.

Srinivasan, N. and Carey, S. (2010). The long and the short of it: On the nature and origin of functional overlap between representations of space and time. *Cognition,* 116, 217–241.

Strickland, B. and Scholl, B. J. (in press). Visual perception involves "event type" representations: The case of containment vs. occlusion. *Journal of Experimental Psychology: General.*

Tardiff, T., Fletcher, P., Liang, W., Zhixiang, Z., Kaciroti, N., and Marchman, V. A. (2008). Baby's first 10 words. *Developmental Psyhcology,* 44, 929-938.

Tincoff, R. and Jusczyk, P. W. (2012). Six-month-olds comprehend words that refer to parts of the body. *Infancy,* 17(4), 432–444.

Tomasello, M. (1992). *First verbs.* Cambridge, England. Cambridge University Press.

Tomasello, M. and Kruger, A. C. (1992). Joint attention on actions: acquiring verbs in ostensive and nonostensive contexts. *Journal of Child Language,* 19, 311-333.

Tomasello, M. and Todd, J. (1983). Joint attention and early lexical acquisition style. *First Language,* 4, 197-212.

Volkova, A., Trehub, S. E. and Schellenberg, E. G. (2006). Infants' memory for musical performances. *Developmental Science,* 9, 583–589.

Wang, S., Baillargeon, R. and Brueckner, L. (2004). Young infants' reasoning about hidden objects: Evidence from violation-of-expectation tasks with test trials only. *Cognition,* 93, 167-198.

Wang, S., Baillargeon, R. and Paterson, S. (2005). Detecting continuity violations in infancy: A new account and new evidence from covering and tube events. *Cognition,* 95, 129–173.

Widen, S. C. and Russell, J. A. (2008). Children acquire emotion categories gradually. *Cognitive Development,* 23, 291–312.

Willatts, P. (1997). "Beyond the 'couch potato' infant: How infants use their knowledge to regulate action, solve problems, and achieve goals". In: G. Bremner, A. Slater and G. Butterworth (Eds.), *Infant development: Recent advances*. Hove, England: Psychology Press, 109-135.

Woodward, A. L. (1998). Infants selectively encode the goal object of an actor's reach. *Cognition,* 69, 1–34.

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Chapter 11

THE EVOLUTION OF A HIERARCHY OF ATTENTION

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ABSTRACT

Humans alone pay joint attention to topics, making language quite different from animal communications. Because language is a tool for drawing attention to topics, its evolution has included the emergence of a hierarchy of new powers of attention. Two existing brain circuits for paying attention were integrated, resulting in speakers that can more fully coordinate their join attention. It also allows them to use complete sentences. Working memory led to the ability to speak about topics and subtopics without losing a conversation's thread. We increased our ability to attend to our subjective states, and to attend to metaphorical language. We also developed a capacity to attend to cultural symbols of changed cultural states. Attention itself is a function of perception and the topics that attention generates are expressed using three features of language -case, intention, and scope - that reveal language's perceptual origins. Like ancestral body structures, the features shape our speech about imperceptible topics. While it is tempting to search for competitive benefits at the level of individual evolution, it is almost certain that most of what shaped *Homo sapiens* was selected at a higher level. Our languages and powers of attention support community success, and became fixed in the species through group competition.

1. INTRODUCTION

"A defining characteristic of the human species is our capacity to rapidly establish topics of mutual contemplation" (Leavens et al., 2005, p. 185).

Topics - the great novelty of human thought and language - are what people pay attention to when they speak. Animal communication systems have nothing similar.

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When animals communicate they control one another. For an archetypal animal communication, consider the case of a bird signaling a territorial claim. One bird, the signaler (S), generates a species-specific sound and another bird of the same species, the auditor (A), moves away. The interaction always ends with a non-vocal response (R). In the example, a potential rival flies away. In other cases a potential mate might approach. The critical point is that the signal is not an end in itself, but a means towards provoking an action. Successful animal communication ends with an action, never with another signal. The basic animal communication can be diagrammed S→A→R.

Animal communications have no overt meanings and do not imply the presence of a mind. The bird communication can be said to be about territory and who patrols it, but in that communication neither S nor A need be directly aware of the territory. S signals; A flies away. Neither needs to think specifically about territory, yet the communication is successful. Of course, a successful, unconscious communication must be unambiguous. Any resolution of ambiguity would force the matter to the conscious level.

Language is often assumed to have evolved from animal systems of communication (e.g., Fitch, 2010; Pinker and P. Bloom, 1990), but if that were true we would expect speech to share some of the properties of animal signaling, albeit in more complex form. For example, computer languages are complex but have been designed to control machinery and are functionally similar to animal systems (Wiener, 1948). Successful machine communications end with some sort of output, just as successful animal signaling ends in an action. Human communication, however, is functionally and structurally unlike animal communications, so much so that, when considering the difference between animal and human communications, Dawkins and Krebs (1978, p. 73) said they were "tempted to abandon the word *communication* altogether." Language is used to tell humans about things; it informs an auditor about a topic. Other animals do not do that. Tomasello (2008, p. 1) sums it up, "you cannot *tell* animals anything, even nonverbally, and expect them to understand."

One possible source of confusion on this difference between animal communications and language lies in the distinction between communication *to* control and communication *by* control. Animals and machines use signals *to* make others act in a particular way. Humans use language to consider topics *by* directing another's thoughts and attention. The difference between prepositions may seem subtle, but it has resulted in a break with the S→A→R structure.

An archetypal human communication does include a signaler and an auditor, but there is a third element, the topic (T), making a triadic relationship.

(1) The bird that just landed on that branch is a lilac-breasted roller.

Communication (1) can be diagrammed as shown in Figure 1.

As with animal communications, a signal travels to an auditor, but in this case both S and A pay joint attention to the topic.

The topic itself must be separate from the signal.

(2)

a. This sentence is a sentence.
b. This sentence is true.

c. This sentence is false.
d. This sentence is in English.
e. Dieser Satz ist auf english.

It is possible to imagine self-referential signals, but they are either self-evident as in (2a), or meaningless (2b), or paradoxical (2c). Signals that seem both meaningful and self-referential point partially outside themselves.

For example, (2d) has a self-referential subject and an external predicate, leading to paradoxes of translation, e.g. (2e) (W. D. Hart, 1970). Self-referential signals can be structured like normal sentences, but without a topic outside the signal itself they cannot function like normal sentences. Sometimes a message may be about both auditor and signaler, which leads to special statement types, discussed later in this chapter.

Because they concern topics rather than control, successful human communications do not always require an active response. The addition of a topic must be understood overtly by all parties to the communication. The less direct a statement is, the greater the risk of communicative failure. At the same time, human language can be ambiguous and still succeed. The topic itself resolves ambiguities.

In the case of sentence (1), if the auditor replies, "Beautiful," the original signaler will assume that the adjective refers to the bird, even though it is nowhere mentioned in the reply. Utterances acquire meaning by directing attention to a topic.

Natural language can, therefore, be defined as a tool for drawing attention to topics. This makes it quite unlike machine languages (tools for operating computers), mathematical languages (tools for performing computations), or animal communications (tools for controlling other animals). For anyone interested in the biology of natural languages, this definition raises a series of puzzles. Where do the topics themselves come from? How did our ability to focus attention on topics evolve? Why did it evolve?

2. THE ATTENTION HIERARCHY

We know that no special evolution was required to utter phrases because apes can generate them by using sign language. Thus the two closest living species to *Homo sapiens*, chimpanzees (*Pan troglodytes*) and bonobos (*Pan paniscus*), have the foundation for considering topics.

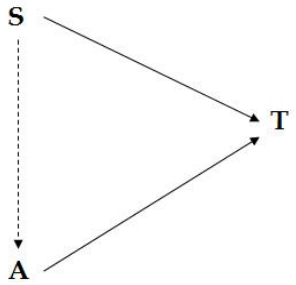

Figure 1. The Linguistic Triad.

They have also been observed swatting the ground to catch a fellow chimp's attention before making a begging gesture (Tomasello 2008), proving that apes are aware of the need for attention and are able to manipulate it.

Captive chimpanzees have even been observed pointing, although their motivational is control - requesting an object - rather than contemplating it (Leavens, Hopkins and Bard, 2005; see also Hopkins et al, 2013). Then, like one- and two-year-old children, apes can be taught to make short phrases in sign language. A phrase is the basic syntactic structure, providing information about a single focus of attention. At the one-word level toddlers can speak about objects (e.g., *juice*, [ba]*nana*, *shoe*), actions (e.g., *eat*, [pick] *up*), and situations (e.g., *allgone*). These words form simple topics and, from the beginning, differ from animal communications.

The standard argument against the proposition that apes are smart enough to use some language is to point out that apes do not talk. That rebuttal, however, assumes the problem is intellectual. It could be something else. What they lack, according to Michael Tomasello (2008), is the motivation to create a linguistic triad. If somehow they evolved the motivation, they could start signaling about topics right away.

Of course, they could not communicate like modern humans, but they would have moved squarely onto a promising evolutionary path. Other steps required to reach modernity would be the evolution of a hierarchy of powers:

a. integrated attention;
b. a complete sentence;
c. subtopics;
d. absent references; and
e. cultural symbols.

Let us examine these evolutionary stages individually.

Integrated attention: There are two basic ways to consider a topic. One is to draw attention to it, as in, "The bird that just landed on that branch…" Once a topic is introduced more information can be added, as in, "…a lilac-breasted roller." Those two actions reflect two separate powers of focused attention created by two distinct regions of the brain (Posner and Rothbart, 2007): reflexive attention and functional attention.

The posterior system is the older form and works like a simple reflex. An animal may, for example, hear a sound that is not intense enough to produce a startle reflex, yet strong enough to make the animal turn its head toward the source of the sound and seem to focus on it. After focusing, the animal may then flee, approach, or resume its previous activity. In a linguistic triad, reflexive attention can introduce and change topics. When pet animals learn to respond to their name, they focus and act, reacting as though their reflexive attention has been triggered. In a conversation, a topic can change many times. A word or phrase pilots the auditor's reflexive attention to the new topic.

The anterior system enables an animal to focus consistently on one task while shifting from one detail to another. For example, an ape may pick fruit, one after another, from a bush. This action requires adjusting one's focus as the scene changes and altering one's behavior to suit the changing situation. Language too uses detailed attention.

(3) The kitten revived, its eyes sparkled, and it seemed ready to raise its tail any moment, spring up on its paws, and play.

Sentence (3) has one topic, but it follows the kitten's introduction with four phrases that require shifts of focus from detail to detail.

Although any single utterance may call for only one attention system, conversations require the ability to switch quickly between the two systems, and many utterances require the use of both attention systems together. We have seen that sentence (1) uses both attention systems. Only humans have a circuit that "regulates integrated activity across the anterior and posterior attention systems" (Mundy and Newell, 2007, p. 271). This circuitry has been established by electroencephalography and imaging data (e.g., Mundy, Card and Fox, 2000; J. H. C. Williams et al, 2005), indicating that the ability to change and explore topics has its own evolutionary history and is not simply the result of social usage of pre-existing animal abilities. Thus, we cannot assume that the first speakers could integrate their distinct attention systems.

Complete sentences: A fundamental rule of attention is that it focuses on one detail at a time. An organism can focus on Mrs. Franklin or a plate of cheese, but not both at once. Yet the finding that we have two attention systems suggests that it might be possible to focus each attention system on a different object.

(4)

a. Mrs. Franklin dropped a plate of cheese.
b. *Mrs. Franklin called a plate of cheese.
c. Mrs. Franklin called the police.
d. Mrs. Franklin dropped the baby.
e. Mrs. Franklin called the baby.

The fact that we can speak sentence (4a) and visualize the scene as a whole seems to indicate that we can focus on two separate things at once.

One- and two-year-old children cannot construct sentences of this type. Neither can chimpanzees who have learned to make hand signs. The best either group can do is make phrases a few words long. A two-year-old, observing Mrs. Franklin drop a plate of cheese, might be able to say *uh-oh*, or *auntie*, or *cheese*, or even *fell*, but the toddler does not combine these separate foci into a complete perception. That ability comes later, when the child is old enough to outpace an ape's ability to specify what it perceives. J. Mandler (this volume) discusses the challenge that infants face when speaking of motions and actions. From the earliest age, motion snares the attention of infants, yet in most languages when babies learn to talk nouns are more common and used at an earlier age than verbs. J. Mandler notes that this behavior does not imply a lack of attention or a lack of interest in motions as a topic. "Single words can only express part of an event."

Traditionally, sentence (4a) is analyzed as NP + VP, a noun phrase (*Mrs. Franklin*) plus a verb phrase (*dropped a plate of cheese*). The parsing then breaks down the verb phrase as a verb (*dropped*) plus a noun phrase (*a plate of cheese*). Functionally, however, we can analyze the sentence as containing two NPs joined by a verb that integrates the two points of attention.

Either NP can be accompanied by the integrator: *Mrs. Franklin dropped…* or *…dropped a plate of cheese*. Functionally, the verb allows an auditor to integrate the two phrases into a whole. If the verb does not integrate both NPs - as in (4b) - the result is confusion. *Called it how?* an auditor might wonder. Yet (4c) does make sense. Sentences (4d) and (4e) are offered as proof that we have not discovered a new either/or category: things that can be either *called* or *dropped*. The test of integration is whether or not the verb makes sense with both points of attention. The acceptance or rejection of an integrating verb is a semantic issue, not a syntactical one.

Complete sentences do require more than simply connecting the two attention systems. The joining circuit must play an active role, so that the user of *dropped* and *called* can be recognized as meaningful or not. More research is required to say whether the integration of the two attention systems was sufficient in itself to permit complete sentences or whether the integrative process required two steps. However it was accomplished, the ability to use complete sentences gives people a clear, intellectual advantage over every other species on earth.

Subtopics: Hauser, Chomsky and Fitch (2002, p. 1569) proposed that a language faculty uses computational elements common to many animals. The only language powers the authors believe to be exclusive to humans are "the computational mechanisms for recursion." Recursion in a syntactic context refers to the ability to generate new sentences by following the rules used to generate simpler sentences. For example, the rule: sentence → [Noun Phrase] + [Verb] can generate a large number of sentences like (5a-c).

(5)

a. The man groaned.
b. The cat scratched.
c. The dog bit.

If we insert the rule into the rule, we get sentence → [NP] + [[NP] + [V]] + [V], and that rule gives us intelligible sentences as well.

(6)

a. The man the cat scratched groaned.
b. The cat the dog bit scratched.
c. *The cat the man groaned scratched.
d. The cat the man groaned at scratched.

To understand recursive sentences (6a-b), we must be able to interrupt our attention without losing the thread. This feat requires a working memory, first proposed by Baddeley and Hitch (1975). Working memory enables an auditor to retain the sounds of a sentence long enough to grasp the whole sentence. A circuit linking Wernicke's area and Broca's area has been identified and seems to function as proposed (Aboitiz and Garcia, 2009), so there appears to be no doubt that we have evolved a working memory that assists us in maintaining attention during complex, even recursive, speech.

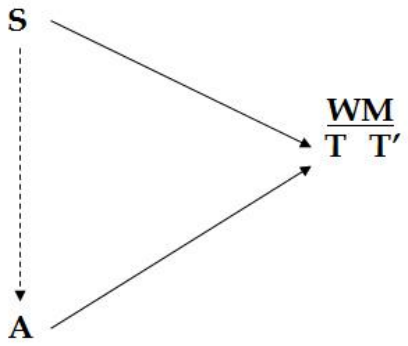

Figure 2. Triad with Subtopic.

Figure 2 shows the recursive relationship in terms of topic and subtopic. Speaker and auditor pay joint attention to a topic or subtopic (T') while working memory (WM) enables S and A to retain topic and subtopic at same time.

The critical feature of sentences (6a-b) is the presence of a subtopic. A subtopic is the subject of a subordinate clause. The topic of (6a) is *the man*; the subtopic is *the cat*. We can designate *the cat* as the subtopic because it scratched the man.

