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Towards Cognitivist Ontologies

On the role of selective attention for upper ontologies

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Abstract Ontologies play a key role in modern information society although there are still many fundamental questions regarding their structure to be answered. In this paper, some of these are presented, and it is argued that they require a shift from realist to *cognitivist* ontologies, with ontology design crucially depending on taking both cognitive and linguistic aspects into consideration. A detailed discussion of central parts of a proposed cognitivist upper ontology based on qualitative representations of selective attention is presented.

Keywords attentional semantics · cognitive semantics · language and cognition · selective attention · upper ontology

1 Introduction

Ontologies as repositories of non-linguistic knowledge have become an important and even essential component of information systems during the past two decades or so. Cases in point are their utilization as a reusable, shared vocabulary in knowledge management (Gruber, 1995), as a reference for the annotation of content in the "Semantic Web" (Berners-Lee et al, 2001; Horrocks, 2008), and furthermore their role as a prerequisite for theoretical and practical progress in the field of computational linguistics/ natural language processing/ language technology (for example, in word sense disambiguation or machine translation). It might therefore be assumed that there is a firm body of methodological principles for the construction of ontologies, sufficient evidence for the efficacy of ontologies in language/information technology, and, above all, overall unanimity about what ontologies are. However, neither of these assumptions is justified.

First, there is a lack of common methodology in practical ontology development, which leads to deficiencies of proposed ontological resources and corresponding standards. For example, Smith (2006) shows in his harsh critique of the ISO Standard 15926 ("Lifecycle Integration of Process Plant Data Including Oil and Gas Production Facilities", a standard for data integration, sharing, and exchange between computer systems) that it violates as many as 14 principles of ontology construction.

Second, existing ontologies often cannot be used (easily) for language processing, because linguistically relevant ontological knowledge (structure) is missing (cf. Lang, Carstensen, and Simmons, 1991; Mahesh, Nirenburg, Cowie, and Farwell, 1996). This is an indication that aspects of language and cognition must not be neglected in the development of ontologies. Regrettably, however, even if there are –to some extent well-considered– ontological structures like DOLCE[1], it may nevertheless happen that some aspects of them are ignored in certain practical applications/contexts: "It was too difficult for ontology engineers to understand the intended meaning of these [DOLCE] terms and to classify their own [concepts] underneath them. Hence, we only kept [X and added Y ...]" (Oberle et al, 2007).

It seems straightforward –and is indeed common practice– to use linguistic taxonomies like Wordnet as a knowledge source, but Gangemi et al (2001b) prove that Wordnet cannot be exploited and/or used as an ontology without modification as it does not satisfy some ontological well-formedness criteria. In spite of these difficulties of using linguistic terminology for the construction of ontologies, however, exactly this is currently proposed as a new methodology (so-called "ontology learning from text") for populating ontologies (cf. Cimiano et al, 2010).

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[1] "Descriptive Ontology for Linguistic and Cognitive Engineering" (Masolo et al, 2003).

Third, there unfortunately is what can be called a *schism* in the understanding of "ontology". On the one side is the (traditional philosophical) view of ontology: "Ontology as a branch of philosophy is the science of what is, of the kinds and structures of objects, properties, events, processes and relations in every area of reality" (Smith, 2003, p.155). According to this *realist* view, one has to investigate the invariants of reality (so-called *universals*), which are denoted by general terms like "mountain", "ice" or "skiing", and the specific entities that instantiate them (so-called *particulars*).

In contrast to that, most of the work in information science is based on Gruber's definition of ontology as an "explicit specification of a conceptualization" (Gruber, 1995) and its use as a shared, reusable vocabulary in knowledge representation. In this "conceptualist" tradition, ontological types[2] seem to be more or less equivalent to "concepts" (even "linguistic concepts"), which are at least one step remote from reality (Carstensen, 2009).

Smith complains that "there occurs an insidious shift in focus: concepts themselves become the very subject-matter of ontology" (Smith, 2004, p.75), while it should be reality itself: "Good ontologies are *reality representations*" (ibid., p.80, his emphasis). His stance therefore seems to be in conflict both with the conceptualist view and language-based ontological engineering.