(6a) Topic	The man groaned.
Subtopic	the cat scratched

If we try to generate sentence (6c), we get an unacceptable sentence even though it follows the same recursive rule that gave us (6a). This difference in result suggests that the generative rule is incomplete as stated. Sentence (6c) fails because it mixes up topic and subtopic. Sentence (6d) illustrates that the source of the confusion is the subordinate clause's verb. When the verb makes sense, the sentence makes sense. Note too that sentence (6d) is longer than (6c), indicating that the problem with (6c) is not memory or attention span. As with integrative verbs in complete sentences, the relation between topic and subtopic in (6d) is semantic.

Sentences can also fail if they try to stray too far from the topic.

(7)

a. *The man the cat the dog bit scratched groaned.
b. The man the cat scratched and the dog bit groaned.

Some linguists would not put an asterisk in (7a) because they consider it an acceptable sentence generated by a legitimate rule even though an auditor will want to pause and work out the sentence's meaning before sorting out how the string of verbs are supposed to work. This chapter uses an asterisk because it analyzes the sentence functionally. The *dog* is a subtopic of the *cat*, which is a subtopic of the *man*. Subtopics are the end of the line linguistically. Subtopics in a single sentence cannot have subtopics of their own.

(7a) Topic	The man groaned.
Subtopic	the cat scratched
*Subtopic2	the dog bit

When we adjust (7a) to get the slightly longer (7b) the sentence makes sense, because both subtopics refer to the same topic.

Questions that call for a yes or no answer, can also have subtopics.

(8) Did the man the dog bit run?

(8) Topic	Did the man run?
Subtopic	the dog bit

Interrogatives - question words that call for more than a yes or no answer - create more complicated situations. Interrogative pronouns serve as breaking points that call for new topics.

(9)

a. The man ran.
b. Which man ran?
c. The man the dog bit ran.
d. *Which man the dog bit ran?
e. Which dog bit the man?

In these bits of dialog, sentence (9a) identifies a topic; (9b) asks for clarification about the topic, calling for a subtopic; (9c) supplies the subtopic; (9d) uses unacceptable syntax in an attempt to gain still further clarification, calling for a subtopic to a subtopic.

(9d) Topic	Which
Subtopic	man ran?
*Subtopic	the dog bit

The solution is to change the topic, as in (9e). Inserting two interrogatives in the same sentence poses problems because we immediately find ourselves with a second subtopic.

(10)

a. I wrote the book.
b. Why did you write the book?
c. She wondered why I wrote the book.
d. *Which book did she wonder why you wrote?
e. Which book did she wonder about?
f. Which book that you wrote did she wonder about?
g. *Which book that you wrote did she wonder why?

The topic is perfectly clear in (10a) and easily allows (10b), but, because of (10b)'s interrogative status, we have reached the limits of direct questioning. (10c) reports the thinking behind (10b) and slips an interrogative into the middle of the sentence. Thus, a question about (10c) leads to problems, as in (10d).

(10b) Topic	Why
Subtopic	did you write the book?
(10c) Topic	They wondered why
Subtopic	I wrote the book.
(10d) Topic	Which
Subtopic	book did she wonder why
*Subtopic2	you wrote?

The solution to this problem shown in (10e) is a bit scandalous because it substitutes a vague locative for a clear interrogative. (10e) does not tell an auditor whether "she" wondered about why the book was written, *when* the book was written, or *where* it was written, or *who* wrote it? However, (10e) does keep the sentence focused on the question being asked. Sentence (10f) demonstrates that the problem with (10d) is not its length. (10f) is longer and perfectly intelligible.

(10e) Topic	Which
Subtopic	book did she wonder about?

It is possible that a poor speaker who does not know the *wonder about* solution will try sentence (10g). This attempt still forces the speaker to reconsider precisely what the question asks.

(10g) Topic	Which
Subtopic	book that you wrote did she wonder why?
*Subtopic2	[implied]

There are a number of tour de force sentences that challenge these observations.

(11)

a. This is the farmer sowing his corn, that kept the cock that crowed in the morn, that waked the priest all shaven and shorn, that married the man all tattered and torn, that kissed the maiden all forlorn, that milked the cow with the crumpled horn, that tossed the dog, that worried the cat, that killed the rat, that ate the malt that lay in the house that Jack built.
b. From a little after two oclock until almost sundown of the long still hot weary dead September afternoon they sat in what Miss Coldfield still called the office because her father had called it that - a dim hot airless room with the blinds all closed and fastened for forty-three summers because when she was a girl someone had believed that light and morning air carried heat and that dark was always cooler, and which (as the sun shone fuller and fuller on that side of the house) became latticed with yellow

> slashes full of dust motes which Quentin thought of as being flecks of the dead old dried paint itself blown inward from the scaling blinds as wind might have blown them.

Sentence (11a) is a famous Mother Goose rhyme that boasts 11 topics, all of them highly visual. It is rhythmic and delightful, and far more than a mind can grasp as a whole. The 122 words of (11b) make up the opening sentence of William Faulkner's *Absalom, Absalom*. They illustrate how language can be used to create a mood. Like (11a) there are more details than the mind's eye can attend to at once, but the words create a sense of torpor and the impression of a lifeless room. Many sentences from Proust and Dickens are also mood pieces rather than statements about topics. Yet even these gems are about something - *until almost sundown … they sat in … the office …with yellow slashes full of dust motes* - and the details are all information about that topic. Long after the biology of language became fixed in our species, a richness of cultural evolutions has continued.

Understanding absent references: Language does not require that a topic be physically present.

(12)

a. President Kennedy filled in the crossword puzzle.
b. President Kennedy thought about the crossword puzzle.
c. President Kennedy wrestled with the crossword puzzle.

Even though we cannot look about us and see what sentences (12a-c) report, we can still understand them. Three types of non-perceptible reference can be imaginary, sympathetic, or metaphoric.

Imaginary pointing: (12a) refers to objects that would be perceptible if they were present. There is ample imaging evidence to establish that sentences like this one function by stimulating the same regions of the brain that the actual perception stimulates (e.g., Evans et al, 2007; Pulvermüller et al, 2001). This pointing to imaginary perceptions rather than actual stimuli appears to rest on powers that are older than the talking lineage. Apes, for example, are capable of signing *want fruit* even in the absence of fruit. Thus, no special evolution appears to have been required for the brain to understand a sentence about Kennedy filling in a crossword puzzle. The relationship between an imaginary topic and attention is shown in Figure 3.

The topic is still outside the signal, but speaker's and auditor's attention are focused on what their own imagination can conjure. Although the topics in the sentence refer to objects, this method of directing attention may result in the speaker and auditor imagining different scenes.

Sympathetic pointing: The verb in sentence (12b) is not directly perceptible; none of Aristotle's five senses allow us to understand the word *thought*. Nevertheless there are subjective sensations that precede or accompany consciousness of a new idea. Thus, we can have a sympathetic understanding of the topic, as shown in Figure 4.

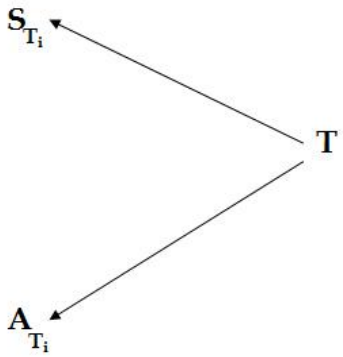

Figure 3. Imaginary Topics.

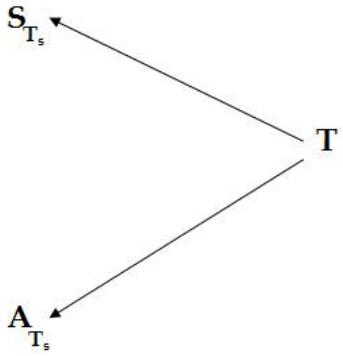

Figure 4. Sympathetic Topics.

The basic structure of the relationship to sympathetic topics matches that of imaginary topics, but instead of evoking an image or sound it evokes a subjective experience. Of course, the speaker and auditor may have quite different thinking experiences and they attend to different things.

Many scholars argue that this kind of sympathetic understanding requires a "theory of mind" (e.g., Carruthers and P. K. Smith, 1996; Premack and Woodruff, 1978; Whiten, 1991), i.e., a belief that the speaker and others have mental states. Taken literally, the hypothesis appears to be false. Many cultures make no distinction between mind and body and, therefore, have no formal notion of mental states. It is, for example, extremely common to speak of subjective states as visitations from outside. Thus, people speak of being angry as having "a devil inside you," of ideas as being "revelations from God" or "temptations from the devil." A believer in minds might wonder what gets tempted if not the mind, but a person with no such concept can say the hand is tempted or the loins are stirred or hunger was aroused. A classic example of ascribing mental states to the body comes from the Book of Exodus in which God hardens pharaoh's heart. (Exodus 7:13; 7:22; 8:15; 8:32; 9:7; 9:35; 10:20; 10:27; 14:8) However, even with no word for a mind, it is possible to speak of anger, hunger, thinking, and so forth. To do so, speakers and auditors need only believe that others can respond to the same sensations they feel.

We cannot say if apes are aware of their subjective sensations. They may simply react to them. Surely they have far less need for such self-awareness.

In every human society there are some people who are well able to control their anger. They feel the sensations that make them aware of their anger, yet they do not act upon these sensations. A person with no such awareness and self-control is a most unwelcome member in any community. Ape societies also require some anger management. It would be dangerous for a lower ranking chimpanzee to attack the alpha male in a fit of anger, but the anger can be redirected toward a still lower ranking ape. Whether any of this behavior rises to the level of self-awareness is impossible to say. It seems clear, however, that life in a human community requires more self-awareness and self-control, and that there would be some pressure, possibly even strong pressure, to evolve humans able to judge their own behavior and control it. In that scenario, the ability to recall one's own subjective sensations and use them in sentences would be a collateral effect of growing communal behavior and not a direct selection for speech itself.

Metaphorical pointing is illustrated in (12c). Here the speaker is trying to name whatever it is that makes a puzzle difficult. We can call what the speaker wants to name a target. Instead of hitting the target, however, the speaker names a substitute. That is how metaphors always function: a metaphor identifies a target meaning by pointing attention to a substitute reference[1]. Figure 5 diagrams the process.

The speaker aims toward the target topic but draws attention to the metaphor instead. Metaphorical pointing can be used for purely rhetorical purposes - e.g., *Einstein wrestled with Bohr over quantum mechanics*, when *argued with* or *questioned* would work just as well - but metaphor is essential when speaking of non-perceptible actions.

Under the old theory of metaphor - that it was a figure of speech in which a speaker was deliberately choosing an indirect expression - metaphorical language was thought to be a purely cultural invention, and any evolution supporting it was necessarily cultural as well. The contemporary theory holds that the overwhelming bulk of our conceptual communication depends on metaphors. Even many mathematical concepts depend on metaphors - e.g., division, dimensions, and squaring. Thus, there is likely to have been some biological evolution required to make the substitution process more efficient and useful.

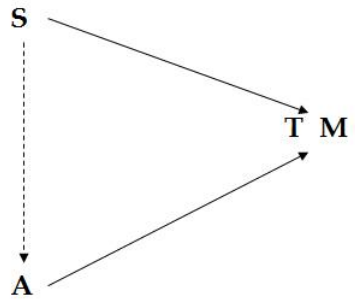

Figure 5. Metaphorical Linguistic Triad.

[1] The account of metaphoric expression used in this chapter is based on the contemporary theory of metaphor developed by G. Lakoff, M. Johnson, and others, and summarized in Lakoff (1993). See also Lakoff and M. Johnson (1980). The account has been modified to fit this chapter's primary hypothesis that language permits the contemplation of topics by piloting the joint attention of speaker and auditor.

Some people find it impossible to understand metaphors, further suggesting there may be a biological basis for their use (Rundblad and Annaz, 2010).

Understanding cultural symbols: There is a common type of sentence that can be found in any culture.

(13)

a. I am Kikuyu.
b. I am married.
c. Today I have become a man.

Each of these sentences has to do with cultural identity. They are neither metaphors nor concrete statements and suggest that extensive cultural evolution must have preceded their emergence. Speech without these cultural symbols may be much older than speech with the symbols.

Cultural identities are generally established via a ceremony and marked with a visible symbol. A classic example is the wedding ceremony that creates the married identity and the donning of rings to show the new identity. Visible symbols make it possible to talk meaningfully about cultural things by providing some image to focus attention on. The relationship between attention and symbolic topics is shown in shown in Figure 6.

The speaker names a topic and the topic evokes a cultural phenomenon. The structure is somewhat similar to that of imaginary and sympathetic topics. In those cases the topic reflects attention back to the brain's subjective workings; cultural symbols reflect attention to something perceptible that serves as a visible sign of an invisible condition.

There may well have been some biological evolution to support the emotional connection that a cultural symbol carries. A wedding comes with an emotional element that cannot be made rational, and it is not at all uncommon for people's behavior to change after an identity-changing ceremony. However, there may not have been any special evolution of the powers of attention. Symbolic language depends on prolonged cultural evolution and special training in how to understand a symbol.

Hierarchy. Bolles (2011) provides some speculation as to when individual levels of the hierarchy might have evolved, but those general dates are far from certain.

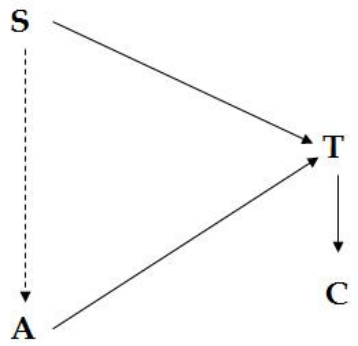

Figure 6. Linguistic Triad with a Symbolic Topic.

What is clear is that the posterior and anterior attention circuits are much older than the human lineage, and the first thing needed for the evolution of a hierarchy of further attention powers was the motivation to share them. Without that motivation, even a complete sentence seems unnecessary, for the thinker already knows what the completing phrase refers to.

Once the motivation emerged, the human lineage was likely to immediately use phrases to direct joint attention to external phenomena and remembered phenomena that had been given names. Possibly they could also develop names for subjective sensations like hunger or fear. The first human-only part of the hierarchy to evolve was probably the circuit that integrates the anterior and posterior attention circuits. This system enables a more rapid coordination of the two older circuits and permits complete sentences that allow a speaker to clarify quickly changing topics.

The other levels of the hierarchy - working memory, understanding of metaphors, and understanding of cultural symbols - may have evolved in the order presented in this section, or they may have overlapped, or they might have evolved in some other order. It seems apparent, however, that each of these powers had to evolve, both culturally and biologically, and had to be selected for continued survival. The genetic structures supporting these traits had to be fixed in the population by the time of our last common *Homo* ancestor.

The emergence of the symbol is often proposed as "the basic unit of human behavior" (White, 1940, p. 451), but this hierarchy proposes an alternate, older, unit: the phrase, or point of focus of attention. The hierarchy offers a way of integrating and expanding this unit and suggests that symbols constitute the apex rather than the foundation of human society and behavior. Thus, language of a more primitive sort than the one we are familiar with must be much older than *Homo sapiens*. Even older, and more basic, of course, is the motivation to form and maintain a human community.

3. WHERE TOPICS GET THEIR CONTENT

Scholars who begin with the axiom that human thought is symbol processing and nothing more (i.e., processing without attention, emotion or sensation) are often perplexed by the discovery of things to think about. Turing machines can process symbols in a solipsistic way, that is to say their processing does not refer to an external world. Even if the data they process comes from a sensor such as a video camera, the machine is unaware of that source as bringing in data from some other entity. The same rule applies to motor processes. A missile can be guided by incoming data to hit a moving target without the missile ever realizing that it is traveling through space. Yet all speakers seem to know that there is a world is full of things they do not know about and must learn about. Where do they get this notion of a world that is separate from themselves? Anne Reboul (2010) takes this problem for granted and therefore argues that a speaker-auditor interaction "presupposes content of some sort, … but cannot account for content" (Reboul, 2010, p. 435).

This chapter assumes that knowledge of the existence of an external world emerges from the attention hierarchy, but the chapter does not presume to say at exactly which level this knowledge becomes conscious. We can imagine a giraffe emerging from a forest and suddenly, upon hearing an unexpected sound, coming to reflexive attention, focusing on the phenomenon and then retreating back into the forest (first level of the hierarchy).

Does the giraffe know there is a world out there to fear? Without the giraffe having language and without knowing anything of giraffe awareness, it is hard to say exactly what the question even means. (For an attempt at an answer, see Panksepp, 2005).

At the top level of the hierarchy, we can imagine human adolescents undergoing a coming-of-age ceremony in which members of the group are welcomed into the tribe by their dead ancestors. These youngsters are aware of themselves as individuals, as members of a group which is surrounded by non-tribes people, and as part of an imperceptible world of ancestors as well. Somehow solipsism has disappeared while moving through the attention hierarchy.

Attention itself is a function of a larger process, perception (Treisman and Geffen, 1967), which binds a mass of sensations - visual, aural, emotional, scented, tactile, etc. - into a coherent scene. Attention searches the scene, sorting the scene into a foreground that gets the focus and a background that is secondary (Palmer, 1990).

We have ample evidence supporting the hypothesis that perception is the source of the topics contemplated via an attention hierarchy. First, many animals, especially our closest primate species, have a sound understanding of the objects and space in their environment, and the basis for this understanding is perception. Second, we have seen that, starting with the ability to focus on the concrete perception of apes, our powers of attention have evolved to allow more subjective, complex, and abstract sentences. A third strong piece of evidence supporting the hypothesis is a series of distinctive traits shared exclusively by natural language and perception -case, intensionality, and scope (Bolles, 2011).

Case expresses a relationship between words in a sentence; it arises from the ability to shift focus from one object to another. It is not enough to direct attention to random points - e. g., Julius Caesar, the Titanic, acrobatics…-because sentences are not lists of things. To be meaningful, shifts in focus must assert the relation between the objects focused on. These relations can be indicated by word order, or inflectional markers, or both. Although there are many possible relationships to express, only a few can be expressed through case.

(14)

a. Jack had lunch with his brother.
b. Tom is bigger than Marissa.
c. If you have five dollars and take away three, you are left with two dollars.
d. Janet came to Mary's wedding.

Sentences (14a-d) express common relationships without using case. (14a) reports a family relationship. We can imagine a language that includes a brethren case, say by adding –bro to the end of a brother's name: **Jack had lunch with Tommy-bro*. Languages, however, are content to express the relationship as a noun phrase: his brother. They do not use case to express family relations.

Sentence (14b) could be written as T>M in which T=Tom and M=Marissa. But even that logical relationship is not expressed by using case. And sentence (14c) can be written as an equation: $5-$3=$2. In fact, natural languages handle mathematical reasoning so poorly that an entirely new notation system has been invented to express the relations. Once again, we do not use case to express the relationships.

Sentence (14d) expresses a social relationship and, like (14a), it is possible to imagine a case that is used to indicate a guest relationship, but natural languages do not have such cases.

Case relationships are perceptible. The most common case relationships identify the acting object (nominative case), the object that is acted upon (accusative), the object that receives the action (dative), or is part of a larger object (genitive). Other case relationships also exist. Latin scholars will remember ablative, vocative, and locative cases.

Even when there is no perceptible justification for the usage, sentences express relationships as though they occurred in space. Recall the subjective sentence (12b). In concrete sentences, *about* refers to the near space, as in *Look about you* or *He scattered seeds about the yard*, or even *President Kennedy scattered random letters about the crossword puzzle.* There seems no sound reason to use *about* in identifying the subject of one's thinking, yet case structure implying that abstractions occupy space is a linguistic universal. Dessalles (2007, p. 239) notes, "Language translates all non-visual relationships into spatial relationships. All languages do this without exception, not just one or a group. This is one of the invariable characteristics of human language."

Because case relationships are universal elements of language, concrete sentences are universally translatable. Other grammatical relationships may be indicated in one culture or another, but are not universal and often go untranslated. For example, *Jane parle dans son langage* is rendered in English as *Jane speaks in her language* even though the French requires a masculine pronoun while English demands a feminine one. Similarly, the Swahili *Watu wote wamerudi nyumbani zake* can be translated as *Everybody returned to their homes* without giving a hint of the separate Bantu categories used to distinguish people from homes.

Literal translation does become a question when a case is used in non-perceptible contexts. We say *think about* while the French use a different preposition altogether. *Je pense a toi* can be translated as "I think about you," but in concrete situations *a* is translated as "in": *Je suis a l'école*; *Nous somme au Portugal*. And even in the same language the word used for a location changes. What does not change is the need to place the non-concrete phenomenon somewhere. Shakespeare used *think on*: *Think on me* (Antony and Cleopatra I, v, 27); *Think on that* (Othello V, i, 4); *I think on thee* (Sonnet II, 13). According to Google's N-gram viewer (http://books.google.com/ngrams) the phrase "think about" first appeared in books in 1860 and began to see regular use during the period of the First World War. It only began to outpace "think of" in the 1960s. So there is ample variety in how an imperceptible reference might be placed in space. Yet the requirement that sentences structure imperceptibles as though they did occupy space persists. In evolutionary terms, the spatial structure seems like a surviving ancestral trait. Just as the five digital bones of a whale serve as evidence of descent from a land mammal, spatial structure supports the hypothesis that abstract speech is descended from concrete speech.

Another property shared by perception and language is intensionality, or possession of point of view. Perception is always about something, and so are utterances. As Piattelli-Palmarini (2008, p. 239) states it, "Word meanings are through and through intensional. No symbol used in animal communications has this property." For example, compare

(15)

a. The boy feared the lion.
b. The lion frightened the boy.

In some objective sense (15a-b) mean the same thing, but the change in the verb selection reflects a change in point of view. No other system for manipulating symbols offers such freedom.

This capacity to report things from different viewpoints reflects language's structural assumption that events have perceivers, even though the assumption is not always useful. Diplomats often need to agree to statements that assume nobody's point of view. Mathematicians have invented a full notational system that allows them to compute without point of view.

Sometimes the point of view shifts to include both the speaker and auditor together while the topic disappears. One example uses the vocative case in which the speaker addresses the auditor directly, transforming the linguistic triad into a dyad. An onlooker might say *Caesar rebuked Brutus* while Caesar himself says, *Et tu Brute*. Latin is unusual in having a distinct vocative inflection, but the viewpoint change is universally denoted. Two common vocative phrases are *Our father* and *Hail Mary.* Procedural documentation shares the same transformation: *Click the icon*; *Press the power button*; *Raise your right hand and repeat after me*. (Note that the most complex animal communication known, the waggle dance of the honeybee, falls into this procedural category.)

Topics also disappear in speech acts, and again this change is accomplished by vocative structure. John Austin (1962) said language is a tool used for a variety of purposes that was not limited to examining either perceptions or conceptions. There is no controversy about the sentence *John promised to love and honor Jane until death do them part.* That recounts a straightforward perception. Speech acts change the nature of the speaker by using a first-person point of view as in, "I promise to love and honor him until death do us part." There are undoubtedly many speech acts, but they are like vocatives addressed to a multitude. Instead of adding a concrete structure onto an abstract consideration, speech acts often transform point of view.

A third shared property of perception and language is the scope of the focus.

(16)

a. The president is speaking.
b. The president is speaking to a cheering crowd.
c. The president, with the vice-president right behind him, is speaking to a cheering crowd.
d. ¿The president, with the vice-president, is speaking to a cheering crowd.

Just as perception can broaden or shrink the foreground, (16a-c) shows how language too can serve as a kind of zoom lens changing the size of what is put in the foreground. The linguistic zoom lens works by adding or deleting groups of words without changing point of view. Sentences (16a-c) each present the scene from the point of view of someone observing a president. As the focus widens to include others, they are located in space relative to the president.

It is reasonable to wonder if such a spatial relationship is required. No one is likely to argue that the *right behind him* phrase in (16c) is demanded grammatically, but notice if we toss it out we get (16d). Without the spatial detail, the sentence becomes a little confusing (as indicated by the inverted question mark).

Is the vice-president speaking too? Just how does he fit into the scene? Why is he mentioned? A skilled writer clarifies the spatial relationships included in a sentence's scope. Once again, no other communication system gives the signaler so much liberty in framing a statement.

The primary objection to the hypothesis that topics are based on perceptions is that it is possible to speak clearly about abstractions that are not in any way perceivable.

(17)

a. My trust in you has been forever shattered by your unfaithfulness.
b. My house in Alabama has been forever shattered by your bomb.

Bickerton (1995, pp. 22-24) proposes (17a) as self-evident proof that we do not understand sentences perceptually. Yet the sentence uses case rules to organize itself as though it were referring to a concrete perception. (17a) has same structure as (17b). Both use the spatial structure __ in __. One is abstract and one concrete. Both also use the verb *shattered*, but it is literal in (17b) and metaphorical in Bickerton's sentence. If language is not based on perception, why not just use a word that directly refers to the imperceptible target? Finally, like many abstract words *trust* and *infidelity* are imperceptible but imaginable. If somebody spoke this sentence seriously, the words would ring home. If the word *infidelity* did not evoke the memory of some action, the auditor would be likely to demand, "What infidelity are you talking about?" Likewise, the word *trust* evokes nothing visual, but it refers to a subjective state that the auditor is familiar with and can imagine. As we have seen, concrete structure, spatial location, metaphorical verbs, and even subjective experience are routine elements of abstract sentences despite their seeming imperceptibility, all suggesting that language began naming concrete things and then began using the further powers of attention described in section 2.

Another objection to the hypothesis that topics build on perception proposes an alternate source of topic content: innate concepts. Proponents differ, of course, in their details, but the chief proposition is that there is a language of thought (call it *mentalese*) and spoken language is a translation of mentalese. Stephen Pinker (2007, p. 91) explains that "word meanings are represented in mind as assemblies of basic concepts in a language of thought." In some ways the mentalese theory fits perfectly well with the one put forth in this chapter: the content of a topic depends on the union of innately perceptible relationships (case) with sensory inputs. But mentalese advocates say that all verbal statements are the computations of a symbol processor, in which attention, sensations and perceptions have no role. The contents of mentalese topics are the logical deductions of mentalese concepts.

The problem with the mentalese theory is the same problem facing all theories in which minds are identical to computers. First, they cannot explain non-computational features of our mental output like scope, intension, or case. Nor can they explain oddities such as the insistence of organizing abstract concepts as spatial events. Certainly spatial organization is not required to process a symbol. Furthermore, they have nothing to say about perceptual experiences such as paying attention, visualizing an idea or sensations, let alone such problems as perceptual illusions and psychotic hallucinations. Also, the commonsense tasks that are easy for us are hard for computers, while the symbolic computations that are easy for

computers are hard for humans. Finally, mentalese theory offers no solution to the question Reboul (2010) raised: where do topics come from?

If as Pinker (2007, p. 259) says, "the human mind and commercial digital computers are two exemplars of the category 'computational system," then we might gain insight into the source of topics by asking how a computer generates a topic. However, computers only generate topics they are set to notice. A computer may have a sensor that detects when a computer network shows pre-defined signs of virus activity, but computers never inform another computer that it has seen a lot of interesting data lately about, say, Lawrence of Arabia. They do not wonder about the data, are not curious about the data, do not speculate about why they have been programmed to exchange this data rather than that data. Computers are not even aware of the fact that they carry data. In short, they pay no more attention to the electricity they carry than a doorbell ponders about who rings and who answers. Sensations, emotions, experiences… these things tell us what matters and guide us to the discovery of new topics.

4. WHY AN ATTENTION HIERARCHY EVOLVED

The absence of topic-sharing from all other species suggests there is some unique need in humans that led to the evolution of our ability to make such specialized use of our powers of attention. Of course, paying joint attention to diverse topics is not the only oddity of humans. We are also unusual for having white eyeballs, making it very easy to see just where our attention is directed. All apes, and most other animals, have black sclera. You cannot tell at a glance where they are looking. Chimpanzees will follow one another's gaze if they can (Tomasello, 2008), but those black eyes mean that when one chimpanzee notices some ripe berries in the distance, others are not so likely to see the momentary catching of the eye. Meanwhile, when something snares a human's eye, others immediately know and investigate the discovery.

Humans and chimpanzees both are interested in peeking at newborn babies when they arrive on the scene, but chimpanzee mothers guard their babies with a jealous eye and it will be many months before anyone else is allowed to put a finger on it. Humans are different. If somebody asks to hold a newborn, it is frequently allowed. In fact, the difficulties of human births being what they are, somebody other than the mother is likely to assist with the baby's delivery and hand the newborn to the mother. Humans also commonly share their meals, while other apes are not so generous.

The pattern is clear. Our nearest ape species are social, but humans have taken sociability two strides further and formed inter-dependent communities. By now, humans have depended on the group for so long that our ability to survive as individuals has atrophied. As a rule, weaned mammals left to their own devices have the instincts to grow into normally behaving adults, but weaned children are nowhere close to being prepared to behave as normal human adults. This difference is commonly explained by saying that culture has replaced instinct, but humans have many group-oriented instincts, including an urge to report their news (Dessalles, 2007), that other animals lack. This need to learn cultural identities, rules, and skills is illustrated by a unique life period, adolescence (Locke and Bogin, 2006).

Puberty for other mammals is the start of adulthood. Among humans puberty is followed by a time of group initiation, training and practice.

Taken together, these traits suggest humans have a rare evolutionary history. Most species have traits that support them individually and, presumably, have been selected at the individual level, but humans suggest something else. Many of our genetic traits appear to support groups and, thus, have been selected at the group level (see e.g., Michod, 1997; Traulsen and Nowak, 2006; Wilson and Wilson, 2007). Most of the adaptations that fit the individual to a particular environment are culturally controlled, turning the members of different cultures into what Lorenz (1966) called pseudo-species.

Another bit of evidence for group-level selection is, paradoxically, human individuality. Selection at the individual level promotes similarity as each member of a species tries to maximize the fitness of each trait. A trait that varies from the standard is usually harmful and is selected against. However, just as multicellular organisms benefit from having cells develop into different organs, human groups can benefit from a range of skills, talents, and interests, so that different group members can be called upon as needed. It is reasonable to suppose that it was competition between populations (pseudo-species) that brought the complex acquisition of ways to contemplate topics.

A striking oddity of the *Homo* lineage is the way its early tendency to branch out failed, leaving only *Homo sapiens*. We are the most successful primate lineage and have adapted to an enormous range of habitats, but instead of ever-more branching, we have thinned our species down to one. Pseudo-species do the local evolving, and they can adapt to new habitats in a speed that no genetically-based true species could manage. A child born to one pseudo-species but raised by another becomes the other, leaving the culture of its genetic parents behind.

Language's cultural evolution continues to this day, and there may be some slower-paced biological evolution as well. There is evidence of a relatively recent change in the brains of some groups that works against the survival of tonal features in language (Dedieu and Ladd, 2007). The critical point about all of this evolution of our biological support for language is that selection was probably always at the group level. Changes begin in individuals so it is tempting to look for reasons for selecting the mutation at the individual level; however, it is difficult to demonstrate that verbal fitness is correlated with reproductive fitness.

A possible mechanism begins with a mutation that includes the potential for increased linguistic benefits. At first the mutation is not negatively selected. Eventually, possibly as the result of drift, a significant percentage of the population has the mutation and its effect on a particular language becomes apparent. Dedieu and Ladd (2007) have shown that at least some features of a language can be standardized without all members of the speaking population possessing the gene that supports the linguistic feature.

Apparently the brain is plastic enough to adapt to cultural features. Once the feature is established in a population it becomes an element in the group's competition with other groups. At this point the trait becomes a candidate for positive selection. If the linguistic trait increases the group's ability to perform tasks collaboratively, it can be expected to eventually replace the group that does not support this feature.

An example of such a process might be a gene that enhances working memory. It might carry some general intelligence benefits that at least mitigate against negative selection, but cannot have much effect on the language because, as of yet, there is no cultural pressure to support the gene.

At worst the gene might lead the bearer to overtax the working memory of his peers and reduce his communicative success. Only when chance has spread the gene to enough of the population members for an increased attention span to benefit communication will the gene begin to be positively selected. Cultures able to use the stronger attention span will out-compete populations that cannot discuss topics as deeply.

A contrary theory of selection comes from Chomsky (2007, p. 22). He argues that "language evolved, and is designed, primarily as an instrument of thought." Chomsky never uses the term "mentalese," but it is a similar concept. A mutation rewires the brain and "The individual so endowed would have had many advantages: capacities for complex thought, planning, interpretation, and so on." Later on an "interface" evolved that enabled these superior thinkers to "externalize" (i.e., speak or sign) their thoughts.

This chapter has already considered some of the problems with mentalese. Chomsky's theory adds problems of selection. Selection, not mutation, is the cause of genetic shifts. Mutations occur all the time and most are discarded because they reduce fitness. Neutral mutations may survive a while due to drift and result in some discernible variety of species. If all it took for linguistic thought to evolve was a mutation to the brain's wiring, there should be plenty more animals thinking linguistically. Thus, we cannot expect that the mutation Chomsky proposes was the first time the mutation occurred. It would have been just the first time conditions were right for the mutation to be selected. Chomsky simply assumes there was a benefit, and that selection took place at the individual level where the newly wise thinkers prospered at the expense of their more foolish neighbors. There must be more to the selection process than that. If there was a race to be the most intelligent primate in a troop with no greater community instincts than those enjoyed by a chimpanzee or bonobo, it is hard to see why those apes do not chatter right along side of us.

5. TOPICS AND AMBIGUITY

There remains much empirical work to be done to explore the details of how verbal interactions reflect the attention hierarchy. This section, however, will limit its suggested further work by focusing on topics and ambiguity. This chapter has asserted that human language can be ambiguous and still succeed. The topic itself resolves ambiguities, but a full understanding of how such resolutions are accomplished requires a much more detailed investigation.

Pinker (1994), for example, includes an amusing discussion of all the ways the expression *Time flies* could be interpreted, and raises the question of how we know what the phrase means. Part of the answer, of course, is that it is a cliché we have heard all our lives. Yet a person ignorant of the cliché can still understand it. How?

(18)

a. *Marsha:* Jorge and Penelope have been married for eight years now.
b. *Harry:* Really. Time flies.
c. *Marsha:* You mean you've known about this?
d. *Harry:* You mean you *didn't* know?

We can imagine a conversation in which Marsha utters sentence (18a) and Harry replies with (18b). How is Marsha to understand the response? It makes sense as a metaphor in response to the "eight years now." So, from Harry's perspective, the topic is the amount of time the couple has been wed.

Marsha will have no trouble understanding the reply if the eight years was the reason for the original sentence. But suppose Marsha was speaking because she knew nothing of the wedding and was amazed that it could be kept a secret for so long. It might then take Marsha extra time to grasp Harry's meaning and respond with (18c). Now it is Harry's turn to be surprised and speak (18d). This dialog has one topic running through it: Jorge and Penelope's marital state. But each speaker in turn responds to that topic in terms of their own perspective on what the other has just said. Each remark moves the conversation further from the declared topic.

How far can speakers move from a declared topic and still understand one another? If this chapter is correct in proposing that topics are the key to resolving ambiguities, it should follow that the further a response strays from an overtly stated topic the more difficulty a listener will have in resolving the ambiguity of whatever was said. This difficulty might reveal itself in the time it takes to respond to a reply. For example, if (18b) responded to precisely the point Marsha intended, the remark would presumably be understood more rapidly than would be the case when (18b) is an unexpected reaction.

Or suppose that Marsha responded to (18b) even more remotely from the declared topic. She might say, "Oh, I seem to be left out of everything!" Her line of internal reasoning might have gone: *Time flies? Oh, Harry knew all along they were married.* And then Marsha gives voice to the sense of isolation that (18b) evokes. If Harry is able to grasp Marsha's line of reasoning, (18d) is still a relevant response. If not, a better reply might be, "What do you mean?"

It seems likely that we could gain a good sense of how topics keep sentences coherent by studying conversations and noting the time between responses, determining if there is a relation between length of pause before making an apt response and the overtness of the topic. How far from the declared topic can a speaker stray before an auditor asks, "What do you mean?"

It should also be possible to develop data on the effects of simple versus complex utterances. A phrase might keep the topic focused, but cause puzzlement. For example, a phrase like "pouring cats and dogs" might make a response about the weather more likely than a whole sentence like, "Jack reports that it's pouring cats and dogs all over town." The sentence might be as likely to inspire a comment about Jack as about the weather. On the other hand, a simple phrase might provoke a response, "What about pouring cats and dogs?"

Another question is whether ambiguity is more easily resolved at the lower levels of the attention hierarchy. Do people have an easier time following sentences about concrete events than they do abstract concepts? If yes, do they find it easier to follow abstract concepts if the language used is richer in spatial language and metaphors? When discussing ritual-based relationships is there a difference in the ability to follow language richer in references to the visible basis of the ritual, or is it sufficient to simply assume the relationship?

Still another issue is language differences. Do speakers of different languages have equal facility using different levels of the attention hierarchy? If not, do the differences reflect cultural differences or do they tell us something about a particular language?

Once we establish norms for resolving ambiguities at various levels of the attention hierarchy, we can consider diagnosis and treatment of language difficulties. Are there people with specific difficulties at following language? For example, patients diagnosed with autistic spectrum disorders might show a variety of measurable differences in their ability to follow a conversation, based on the demands placed on the attention hierarchy. Do people with little empathy have a hard time keeping up with the way conversational topics stray? What do differences in people's abilities to stay on topic tell us about differences in their powers of attention?

CONCLUSION

The evolution of language began with the motivation to work collaboratively. Apes are social, but their motivations and instincts are mostly self-oriented. They do not trust one another enough to allow troop members to hold their infants or even to make it easy for others to follow their gaze. But once human ancestors became collaborative, sharing information became natural.

In language, speakers and auditors pay joint attention to topics, which need not be perceivable, but utterances must always be organized as though talking about a concrete, sensible perception. Both speaker and auditor bring their ability to focus attention on what they perceive to the task of communicating. The properties of case, intension, and scope are found in all languages and are fully translatable when used in concrete sentences.

Linguists have traditionally limited their inquiry to the utterances of the speaker. Behaviorists, who dominated the decades immediately before Chomsky, assumed that all the information needed to understand an utterance was in the signal itself (e.g., Skinner, 1957). Chomsky (1959) disproved that claim and redirected linguistic theory to consider the process of generating the signal. The signal's topic remained outside the scope of study; however, it requires the whole linguistic triad to understand the nature of language. Language studies trip into paradoxes when they overlook the role of topics.

This chapter has proposed that language be understood by looking at how it directs the speaker and auditor's joint attention toward a topic. Once the motivation to share perceptions appeared the next evolutionary phases expanded our powers as shown in Table 1.

This hierarchy of powers likely took thousands of generations to evolve, and - as the hierarchy is universal among *Homo sapiens* - the supporting genes must have been fixed in the population by the time of our last common ancestor.

The hierarchy puts us in a better position to understand the oddities of many sentences. Chomsky (2007, p. 21) says that verbal "communication is a more-or-less affair, in which the speaker produces external events [speech sounds] and hearers seek to match them as best they can to their own internal resources."

(19)

a. Two classes of justice present themselves in the law.
b. Look at those two attorneys whispering in court.

Table 1. Hierarchy of Attentive Powers

Rank	Biological change	Behavioral Result
6	Hypothetical emotional circuit	Attend to cultural symbols
5c	Hypothetical metaphorical circuit	Attend to substitute
5b	Hypothetical emotional awareness circuit	Attend to subjective reference
5a		Attend to imaginary reference
4	Working memory	Can follow a topic and subtopic
3	Integrative circuit	Use complete sentences
		Coordinate joint attention
2	Anterior attention circuit	Detailed attention to changes
1	Posterior attention circuit	Reflexive attention to stimuli

Chomsky's description works very well in the case of (19a). The abstract nouns, metaphorical verb, and locative structure all force the auditor to focus their attention on imaginary points and substitute actions. But Chomsky's definition is overly broad when it comes to (19b). There the speaker and auditor are looking at something in front of them. By understanding the way (19b) directs attention to topic (*two attorneys whispering…*) and location (*…whispering in court*), we are in a much better position to understand why there *must* be a metaphor and a locative phrase in (19a).

The hierarchy of powers also makes it easier to understand the paradoxes of verbal references. It might seem plain commonsense to say that words refer to things out there in the real world.

(20) Pegasus does not exist.

A classic example like (20) shows the problem. If words refer to things out there and Pegasus is not out there, how can there be the word *Pegasus*? The same problem lies in the word *exist*. Everything out there exists, but is existence out there? If *yes*, then what is it? If *no*, how can the word *exist* exist? (K. Bach, 1987)

A similar problem arises in the study of perception. Naïve thinkers assume that what we perceive is "out there" in the real world, but perception actively interprets inputs and is full of false identifications and illusions. Dreams and hallucinations are familiar examples of perceptions with no external stimuli at all (L. Ross and Ward, 1996). Only the simplest of topics is so concrete as to refer solely to what lies out there beyond speaker and auditor. Language allows paying attention to imaginary objects and metaphorical actions as long as they are presented in perceptual terms.

Finally, it was long supposed that language was flexible enough to express anything, and that individual languages could be infinitely different from one another. This assumption proves not to be true. The linguistic triad prevents speakers from straying too far from the contemplation of topics, but within that function we can be as creative and coherent as our collaboration can take us.

REFERENCES

Aboitiz, F. and Garcia, R. (2009). Merging of Phonological and Gestural Circuits in Early Language Evolution. *Reviews in the Neurosciences*, 20, 71-84.

Austin, J. L. (1962). *How to Do Things with Words*. Cambridge, MA: Harvard University Press.

Bach, K. (1987). *Thought and Reference*. Oxford, UK: Oxford University Press.

Baddeley, A. D. and Hitch, G. J. (1975). Working Memory. *The Psychology of Learning and Motivation*, 8, 47-89.

Bickerton, D. (1995). Language and Human Behavior. Seattle: University of Washington Press.

Bolles, E. B. (2011). *Babel's Dawn: A Natural History of the Origins of Speech*. Berkeley: Counterpoint Press.

Carruthers, P. and Smith, P. K. (eds.) (1996). *Theories of the Theory of Mind*. Cambridge, UK: University of Cambridge.

Chomsky, N. (1959). A Review of B. F. Skinner's Verbal Behavior. *Language*, 35, 26-58.

Chomsky, N. (2005). Three Factors in Language Design. *Linguistic Inquiry*, 36, 1-22.

Chomsky, N. (2007). Of Minds and Language. *Biolinguistics*, 1, 9-27.

Dawkins, R. and Krebs, J. B. (1978). "Animal Signals: Information or Manipulation". In: J. B. Krebs and N. B. Davies (Eds.), *Behavioral Ecology: An Evolutionary Approach*. Malden, MA: Blackwell Scientific Publications, 282-309.

Dedieu, D. and Ladd, R. (2007). Linguistic Tone Is Related to the Population Frequency of the Adaptation Haplogroups of Two Brain Size Genes, ASPM and Microencephalon. *PNAS*, 104, 10944-10949.

Dessalles, J. L. (2007). *Why We Talk*. New York: Oxford University Press.

Evans, V., Bergen, B. K. and Zinken, J. (2007). "The Cognitive Linguistics Enterprise: An Overview". In: V. Evans, B. K. Bergen and J. Zinken (Eds), *The Cognitive Linguistics Reader*. London: Equinox Publishing, 2-36.

Fitch, W. T. (2010). *The Evolution of Language*. Cambridge, UK: Cambridge University Press.

Hart, W. D. (1970). On Self-Reference. *The Philosophical Review*, 7, 523-528.

Hauser, M., Chomsky, N. and Fitch, W. T. (2002). The Faculty of Language: What Is It, Who Has It, and How Did It Evolve? *Science*, 220, 1569-1579.

Hopkins, W. D., Russel, J., McIntyre, J., and Leavens, D. A. (2013). Are Chimpanzees Really So Poor at Understanding Imperative Pointing? Some New Data and an Alternative View of Canine and Ape Social Cognition. *PLOS One*, 8.11: e79338.

Lakoff, G. (1993). "The Contemporary Theory of Metaphor". In: A. Ortony (Ed.) *Metaphor and Thought*, 2nd edition. Cambridge, UK: Cambridge University Press, 202-251.

Lakoff, G. and Johnson, M. (1980). *Metaphors We Live By*. Chicago: Chicago University.

Leavens, D. A., Hopkins, W. D. and Bard, K. A. (2005). Understanding the Point of Chimpanzee Pointing: Epigenesis and Ecological Validity. *Current Directions in Psychological Science*, 14, 185-189.

Locke, J. L. and Bogin, B. (2006). Language and Life History: A New Perspective on the Development and Evolution of Human Language. *Behavior and Brain Sciences*, 29, 259-280.

Lorenz, K. (1966). *On Aggression.* Trans, M. Latzke. London: Methuen.

Marcus, G. (2008). *Kluge: The Haphazard Construction of the Human Mind*. Boston: Houghton Mifflin.

Michod, R. E. (1997). Cooperation and conflict in the evolution of individuality: 1. Multilevel Selection of the Organism. *American Naturalist*, 607-645.

Mundy, P., Card, J. and Fox, N. (2000). Fourteen-month cortical activity and different infant joint attention skills. *Developmental Psychology*, 30, 323-338.

Mundy, P. and Newell, J. (2007). Attention, Joint Attention, and Social Cognition. *Current Directions in Psychological Science*, 16, 269-274.

Palmer, S. E. (1990). Modern Theories of Gestalt Perception. *Mind and Language*, 5, 289-323.

Panksepp, J. (2005). Affective consciousness: Core emotional feelings in animals and humans. *Consciousness and Cognition*, 14, 30-80.

Piattelli-Palmarini, M. (2008). Novel Tools at the Service of Old Ideas. *Biolinguistics*, 2, 237-246.

Pinker, S. (1994). *The Language Instinct*. New York: William Morrow and Company.

Pinker, S. (2007). *The Stuff of Thought: Language as a Window into Human Nature*. New York: Viking.

Pinker, S. and Bloom, P. (1990). Natural Language and Natural Selection. *Behavioral and Brain Sciences*, 13, 707-784.

Posner, M. and Rothbart, M. (2007). *Educating the Human Brain*. Washington, D.C.: American Psychological Association.

Pulvermüller, F., Härle, M. and Hummel, F. (2001). Walking or Talking? Behavioral and Neurophysiological Correlates of Action Verb Processing. *Brain and Language*, 78, 143-168.

Premack, D. and Woodruff, G. (1973). Does the Chimpanzee Have a Theory of Mind? *Behavioral and Brain Sciences*, 1, 515-526.

Reboul, A. (2010). Cooperation and Competition in Apes and Humans: A Comparative and Pragmatic Approach to Human Uniqueness. *Pragmatics and Cognition*, 18, 422-441.

Ross, L. and Ward, A. (1996). "Naïve Realism in Everyday Life: Implications for Social Conflict and Misunderstanding". In: E. S. Reed, E. Turiel and T. Brown (Eds.), *Values and Knowledge*. Mahwa, NJ: Lawrence Erlbaum Associates Inc., 103-136.

Rundblad, G. and Annaz, D. (2010). The Atypical Development of Metaphor and Metonymy Comprehension in Children with Autism. *Autism*, 14, 29-46.

Skinner, B. F. (1957). *Verbal Behavior*. New York: Appleton-Century Crofts.

Tomasello, M. (2008). *Origins of Human Communication*. Cambridge, MA: MIT Press.

Traulsen, A. and Nowak, M. A. (2006). Evolution of Cooperation by Multilevel Selection. *Proceedings of the National Academy of Sciences*, 103, 10952-10955.

Treisman, A. and Geffen, L. (1967). Selective Attention: Perception or response? *Quarterly Journal of Experimental Psychology*, 19, 1-17.

White, L. (1940). The Symbol: The Origin and Basis of Human Behavior. *Philosophy of Science*, 7, 451-463.

Whiten, A. (ed.) (1991). *Natural Theories of Mind*. Oxford: Basil Blackwell.

Wiener, N. (1948). *Cybernetics; or control and communication in the animal and the machine*. Oxford, UK: John Wiley.

Williams, J. H. C., Waiter, G. D., Perra, O., Perrett, D. I., and Whiten A. (2005). An fMRI study of joint attention experience. *NeuroImage*, 25, 133-140.

Wilson, D. S. and Wilson, E. O. (2007). Rethinking the Theoretical Foundations of Sociobiology. *The Quarterly Review of Biology*, 82, 327-348.

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Chapter 12

THE SEMANTICS OF SENSOR OBSERVATIONS BASED ON ATTENTION

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ABSTRACT

Increasingly large amounts of data are being generated by technical sensors distributed in the human environment. However, a naked sensor value alone is meaningless. It lacks crucial meta-information, including the support and spatio-temporal resolution, and more generally the observation and interpretation process in which it is embedded. In order to make use of the wealth of knowledge underlying sensor data, information science faces the challenge of making this context explicit. In this chapter, we argue that there is a close correspondence between human attention and sensor observation in the sense of a technical metaphor, and that this analogy serves to explain how humans attribute meaning to technical sensor observations. The semantics of sensor observations can be described in terms of an attentional process in which a technical observer draws the attention of another observer to something. We argue that this analogy captures the observation context on a very general level and allows us to precisely define terms such as technical observation, time and space of measurement, resolution, in-situ and remote sensing. The approach may be used for sensor and data discovery as well as automated sensor classification.

1. INTRODUCTION

How can we know what a sensor is actually sensing? How can we know that a measurement is actually a measurement *of* something? At first sight, answers to such questions seem primarily of philosophical interest. Sensor and measurement technology is based on established scientific practice, and in contrast to philosophers, practitioners do not

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have to bother about the epistemological basis of their practice provided that it does what it should. At closer inspection, however, these questions reveal a practical problem. Understanding the meaning of a measurement or sensor value allows us to *compare* it in certain specific ways, as well as to *communicate* it, and thus to make use of it in technical applications across particular groups of practice (Probst, 2008).

The value of a measurement is a formal symbol, e.g., a number. Measurement values require a precise interpretation. This includes what we call the *observation context*, such as the *observed feature* (i.e., the object which has the measured quality), the *spatio-temporal resolution* (Degbelo and Kuhn, 2012), the *scale of measurement*, the *observation process*, as well as the *phenomenon* being sensed. As science requires inter-subjectivity, such an interpretation must be *reproducible* (Boumans, 2005). This means that different scientists need to come to equivalent results when interpreting numbers in a standard way.

Over hundreds of years, the sciences have established reliable routines of measurement which allow them to abstract away from this observation context. Tracing the establishment of a technical measurement term which is now taken for granted through the history of science, as was impressively done by Chang (2004) for the notion of temperature, can sometimes reveal surprising complexity. For example, keeping fix points of the temperature scale (e.g. 0 ◦C and 100 ◦C) fixed puzzled generations of researchers, since boiling points move with the change of environmental and pressure conditions. How can we determine fix points for defining a thermometer without already relying on this thermometer? In a similar way, one can ask what exactly establishes the observation context of a technical sensor without already relying on this sensor. Chang (2004) argued for a strategy of *mutual grounding*, where different sources of experience and measurement are coherently combined.

Science has developed highly sophisticated expert languages. However, the latter *require such routines to be already established*. For example, Newtonian physics requires that the terms space, time and mass are established in terms of measurement routines, in order for terms like mechanics, gravitation and electromagnetism to have any understandable meaning (Lorenzen, 1964). This, however, makes it difficult if not impossible to talk about the basis of measurement and sensing in the language of this science itself (Kamlah and Lorenzen, 1996). It also leads to the problem that scientists often have difficulties in saying precisely what these routines consist in, such that people from other disciplines could possibly know what they are talking about. We tend to forget that the foundations of scientific progress are based on culture, not nature (Kamlah and Lorenzen, 1996).

Information science is directly confronted with the consequences of this cultural obliviousness. In the age of the Web, information about measurements and sensors abounds and may offer a new way of doing science (Hey et al., 2009). However, the underlying cultural practices are usually not part of this information. Thus a user of the information is often left alone with the problem of guessing what was meant. In recent years, the problem of describing the semantics of sensors has gained attention (Sheth et al., 2008). It is part of a larger challenge of providing meta-data for scientific data management (Gray et al., 2005). However, as Corcho and García-Castro (2010) argue, it is still unclear how *abstraction and quality levels* of sensors should be described, and this includes, in particular, aspects of their observation context.

In this chapter, we propose to approach this problem from an unusual *human-centric* rather than a *techno-centric* view. This allows us to make explicit the underlying cultural techniques. For this purpose, we suggest to regard sensors and measurements as *extensions* of

human competences for observing the environment. The latter are based on *human attention*. To illustrate our approach, we use two examples throughout the paper.

Example 1: Temperature measurement. A temperature sensor has been installed, as part of a weather station, on the top of our institute. It follows the general conventions for measuring air temperature. The question is to what exactly the sensor raises attention, and this, in turn, relates to the question why it has been installed on top of our institute and what exactly is represented by a particular data set.

Example 2: Camera observations. Cameras are used to take pictures of remote scenes. They can move their focus and can be moved themselves. Describing the meaning of data produced by cameras, such as remote sensing data, involves understanding not only the light spectrum sensitivity of the camera but also its angle of view in time and space.

In the next section, we discuss background work. In Section 3, we present our main idea and introduce a sensor language which allows to distinguish basic notions of the observation context in terms of attention. In Section 4, we apply our approach to the sensor examples, before we conclude with an outlook in Sections 5 and 6.

2. FROM SENSOR TECHNOLOGY TO CULTURE AND BACK

In this section, we discuss related work on sensor semantics as well as on human attention with the goal of highlighting the cultural roots of technical observation. In doing so, our intention is not to deny or level the fundamental differences which exist between human-level observation and technical sensing, both regarding the (cognitive) sensing processes that are going on, as well as regarding the distinctively intentional behavior of human agents. Rather, we argue that the meaning of technical sensor measurements requires understanding the essential role of the "human in the loop".

2.1. Describing the Semantics of Sensor Observations

Originally, technical sensors were deployed for special application purposes, and those analyzing the data usually had precise knowledge about the sensing procedure and the context in which the observations were taken. With a growing amount of sensor observations available in the Web, the need for standardized meta-data and formalized semantics[1] of sensors and sensor observations became apparent, as the distance between those who collect the data and those who are using the data increases.

The Sensor Web initiative of the Open Geospatial Consortium (Bröring et al., 2011) aimed to address this issue by introducing a standard for the description of sensors, the Sensor Model Language (Botts and Robin, 2007) as well as the Observations & Measurements

[1] Note that the term "semantics" is not restricted here to the meaning of a linguistic utterance, but rather involves structured formal data among the symbols whose meaning is in question. Thus the term is used as in Information Ontology and Information Science.

standard[2] (International Standardization Organisation (ISO), 2011). However, these standards largely address interoperability of sensor observations on a syntactical level. The *semantics of observation data* and especially the observation context of sensors are not well captured (Probst, 2008).

The NASA SWEET ontologies[3] are basically taxonomies of observable phenomena. The relation of sensing devices to observable properties and observations is not captured therein.

The World Wide Web consortium initiated an incubator group for semantic sensor networks (SSN)[4] in order to develop ontologies for describing the capabilities of sensors and related observations. The group proposed the SSN ontology (Compton et al., 2012), which describes sensing procedures, their implementation in terms of sensing devices, and the observations generated by sensors. The ontology captures some of the observation context and comes closest to our approach.

However, there are general problems with all of these approaches. First, they describe the "carriers" of observed qualities in terms of so called "features of interest", i.e., objects whose qualities are being sensed. However, it is often unclear whether there is any corresponding object involved in a measurement. For example, think about the measurement of air temperature. There seems to be only a quality involved without any identifiable object. Furthermore, the approaches leave open what the spatial and temporal support is and how the spatio-temporal resolution of a measurement was generated. Support and resolution may not be associated with any object. We argue that this problem can be solved if we take into account the attentional focus as a carrier of information and as a spatio-temporal referent[5]. Current approaches also seem to conceive of the sensing process as a kind of simplistic unidirectional information flow from the environment (stimulus) to a device, rather than a result of environmental-human-technological interaction. As a particular consequence of this view, the approaches fail to capture *intention* ("Why is the sensor deployed at this location with this particular sampling rate?").

2.2. The Cultural Relevance of (Joint) Attention

Attention is the human capacity of bringing a certain aspect in the window of perception to consciousness. In order to understand the cultural relevance of this mechanism, one first has to understand what we mean by *window of perception* and by *bringing to consciousness*.

Recent cognitive research has widely converged to the view that perception is *unconscious* or *pre-conscious* to a large extent (Pylyshyn, 2007). This means that perceived phenomena as well as the embedding in their surroundings, e.g., moving objects in a visual field, are not a product of an abstraction from neutral sensor signals that humans are aware of, but rather a product of subconscious routines which *autonomously project* those phenomena into a signal background (Scholl, 2001). Through this very process (the precise working of which is still largely unknown), our perceived world, as a matter of fact, is not one of

[2] The Observations & Measurements standard has also been published as an ISO standard.
[3] The SWEET ontologies are accessible at http://sweet.jpl.nasa.gov/ontology/.
[4] http://www.w3.org/2005/Incubator/ssn/
[5] In addition to providing carriers of information, attention is also active in constructing information, due to its selective and reflexive character, compare Glasersfeld (1995). We focus in this chapter on the former aspect.

disturbingly neutral pixels or sensor signals, but one of *intuitively graspable phenomena* coming with *a multitude of stable perspectives* (Lehar, 2003).

In such a perspective, phenomena are circumscribed with respect to a background, in pretty much the same manner as Gestalt psychologists envisioned figures to be identified with respect to a *ground* (Köhler, 1992). We call background and foreground the window of perception. By moving the scope of our visual field, we move the ground, and with it, different figures are being reified subconsciously in the foreground.

Human attention allows to select from this window of perception in order to bring certain aspects to mind, just like an index (Pylyshyn, 2007). We can consciously *focus our attention* on either some of these phenomena[6], or to the background, or to arbitrary parts thereof, without spending any effort on consciously encoding sensoric properties. However, our attention is finite, and thus attentional foci are finite, too (VanRullen and Koch, 2003). Infinite space, in contrast, is an abstraction which may be based on our experience of repeatability of attentional focusing (Scheider and Kuhn, 2011).

The cultural relevance of this attentional mechanism is substantial. In a nutshell, it explains why humans can have different *perspectives* on a domain while at the same time being able to *share* them. It is this capacity for sharing perspectives by guiding human attention which enables humans to develop a natural language, and to play an active role in the establishment of its semantics.

Many authors have argued for basing human concepts and language on attentional perspective. According to linguists like Langacker (1987) and Talmy (2000), the mechanisms of scoping, scanning and focusing attention are basic for the semantics of nouns and verbs. Langacker (2005) suggested attentional behavior as basis for logic as well as linguistic meaning. Glasersfeld (1995, 1981) suggested reflexive human attentional behavior as a basic tool of conceptual construction. Carstensen (2007) based top-level ontological distinctions on attention. Marchetti (2006) proposed the research field of attentional semantics, which identifies human attention as the center point of semantics research.

Other authors have argued that attention is responsible not only for generating perspective, but also for sharing it, and thus for rendering meanings intersubjective[7]. The anthropologist Michael Tomasello investigates how humans are able to exchange perspectives and language across individuals and generations (Tomasello, 1999). It is the process of *joint attention*, he argues, which allows humans to effectively guide each other's attention.

Humans join their attention if they *mutually draw each other's attention to something in their perceptual window*. Drawing the attention is an atomic form of a *speech act*. It makes others aware of something in their perceptual window by overtly focusing on it or pointing to it. This requires interaction in a triadic manner (compare Figure 1). Two agents, one in the role of a *guide*, the other in the role of a *follower*, need to interact with each other and with some phenomenon in this way:

1. The guide needs to focus on a phenomenon and thereby prompts a following
2. The follower needs to perceive the guide focusing on something, and to understand this as a prompt to follow the guide's attention

[6] Some scholars think we can pay simultaneous attention to at most 4 phenomena (Pylyshyn, 2007).
[7] For a discussion of how this contributes to solving the problem of *semantic reference*, see Scheider (2012).

3. The follower needs to follow the attention of the guide with his own attention (based on visual or other clues).

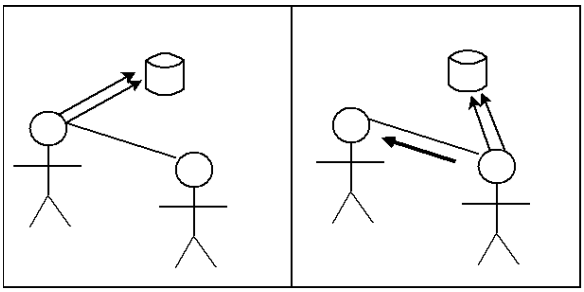


Figure 1. Two types of intentional interaction: following someone's attention to something (left, thin arrows) and drawing someone's attention (right, thick arrow) to something, cf. Tomasello (1999).

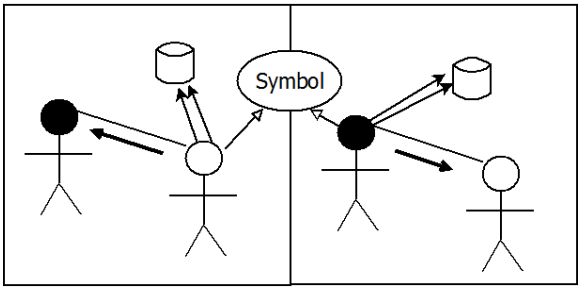


Figure 2. A speech act (symbol uttering) involves drawing the attention to something, cf. Tomasello (1999).

According to Tomasello (1999), if the two agents exchange roles in this interaction game, then they make each aware of the other's intentions towards the world. There is a considerable complexity hiding behind joint attention, as it requires not only attention perception and manipulation, but also *social coordination* (because of the exchange of roles) and *intentional understanding* (Kaplan and Hafner, 2004). The latter is needed because the perceived attentional act of the guide is understood by the follower as having the intention to guide his own attention, which, by recursion and through role exchange, leads to an arbitrarily complex chain of mutual awareness (Peacocke, 2005).

What is of interest here is how drawing attention supplies a basic pattern of a speech act which allows people to establish meanings and referents of symbols (Figure 2). We argue that it is exactly this pattern that allows humans not only to impute meanings to other observers, but, in a metaphorical sense, also to technical sensors.

2.3. Sensors as Artificial Limbs for Human Attention

Let us think for a moment about what technical devices exactly are. Technical devices allow *humans to do things they are not able to do without them*. That is, they increase the efficiency and range of human action. Think about Galilei's telescope, which allowed him to

distinguish the rings of Saturn (Eco, 2000), the microscope, which allows humans to see things that are too small to see for the human eye, or Wedgewood's pyrometer, which allowed for the first time to measure temperatures such as the melting point of iron (Chang, 2004). Technical devices are like artificial human limbs, as Eco (2000) argued. They extend the range of human action into unknown territory. This implies, however, that technical devices can be properly understood only in the context of human action. This insight sounds obvious, however, it has some not so obvious consequences.

The question arises what kinds of human action are extended by technical sensors. We suggest that humans *extend the range of their attention to something which is not directly perceivable*. This is the case for the image of the Saturn on the lens of Galilei's telescope (Eco, 2000), or the contraction of the pieces of clay after cooling in Wedgewood's pyrometer (Chang, 2004), which allows measuring the temperature they were exposed to.

The lens image and the clay contraction have a meaning only because they reflect something else, namely the Saturn or high temperature. In this, they are similar to *indexical signs*. However, they are special, since they stand for something which itself could not be a subject of perception of a human observer. At Galileo's time (1610), the rings of the Saturn were too remote to be observable. And very high or very low temperatures cannot directly be experienced by a human being. Which means, they are to some extent "invented" by humans (Chang, 2004).

Modern technical sensors encode their measurement results into symbols, which are automatically fed into the Sensor Web. We argue that also in this case, symbols get their meanings through extending human attention. This process may consist of various attentional processes and may involve several people, as we will see. In the following, we will analyze this process in detail and describe it in a formal model.

3. THE TECHNICAL EXTENSION OF HUMAN ATTENTION BY SENSORS

In this section, we will give the idea which was motivated in the last section a precise form. This allows us to specify the meaning of some central terms of the sensor observation context.

3.1. A Sensor Language Based on Attention

The formalism is written, implemented and tested in *Isabelle/HOL*[8], a typed higher-order logic (HOL) which allows for reasoning over functions. We adopted the notational style of Isabelle, since it follows ordinary conventions known from mathematics books, and thus should be readable. Furthermore, we also tested and proved all our theorems with Isabelle[9].

A theory in Isabelle consists of (1) declarations of (*basic*) *types* and *type definitions*, using type constructors such as *'a* ⇒ *'b* for function types and *'a set* for the type of sets with elements of type *'a*, with variables *'a*, *'b*, *'c* standing for some types. We also use *sum types* *'a* + *'b*, i.e., types that are the union of two other types. Sum types allow us to express a kind

[8] http://isabelle.in.tum.de/.
[9] http://www.geographicknowledge.de/vocab/attentionalmodel.thy.

of type hierarchy[10]. In this paper, types are written in uppercase letters. Theories furthermore consist of declarations of (2) *constants*, which include *functions* and *object constants* in lowercase. Declaring constant *c* or variable *v* to be of a certain type *T* is done using double colons, e.g. (*v* :: *T*) or (*c* :: *T*). *Predicates* are just functions that map into the predefined type *bool*, e.g., (*p* :: *T* ⇒ *bool*). Isabelle theories furthermore may contain (3) *non-recursive definitions*, which are introduced in this paper by the numbered Definition environment with the symbol ==, as well as (4) *axioms* as arbitrary sentences in HOL. For the latter we use the numbered Axiom environment.

f a means applying function *f* to *a*. *ιx.P x* denotes the unique *x* that satisfies the predicate *P*. Functions are always *curried*, i.e., function domains are written as a (right-associative) concatenation of functional types:

(((f :: *'a* ⇒*'b* ⇒ *'c*)(a :: *'a*) :: *'b* ⇒*'c*)(*b* :: *'b*) :: *'c*).

Furthermore, in Isabelle, all functions are required to be total. Logical symbols are used in a common way.

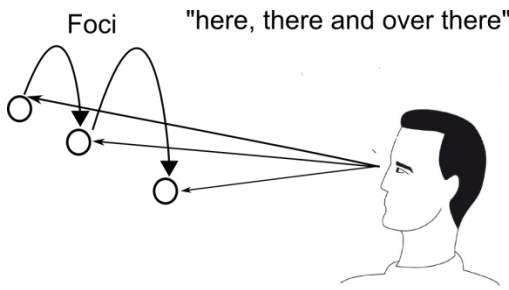
3.1.1. Attentional Focus and Agent

In a first step, we introduce the notion of a *focus*. In a standard sense, a focus is an entity which is generated by some human agent focusing his or her attention on something (compare Figure 3a). Humans move their attention, e.g., in correspondence with their saccadic eye movements to objects in their visual field, which generates granular entities which enter their consciousness (Pylyshyn, 2007). Humans can focus on their perceptual window as well as on abstract entities, such as the number 3 (not the symbol, but the mathematical entity). Following Langacker (2005), abstract entities are assumed to be located inside an *imaginary window*. Inside the perceptual window, one may focus either on some *phenomenon*, e.g., some perceivable object or event, or on some arbitrary spot which lies, e.g., halfway in space between two objects (Scholl, 2001).

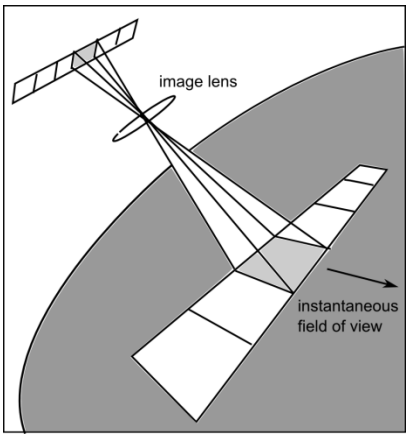
In a non-standard sense, however, a focus may also be interpreted as the focus of a sensor. This correspondence is illustrated by Figure 3b in terms of the so called *instantaneous field of view* (IFoV) of a remote sensor (satellite). The IFoV corresponds to the spatio-temporal focus of a single pixel in a satellite image, i.e., to some area on the ground and some time interval during which the sensor recorded surface radiation. In this case, we use the idea of an attentional focus *as a metaphor* (Lakoff, 1990). This means that we behave for a moment *as if* the act of attentional focusing could be played not only by a human being, but also by some technical sensor.

One may legitimately ask whether we confuse two incomparable processes here. As a matter of fact, human agents are not sensors. As argued above, attention is intentional behavior, directed towards objects which are subconsciously circumscribed against some perceptual background. Technical sensing, in contrast, is based on a simple stimulus response mechanism on signals. However, this just tells us that our metaphor should not be mistaken as identity of the underlying process categories.

[10] In order to simplify our syntax, we do not use any “upcasting” or “downcasting” sign for sum types.



(a)



(b)

Figure 3. A focus is an abstraction over foci of human attention and spatio-temporal sensor foci. In both cases, foci are results of a shifting observation process, which takes into focus a given excerpt of the environment at a given moment. (a) Foci of attention of some human observer. (b) Instantaneous field of view of remote sensor.

In order to understand what is going on here, we need to understand first how attention can be *metaphorically imputed* (by humans) to technical devices instead of humans. This imputation does not entail that process categories are identical, but rather that an observer is able to disregard the differences in favor of a certain view which helps handle and understand measurements.

3.1.2. Signs and Triadic Attention

For this purpose, we make precise the idea of a *sign* in terms of attention. In this paper, signs are perceivable phenomena which are capable of *drawing the attention* to some other thing[11]. As illustrated in Figure 4, this idea of a sign applies to a variety of phenomena, ranging from *pointings*, which are *speech acts* in a narrow sense of the word, to *formal symbols*[12].

[11] The referent of the sign. In distinction from objectivist philosophy, we do not hold that signs refer to or denote referents by themselves. Symbols do not mean, only people do. However, people do this indirectly, via drawing attention based on symbols.

[12] Peirce and many researchers in semiotics distinguished symbols (as formal signs), icons (which resemble what they stand for) and indexicals (which are similar to pointings) (Eco, 1977). We will not emphasize these distinctions here, and they are all compatible with our notion of a sign.

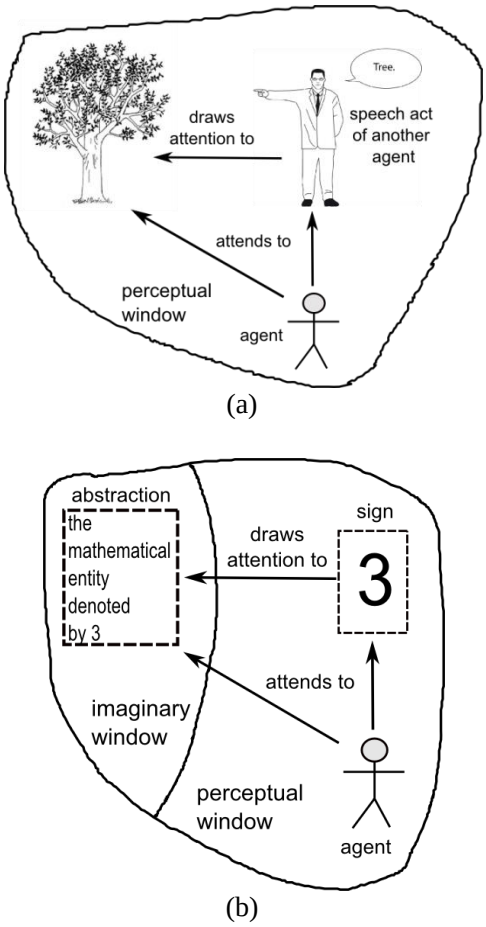


Figure 4. The correspondence of speech acts, such as pointings (German: Zeigen), and signs (German: Zeichen). (a) A speech act draws human attention to something else, e.g., to something in focus in the perceptual window. (b) Signs are capable of drawing human attention also to foci in an imaginary window.

In all these cases, we have an agent (the "follower") whose attention is drawn by the sign to something else, either based on conventional training in the case of a formal symbol, or by attentional following in the case of a perceived pointing. That is, we have a triadic relation between a *sign*, something to which it draws attention, and a follower who attends to both (Figure 4).

From the perspective of the follower (who is also an observer), the sign, i.e., the speech act or symbol, as well as the thing to which attention is drawn, are contained in his or her perceptual or imaginary window. That is, in any case, *it is a human observer who imputes the roles of the attentional triangle to perceived or imagined entities*. This corresponds to Peirce's dictum: "Nothing is a sign unless it is interpreted as a sign".

In order to formalize this basic idea, we make use of three formal types, namely *foci*, *phenomena* and *referents*, as introduced in Table 1 and Figure 5. Corresponding to the "follower" agent discussed above, we assume that there is an *(implicit) human observer* who

moves his or her attentional focus[13] on phenomena in the perceptual window as well as on technical abstractions in some imaginary window. Phenomena may be other human beings, technical devices, symbols as well as events. Technical abstractions may be the temperature denoted by 15 ◦C. Both remain undefined in our formalism[14].

Both abstractions and phenomena are also called referents, since they can be referred to by agents through focusing attention on them. We distinguish several *kinds of phenomena* on which one can focus, such as humans, devices, objects and events.

Table 1. Some formal types of an attentional theory of signs

Type	Description	Examples	Isabelle declaration
Focus	Foci of attention of an observer	here (now), there (then), …	*start* | *moveFocus Focus*
Phen	Phenomenon in the perceptual window of an observer	perceivable objects (humans, devices) and events	undefined
Referent	Type of things on which one can focus attention	Supertype of phenomena and technical referents. In contrast to perceivable phenomena, technical referents are abstractions, such as the temperature denoted by 15 ºC	*Phen* + *Technical*
Technical	Technical referent	See below	*Time* + *Location* + …
Time	Temporal referent	xsd:datetime, e.g., 2001-10-26T21:32:52	*rat set*
Location	Spatial referent	WGS84, e.g. 52º North, 7º East	(*rat* × *rat*) *set*

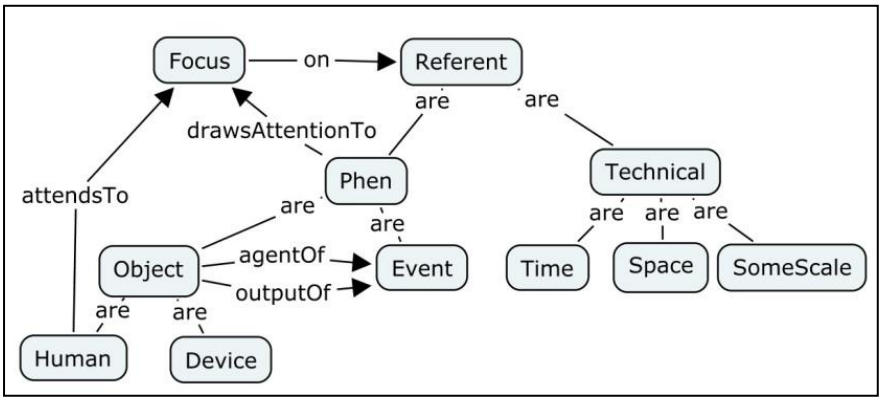


Figure 5. *Basic attentional model as RDF theory.* Arrows indicate domain and range restrictions on relations. The relation "are" links subclasses.

[13] This movement may be defined by a recursive type declaration, which constrains foci to be only those entities generatable by some recursive function *moveFocus*, which stands for the shifting of attention of the implicit observer.

[14] This acknowledges the fact that both Gestalt perception as well as technical referents are not reducible to a logical definition. For example, even though we may consider temporal referents in terms of rational numbers, these numbers involve a unit of measure (e.g. an hour) which is not logically definable.

Table 2. Relations between things in an attentional sign triangle

Declaration	Description
on :: *Focus* ⇒ *Referent*	Returns the referent on which a focus is "focused"
attendsTo :: *Phen* ⇒ *Focus* ⇒ *bool*	Phenomenon attends to some focus
drawsAttentionTo :: *Phen* ⇒ *Focus*	Returns the focus to which some phenomenon draws attention
agentOf :: *Phen* ⇒ *Phen* ⇒ *bool*	Phenomenon is an agent of some event
outputOf :: *Phen* ⇒ *Phen*	Returns the output of some event

An overview of all these concepts together with their relations is given in Figure 5. The figure is based on a simplified RDF[15] version of our theory.

We introduce now a small set of relations on instances of these types (Table 2), which a human can distinguish.

The function *on* returns for each focus some referent on which it is focused. We use a function because we assume there is always a unique thing of that kind[16]. We can now distinguish those foci of attention which are on perceptual phenomena (i.e., which focus on the perceptual window) from those focused on abstractions (i.e., which are inside some imaginary window):

Definition 1 (Perceptual).
(*Perceptual* :: *Focus* ⇒ *bool*) *f* == (∃(y :: *Phen*).*on f* = *y*)

The implicit human observer can also identify participants in an event. We distinguish two types of participants, namely the *agentOf* some event, and the *outputOf* some event. Agents are objects which play some active role in the event, while outputs are objects which are generated by the event.

attendsTo is a central relation in the sign triangle. It expresses that some object (in the perceptual window of the implicit observer), such as another human being, apparently *pays attention to some focus*. Note that this focus was actually generated by the implicit observer of the scene, not by the perceived object. However, *attendsTo* expresses that the implicit observer followed the attention of the object (e.g., the human gaze) and took the focus as that which the object apparently focused on. That is, *attendsTo* expresses an implicit *attentional following* of the observer, as described in the triangle of Figure 4a.

The most essential relation of this triangle is a function which is called *drawsAttentionTo*. It expresses that some sign draws attention to some focus (such that observers *are intended* to follow with their attention). The sign may be any kind of phenomenon, e.g., an object or an event. We use this relation to formally define signs below.

[15] Resource description framework, see http://www.w3.org/RDF/. Subclass hierarchies are easier to handle in RDF than in Isabelle, while Isabelle allows more expressive definitions. In this paper, we treat phenomenon superclasses as Isabelle types and phenomenon subclasses in terms of predicates. Thus our class hierarchy is not fully reflected in terms of Isabelle types.

[16] Note that there may still be several foci at a time. Foci are like "fingers on instantiations" (Pylyshyn, 2007).

We add some axioms which describe these relations in more detail. For example, only objects can attend to something[17]. Agents are objects which participate in events. Outputs are also objects. Furthermore, agents can draw attention to some focus only once, i.e., through a unique event. That is, there can be at most one drawing of attention of a certain agent to a certain focus. This assures that an observation of an agent is unique in space and time.

Axiom 1 (Attentional drawings).
attendsTo a b $\rightarrow$ *Object a*
agentOf ag e $\rightarrow$ *Event e* $\wedge$ *Object ag*
outputOf e = o $\rightarrow$ *Object o*
(*drawsAttentionTo e = drawsAttentionTo e'*) $\wedge$ *agentOf a e* $\wedge$ *agentOf a e'* $\rightarrow$ *e = e'*

Based on these primitive concepts, we can supply a definition of a sign. Remember that functions in Isabelle are total. Since *drawsAttentionTo* is a function, all phenomena draw the attention to something, whatsoever. How can we then distinguish signs from arbitrary phenomena? Simply by conceiving phenomena which are not signs as things which draw the attention (only) to themselves. Signs can then be defined as exactly those phenomena which *draw attention to something else* (i.e., as phenomena which are not self-referential):

Definition 2 (Sign). (*Sign* :: *Phen* $\Rightarrow$ *bool*) *s == on* (*drawsAttentionTo s*) $\neq$ *s*

We can go on now and define different kinds of signs, depending on what kinds of objects and events are involved in the attentional drawing. For example, one may define a speech act as an event sign (a sign which is a perceived action), and a speaker as a required agent of this event. We may define a symbol, in slight deviation from its usage in semiotics, as an object sign (a sign which is an object). Furthermore, we can define speech as a speech act with some output, and restrict this output to be a symbol, i.e., an object which is a sign itself.

Definition 3 (Speech and Symbol).
(*SpeechAct* :: *Phen* $\Rightarrow$ *bool*) *e == Sign e* $\wedge$ *Event e*
(*Speaker* :: *Phen* $\Rightarrow$ *bool*) *a* == ($\exists$*e.agentOf a e* $\wedge$ *SpeechAct e*)

(*Symbol* :: *Phen* $\Rightarrow$ *bool*) *e == Sign e* $\wedge$ *Object e*
(Speech :: *Phen* $\Rightarrow$ *bool*) *e == SpeechAct e* $\wedge$ ($\exists$*a.outputOf e = a*)

Axiom 2.
SpeechAct e $\rightarrow$ ($\exists$*a.agentOf a e*)
SpeechAct e $\wedge$ *outputOf e = s* $\rightarrow$ *Symbol s*

3.1.3. Observations

What does it mean that someone observes something? We suggest that observation is more complex than perception in that it requires also a communicative act. However, it is not

[17] In a less metaphorical setting, one could require that only humans can attend to something. However, we would like to impute attention to devices and thus need to leave this possibility open.

simply a drawing of attention to a certain spot in the environment. It also results in a report about *what* was observed, i.e., a symbol which itself draws attention to the observed referent. As depicted in Figure 4a, because of the triangular relation of signs, this implies that besides the implicit observer, there must be a perceived observer who draws attention to some spot in the perceptual window and at the same time utters a description which refers to some referent. In essence, observations are therefore utterances of symbols which are at the same time pointings to some perceptual focus:

Definition 4 (Observation).
drawing e f ag == (*drawsAttentionTo e* = *f* ∧ *agentOf ag e*)
obsdrawing e f ag r == (*drawing e f ag* ∧ *Perceptual f* ∧
on (*drawsAttentionTo* (*outputOf e*)) = *r* ∧ *r* ≠ (*outputOf e*))
observes ag r f == ∃ *e.obsdrawing e f ag r*
Observer ag == ∃ *f r.observes ag r f*
Observation e == ∃ *f ag r.obsdrawing e f ag r*

In this definition, *drawing e f ag* means that *e* is a "drawing", i.e., an event by which some agent *ag* draws attention to some focus *f*. An observation is a special kind of drawing which additionally refers to some (potentially abstract) referent *r* observed at some perceptual *f* by way of some symbol output. *observes ag r f* means that the agent *ag* observes referent *r* at focus *f*. Due to Definition 4, this simply means that there is a drawing to some perceptual *f* (*obsdrawing*) which at the same time generates some output which itself draws attention to some referent *r* (compare Figure 6). The agent is also called *observer* and the event is called *observation*[18]. The two implicit observers in Figure 6 are not part of the formalism and they may actually be the same person. The referent *r* needs to be different from the observation output, in order to prevent the production of symbols without meaning.

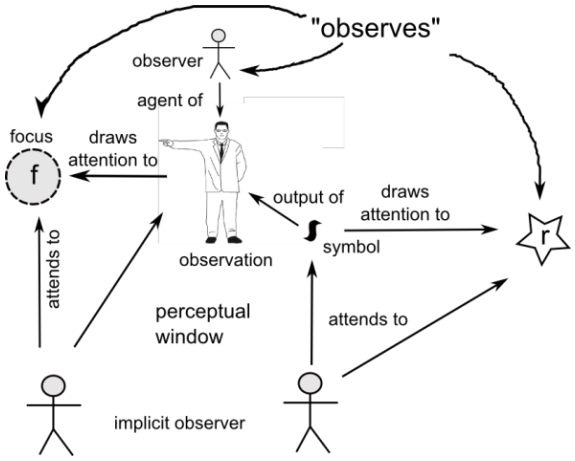


Figure 6. How observers "draw attention" in the course of an observation. An observation is an event (the pointing action) in which the observer participates, and which outputs a symbol.

[18] Note that the picture of the pointing man stands for an event, namely the pointing, not for the involved agent.

It can be proved now that if someone observes something, then there is always an observation event involved, as well as some symbol generated by that event:

Theorem 1. observes ag r f → (∃*e.Observation e*) ∧ (∃*s.Symbol s*)

Note that the observation event, in being a "drawing", may or may not draw attention to some other thing. In the former case, the event is a speech act, and thus we have actually two triadic sign relations involved, one for the symbol, and one for the speech act which draws attention to some spot, as depicted in Figure 6. The reason why we do not require this is that we would like to leave open the possibility of *self-referential observations*, i.e., observations of the observation itself (compare next section).

Furthermore, based on Axiom 1, it can be proved that an observer can observe at most a single referent at some given focus of attention:

Theorem 2. observes ag r f ∧ *observes ag r' f* → *r = r'*

This allows to uniquely identify the outcome of some observation, and thus to construct observation functions.

3.1.4. Technical Observation

Based on this formal apparatus, we can describe how humans extend their attention in the case of a technical measurement.

We know that a basic semantic capacity of humans is to apply roles to things for which they were not intended, in the sense of a metaphor (Lakoff, 1990). The double triangle of drawing attention, as specified above in our definition of what constitutes an observation (see also Figure 6), serves as an image schema (M. Johnson, 1987) which can be applied beyond its original realm. We simply assume that the implicit human observer applies corresponding observation roles to a sensing event instead of a human speech act. That is, even though a technical sensor in fact never intentionally *prompts* an attentional following, the implicit observer can act *as if* this was the case, regardless of whether the technical sensor actually has the capacity to do so. The usage of the word "observation" also for sensors in ordinary speech demonstrates that this metaphor is actually in common use.

The metaphor of attentional drawing of technical sensors is depicted in Figure 7. As in the case of a human observation, there are *two different drawings* involved. One is the *drawing of sensing results* (symbols) to some region on a measurement scale. Measurement scales are *abstractions* over experiential values of some phenomena, such as temperature. The other one is the *drawing of the sensing process itself* to its technical focus. While the former drawing is conventional, the latter drawing is based on visual cues of the sensing device and knowledge about the way it was constructed.

We define a measurement as an observation (as defined above) performed by some technical device which outputs some technical referent[19]:

[19] The definition actually requires the casting of type Referent to Technical in Isabelle. This is left out for reasons of better readability.

Definition 5 (Measurement).
measure d f r == *Observes d* (*r* :: *Technical*) *f* ∧ *Device d*
Measurement e == ∃ *f d r.obsdrawing e f d* (*r* :: *Technical*) ∧ *Device d*

measure d f r means that device *d* measured technical referent *r* at focus *f*. Measurements are the corresponding events.

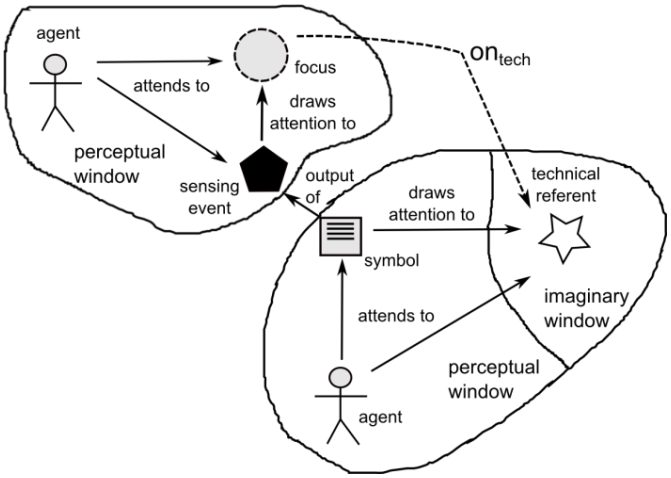


Figure 7. *How sensors "draw attention" in the course of a technical observation*. We propose that this double triangle also enables the metaphorical extension of human attention by sensors. We denote this by the relation on_{tech}.

We can also define a sensor, correspondingly, as an observer which is a device:

Definition 6 (Sensor). Sensor a == (*Observer a* ∧ *Device a*)

The definition of a measurement introduced above is dependent on a particular device. However, the usefulness of technical observation is based on its independence from particular measurement devices. This independence is a result of *calibrating* instruments with each other, which enables to regenerate equivalent measures across them. We can say that two devices are calibrated if they behave correspondingly on the (non-empty) subset of foci on which measures are taken[20]:

Definition 7 (Calibration).
(*calibrated* :: *Phen* ⇒ *Phen* ⇒ *bool*) *d d'* ==
(∀ *r r' f .measure r f d* ∧ *measure r' f d'* → *r* = *r'*) ∧
(∃ *r r' f .measure r f d* ∧ *measure r' f d'*)

[20] This is a simplified account. More sophisticated accounts would need to include a certain range of attentional overlap and some kind of theoretical correspondence between measured reference systems, compare Chapter 3 in Chang (2004).

Calibration introduces equivalence classes of instruments. We can therefore define a device-independent measure by the following relation, where δ stands for any member of such an equivalence class:

Definition 8 (General measure).
genmeasure δ *f r* == ($\exists$ *d.measure d f r* $\wedge$ *calibrated d* δ)

genmeasure δ *f r* means that referent *r* has been measured at focus *f* by some instrument calibrated with δ.

3.1.5. Extending Human Attention by Technical Observation

We have suggested above that technical observation involves more than just the production of measurement symbols by some device. It also involves two triadic sign relations, one relating the sensor focus with the measurement event, the other one relating the symbol output with its referent. How does this relation *serve to extend the attention* of an implicit observer?

The problem is that the referent measured by the device is an abstraction and thus cannot be in the perceptual window of the implicit observer. The focus of measurement can only be on perceptual phenomena. However, the observer behaves *as if* the perceptual focus was on the abstract referent.

In terms of our theory, we may say that the implicit observer constructs a new kind of technical *on* relation, which we call on_{tech}. Just as the *on* function, it returns the referent on which a focus is "focused". However, unlike *on*, it always points to a technical referent instead of a perceptual phenomenon. It is defined as the technical referent of some measurement focused on *f* using some device *d*, for example some calibrated thermometer *thermo*:

Definition 9 (attention extension).
on_{tech} *d f* == (ι *r.genmeasure d f r*)
on_{thermo} *f* == on_{tech} *thermo f*

3.2. The Sensor Observation Context

The apparatus introduced so far can be used to precisely define some basic notions of the observation context, namely time and location of measurement, resolution, as well as in-situ and remote sensors.

3.2.1. Time and Location of Measurement

Foci of attention can be regarded as a basis for referring to measurable space as well as time[21]. As Marchetti (2009) argues, they provide a non-circular account of time, because experiences of *succession* and *duration* are not attributed to some unobservable physical flow of time, but regarded as results of attentional activity.

[21] For an approach which demonstrates how spatial reference systems could be logically constructed based on attention, see Scheider and Kuhn (2011).

The absolute time underlying *temporal reference systems*, such as calendars and standard time, are results of *paying attention to standard periodic artificial or natural events and calibrating instruments based on them*. For example, the ticking of a clock can be used to infer times on foci of attention, based on paying attention to the number of ticks or hourly strikes.

Let us assume we conventionally establish a certain standard clock, simply called *clock*. Then each and every clock calibrated with the latter will generate "our" specific time. Abstracting from particular instruments, we can define our time as a function *when* from foci into temporal referents based on any clock calibrated by our *clock* standard:

Definition 10 (Time).
(*when* :: *Focus* ⇒ *Time*) *f* == (*ι* (*t* :: *Time*).*genmeasure clock f t*)

If we expand on this definition, then *when f = t* holds precisely because there is an (implicit) *ticking event* (i.e., the "observation" event required by Theorem 1) of *some* (*implicit*) *clock* (the sensor), which is calibrated with the standard *clock*. This event draws attention to *f*, which can in this case be considered on the ticking event itself (thus, the event is self-referential, as discussed in Section 3.1.3). The event has, furthermore, generated some symbol (such as "14:00") (according to Theorem 1) which draws attention to some temporal referent *t*.

If we measure a location by some device, such as a GPS receiver[22], then we proceed analogously. The device triggers an observation event (a so called "fix"), which draws attention to itself (i.e., it is self-referential), just as in the case of a clock. Simultaneously, the device outputs a coordinate, which corresponds to the point location of the fix event and is in some abstract spatial reference system, such as WGS84. Note that the location measured is the one of the fix event, not the device, since the GPS receiver may move (and thus change its location). GPS receivers also need to be calibrated against some standard *gps* in order to be useful.

Definition 11 (Location).
(*where* :: *Focus* ⇒ *Location*) *f* == (*ι* (*t* :: *Location*).*genmeasure gps f t*)

If we measure the time and location of a measurement (or observation), then we simply perform two further measurements which measure this event. Simply put, each focus on this event tells us something about when and where the measurement event happens:

Definition 12 (Time and location of observation).
timeofobs e t == ∃ *f* .*on f = e* ∧ *when f = t*
locofobs e s == ∃ *f* .*on f = e* ∧ *where f = s*

Note that the location of some object may require a different and slightly more involved observation process compared to the when and where of some focus. In particular, we expect that the location of some object and the location of some focus on the object are spatially related but different.

[22] http://en.wikipedia.org/wiki/Global_Positioning_System

3.2.2. Spato-temporal Resolution

We are now able to differentiate among the *time and location of some measurement* and the *time and location of the focus of measurement*. The latter may be considered a proxy measure of the resolution of data produced by the sensor[23].

The (spatio-temporal) resolution of a symbol *sy* may therefore be defined as the time *t* or location *s* of the focus to which the measurement event, which generated the symbol, draws our attention.

Definition 13 (Resolution).
$Resolution_{temp}\ sy\ t ==$
$\exists\ e\ f\ d\ r.outputOf\ e = sy \wedge obsdrawing\ e\ f\ d\ r \wedge when\ f = t$
$Resolution_{loc}\ sy\ s ==$
$\exists\ e\ f\ d\ r.outputOf\ e = sy \wedge obsdrawing\ e\ f\ d\ r \wedge where\ f = s$

Note that both, resolution and location of measurement, imply multiple events and devices, and, thus, also multiple corresponding attentional double triangles. In the case of resolution, these double triangles are linked via the focus of measurement, whereas in the other case, they are linked via the measurement event.

3.2.3. In-situ and Remote Sensors

Depending on the location of the measurement event which generates a symbol, compared to location of its technical focus, we can distinguish in-situ and remote sensors.

In a nutshell, in-situ sensing happens inside the location of the focus to which the event draws our attention. Remote sensing happens outside of this location, where insideness may be defined simply in terms of subsets of spatial coordinates:

Definition 14 (In-situ and remote sensing).
$InSituSensor\ d == Sensor\ d \wedge \forall\ e.agentOf\ d\ e \rightarrow (\forall\ s\ s'.locofobs\ e\ s \wedge$
$Resolution_{loc}(outputOf\ e)\ s' \rightarrow s \subseteq s')$
$RemoteSensor\ d == Sensor\ d \wedge \forall\ e.agentOf\ d\ e \rightarrow (\forall\ s\ s'.locofobs\ e\ s \wedge$
$Resolution_{loc}(outputOf\ e)\ s' \rightarrow \neg(s \subseteq s'))$

4. THE ATTENTION ANALOGY BY SENSOR EXAMPLES

We will illustrate all formal distinctions introduced above by two examples and show how the observation context can be inferred based on our definitions.

4.1. Cameras and Satellites

Analog cameras are devices which "observe" a visual layout by way of light exposure events. Each exposure event is a measurement in our sense (since it draws attention to some

[23] The terms support or grain may also be used as synonyms for resolution as described by Degbelo and Kuhn (2012).

illuminated layout and outputs a photo, which is a symbol in our sense), and it has a time as well as a location.

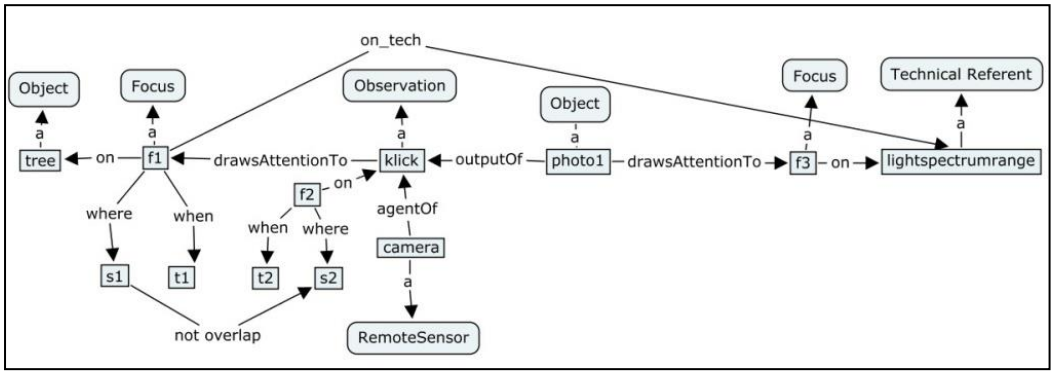


Figure 8. A formal model of a camera observation annotated with an RDF version of our theory.

The time is the time of exposure with light, and the location of the event is the location of the lens inside the camera. Modern cameras therefore have clocks as well as built in GPS devices. But cameras also have a focus, which corresponds to the spatial area taken into focus and is located beyond the lens. This focus is reconstructed by some implicit observer who notices the direction as well as the range of the camera focus. Cameras are therefore remote sensors. They may be mounted on some pole in order to change their field of view, or they may be moved around some spot in focus. In the former case, we move the focus while keeping the location of the camera (and thus, the location of measurement). In the latter case, we change the location of measurement, while keeping the location of the focus. For example, when we walk by a building and take photos of its front from different angles.

Satellites as well as modern digital cameras are slightly different, because they actually consist of thousands of sensors, several ones (one for a color spectrum) for each pixel. Each one of these sensors is a remote sensor. Together, they are like cameras whose exposure events are synchronized and whose foci are spatially configured in a grid. The *instantaneous field of view* (IFOV) is the angle of view of a single sensor. Multiplied by the distance to the reflecting surface during the exposure event, it allows estimating the spatial area of the *resolution cell*. It precisely corresponds to the spatial resolution of a single raster data item.

The abstract reference space to which the raster data sets draw our attention is an abstract space of intensities of light spectrum ranges or colors.

A formal model of this example annotated by an RDF version of our theory is depicted in Figure 8.

4.2. Temperature Sensors

Heat temperature sensors, such as thermometers, are devices which measure temperature at the spot where the sensor is located for a time interval defined by the temperature recording event, which takes place on the device. The focus to which this event draws attention is also exactly on this device, and thus overlaps with the location of the recording event. Temperature measurements are therefore in-situ observations.

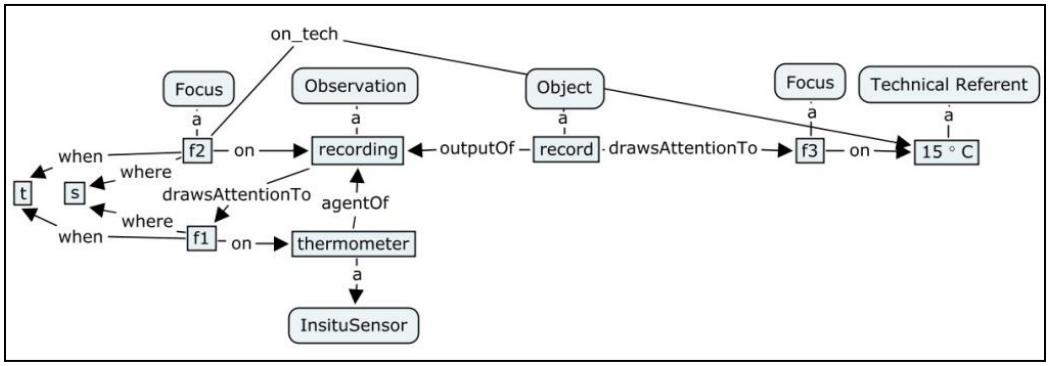


Figure 9. A formal model of a thermometer observation annotated with an RDF version of our theory.

In consequence, the spatial resolution of a temperature record is the location of the device during observation, and the temporal resolution is the recording interval, see Figure 9. The abstract space to which temperature measurements draw our attention is the space of a temperature scale, such as degree Celsius. Humans extend their sense of temperature by acting *as if* the focus on the device was actually on the referent of the temperature scale. Their normal sense of temperature, in contrast, is a perceptual phenomenon on which they can directly focus inside their window of attention.

5. Possible Applications and Future Works

The proposed vocabulary makes explicit the attentional processes and their participants involved in a sensor measurement. It enables to describe and document human as well as technical observation processes in a single approach. We see four major application areas:

5.1. Automated Classification of Data

The definitions introduced in this chapter can be used to automatically classify sensor data which was annotated using our vocabulary. Definitions describe the observation context of this data, such as observation, measurement, sensor, calibration, spatio-temporal resolution and support, as well as in-situ and remote sensors. They allow deciding, e.g., whether a data set was generated by a measurement using some sensor calibrated to some particular standard, what exactly its spatio-temporal resolution is, and whether a sensor is remote or in-situ.

In order to do so, definitions have to be translated into a form which allows computing classifications. This can either be done by translations into decidable language standards in the Semantic Web (Janowicz and Hitzler, 2012), or by providing some algorithm which does this on a case-to-case basis. Both can be considered future work. In Stasch et al. (2014), we have shown a way how data sets can also be classified based on underlying observation procedures, allowing to link data to appropriate analysis tools.

5.2. Sensor Discovery and Observer Description

Sensors are distributed over the environment but can be linked via common interfaces to the Web. Our vocabulary can be used to describe such sensors in great detail, e.g., regarding calibration standards, abstract reference spaces, technical foci and spatio-temporal resolution, as well regarding the location of observation events and sensors at different times. It could even be used to encode the devices used to measure space and time of some observation event.

The flexibility of using foci as referents with space and time extensions makes it possible to describe the movement of sensors as well as the moving of a sensor focus, e.g., the shifting of a camera focus. Analogously, one may describe attentional shifts and movements of human observers.

This flexibility allows discovering sensors on the Web based on their focus. An RDF version of our vocabulary may be used to annotate sensors and to perform queries, using standard linked data technology (Sheth et al., 2008). For example, one may search for sensors which are currently focused on a certain location in space or on some object.

5.3. Data Discovery and Comparison

Instead of annotating sensors, one can also annotate observation data with our vocabulary. One could state, e.g., that a certain data set is output of some observation event in which a certain sensor was involved which focused during that event on a certain location or on a certain object from a certain angle.

This allows comparing data not only based on the involved devices, but also in terms of the configuration of participants in observation processes. For example, one could find data which depicts a certain building from a single or from different angles at different times, using daylight or infrared lightwave spectrums.

5.4. Intention of Measurement

Making explicit the attentional process behind measurement is the first step in order to capture the intention of some scientist deploying some sensor on a specific spot of the environment (Couclelis, 2009). In future work, one may use our approach to describe the purpose of a measurement in this sense.

CONCLUSION

In this chapter, we have argued that the meaning of data produced by sensor technology can be described more adequately in terms of attentional processes, rather than technological ones. Based on the cultural relevance of joint attention, we have argued for the view that sensors can be regarded as artificial limbs for human attention. We have suggested that the technical extension of human attention by sensors is realized in terms of a metaphorical

schema. In this schema, an observation event draws the attention of some implicit observer, in a twofold triadic way, to the technical focus of its technical device as well as to some referent which is denoted by its symbol output. We formalized this schema in terms of a HOL theory, provided a simplified RDF version, and introduced formal definitions of calibration, attention extension, time and location of observation, spatio-temporal resolution and in-situ and remote sensing. We discussed these suggestions based on the examples of camera and temperature sensors. We furthermore sketched future research which may apply our approach to sensor and data discovery, as well as to automated classification.

REFERENCES

Botts, M. and Robin, A. (Eds.) (2007). OpenGIS Sensor Model Language (SensorML) Implementation Specification. OGC 07-000. Open Geospatial Consortium Inc., http://portal.opengeospatial.org/files/?artifact_id=21273. Accessed 22 March 2011.

Boumans, M. (2005). Measurement outside the laboratory. *Philosophy of Science*, 72, 850–863.

Bröring, A., Echterhoff, J., Jirka, S., Simonis, I., Everding, T., Stasch, C., Liang, S., and Lemmens, R. (2011). New Generation Sensor Web Enablement. *Sensors*, 11, 2652–2699.

Carstensen, K.-U. (2007). Spatio-Temporal Ontologies and Attention. *Spatial Cognition and Computation*, 7, 13–32.

Chang, H. (2004). Inventing temperature. Measurement and scientific progress. Oxford: Oxford University Press.

Compton, M. et al. (2012). The SSN ontology of the W3C semantic sensor network incubator group. *Web Semantics: Science, Services and Agents on the World Wide Web*, 17, 25-32.

Corcho, O. and García-Castro, R. (2010). Five challenges for the Semantic Sensor Web. *Semantic Web*, 1, 121–125.

Couclelis, H. (2009). The abduction of geographic information science: transporting spatial reasoning to the realm of purpose and design. *Proceedings of the 9th international conference on Spatial information theory, COSIT'*09, 342–356.

Degbelo, A. and Kuhn, W. (2012) A Conceptual Analysis of Resolution. XIII GEOINFO, Brazilian Symposium on Geoinformatics, Campos do Jordao, 11–22.

Eco, U. (1977). Zeichen. Einführung in einen Begriff und seine Geschichte. Frankfurt am Main: Suhrkamp.

Eco, U. (2000). Kant and the Platypus. Essays on Language and Cognition. London: Vintage.

Glasersfeld, E. von (1981). An attentional model for the conceptual construction of units and number. Journal for Research in Mathematics Education, 12, 83–94.

Glasersfeld, E. von (1995). Radical Constructivism: A Way of Knowing and Learning. London: The Falmer Press.

Gray, J., Liu, D.T., Nieto-Santisteban, M.A., Szalay, A.S., DeWitt, D.J. and Heber, G. (2005). Scientific data management in the coming decade. CoRR, abs/cs/0502008.

Hey, T., Tansley, S., and Tolle, K. (Eds.) (2009). The fourth paradigm. Data-intensive scientific discovery. Redmond, Washington: Microsoft Research.

International Standardization Organisation (ISO), (Ed.) (2011). ISO 19156:2011. Geographic information. Observations and measurements. International Standardization Organisation (ISO).

Janowicz, K. and Hitzler, P. (2012). The digital earth as knowledge engine. *Semantic Web Journal*, 3, 213–221.

Johnson, M. (1987). The Body in the Mind. The Bodily Basis of Meaning, Imagination and Reason. Chicago: The University of Chicago Press.

Kamlah, W. and Lorenzen, P. (1996). *Logische Propädeutik. Vorschule des vernünftigen Redens*. Stuttgart, Weimar: J.B. Metzler.

Kaplan, F. and Hafner, V. V. (2004). The challenges of joint attention. *Interaction Studies, 7*, 67–74.

Köhler, W. (1992). Gestalt Psychology. An Introduction to new Concepts in Modern Psychology. New York: Liveright.

Lakoff, G. (1990). Women, fire and dangerous things: What categories reveal about the mind. Chicago: Univ. of Chicago Press.

Langacker, R.W. (1987). Nouns and verbs. *Language*, 63(1), 53–94.

Langacker, R.W. (2005). "Dynamicity, fictivity and scanning. The imaginative basis of logic and linguistic meaning." In: D. Pecher and R. A. Zwaan (Eds.), Grounding Cognition. The Role of Perception and Action in Memory, Language and Thinking. Cambridge: Cambridge Univ. Press, 164–197

Lehar, S. (2003). The world in your head. A Gestalt view of the mechanism of conscious experience. Mahwah, London: Lawrence Erlbaum Associates.

Lorenzen, P. (1964). "Wie ist die Objektivität der Physik möglich?" In: P. Lorenzen, *Methodisches Denken*. Frankfurt a. M.: Suhrkamp, 142–151,

Marchetti, G. (2006). A presentation of attentional semantics. *Cognitive Processsing*, 7(3), 163–194.

Marchetti, G. (2009). Studies on time: a proposal on how to get out of circularity. *Cognitive Processsing*, 10, 7–40.

Peacocke, C. (2005). "Joint attention: Its nature, reflexivity, and relation to common knowledge." In: N. Eilan, C. Hoerl, T. McCormack, & J. Roessler (Eds.). Joint Attention: Communication and Other Minds: Issues in Philosophy and Psychology: Issues in Philosophy and Psychology. Oxford: OUP, 298-324.

Probst, F. (2008). Observations, measurements and semantic reference spaces. *Applied Ontology*, 3, 63–89.

Pylyshyn, Z.W. (2007). Things and Places. How the Mind Connects with the World. Cambridge, Massachusetts: The MIT Press.

Scheider, S. (2012). Grounding geographic information in perceptual operations. Vol. 244 of Frontiers in Artificial Intelligence and Applications. Amsterdam: IOS Press.

Scheider, S. and Kuhn, W. (2011). Finite relativist geometry grounded in perceptual operations. Spatial information theory: 10th international conference, COSIT 2011, LNCS 6899, 304–327.

Scholl, B.J. (2001). Objects and attention: the state of the art. *Cognition*, 80, 1–46.

Sheth, A., Henson, C., and Sahoo, S. S. (2008). Semantic sensor web. *Internet Computing, IEEE*, 12, 78–83.

Stasch, C., Scheider, S., Pebesma, E., and Kuhn, W. (2014). Meaningful spatial prediction and aggregation. *Environmental Modelling & Software*, 51, 149 –165.

Talmy, L. (2000). "The windowing of attention in language." In: L. Talmy (Ed.), Toward a Cognitive Semantics - Vol. I. Cambridge, Mass: The MIT Press, 257–309.

Tomasello, M. (1999). The cultural origins of human cognition. Cambridge, MA: Harvard University Press.

VanRullen, R. and Koch, C. (2003). Is perception discrete or continuous? *Trends in Cognitive Sciences*, 7, 207–213.

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