I clearly side with Smith in his criticism. But, as Gangemi et al (2001a) put it: "Is ontology about the 'real world' (as seen, say, by a physicist)? Or, rather, should it take cognition into account, including the complex interactions and dependencies between our ecological niche and us?".

While the authors explicitly avoid taking up a stance on this ("We will not attempt a general answer to this question") –although they tend to the latter option–, it will be argued in this paper that the realist view of ontology is not tenable on closer inspection, and that it has to be replaced by a "cognitivist" view which regards ontologies as reality representations *from human perspective* and is therefore in between the realist and conceptualist position. It will be shown that the cognitivist position is not only logically necessary but also in line with the constraints imposed by scientific evidence about language and cognition, and therefore sheds new light on (the structure of) ontologies and their role in language/information technology.

Carstensen (2007) introduced the idea that the qualitative representation of the working of selective attention provides the criteria for representing important aspects of what has been informally called *human perspective* and that it leads to domain-independent upper ontologies. This paper elaborates on that idea and gives a more detailed (and in part differentiated) picture of what will be called *cognitivist ontologies*.

[2] I will be using the term "type" here in the sense of what is called "property" in Masolo et al (2003).

2 Deconstructing Reality Representations

2.1 Are there Universals in Reality?

To question universals seems to be odd, as they are supposedly the prerequisites of secondary phenomena like the perception of or reasoning about reality. However, Gangemi et al (2001a) already discuss the notion of *constellation* and conclude that it should be regarded as a universal dependent on states of the mind ("cognitive entity"). A realist could react in two different ways to this challenge. Either he would simply agree by embracing all cognitive phenomena under "reality". Or he would deny that `Constellation` is a genuine universal and would call it a perceptually based human concept to be distinguished from real-world universals.

Both reactions are not satisfactory. Subsuming cognitive phenomena under the notion "real world" somehow blurs this very notion. Denying the status "universal" for some notion because it is perspective-based (although it has instances) overlooks the fact that by closer inspection many/most/all (?) alleged universals are based on human perspective. Just imagine a microscopic scenario: for a sub-atomic intelligence there would be no `Mountain`, `Ice`, or `Skiing` but instead other entities depending on its perceptual apparatus. Or think of mountains, whose existence is explicitly discussed in Smith and Mark (2003): Imagine a mega-giant for whom hills and mountains are just varying degrees of the earth's surface variation like for us are different wrinkles on a bed sheet. Or imagine a god-like creature for whom an era of our time scale is but a blink of an eye: it would not grant mountains the same status of 'universal' as we do but would rather view them as transitory stages of continuous surface transformation —just as we do not name the varying features of a calm lake's surface. And even if it did, the resulting ontological type would be different from `Mountain` (for example, it would have lost immobility). Note that although these are constructed examples, they show that the allegedly objective category 'universal' is ultimately a construct based on human perspective.

Another problem for real existing universals is the identity criteria for their existence and their mutual demarcation. For example, what is the demarcation line between mountains and hills (intensional demarcation)? Where is the border between spatial regions belonging or not belonging to some particular mountain (extensional demarcation)? If there is no clear-cut characterization of a particular (see also below), how can there be one for the corresponding universal? There is, therefore, some reason to doubt the existence of objective criteria. Instead, it is just the purpose and task of our perceptual/conceptual systems to impose discrete structure onto continuous aspects of the world for us to effectively act in it.

Finally, why should universals exist objectively anyway? Closer inspection reveals that their assumption is based on a human-cognition bias: our intellectual abilities are strongly dependent on abstraction and on categorizing perceptual input wrt. these abstractions. Now, imagine creatures with a very different mental apparatus. Assume that they do not store abstractions but instead reduced/compressed data sets of their perceptual input, and that they have corresponding procedures for the computation of similarities between these data. Assume further that they communicate not by naming categorized input (as we do) but by multi-frequency channelled data transmission. These aliens would perhaps behave like we do but would have no understanding of concepts, and no philosophical need either to distinguish between universals and particulars or to insist on their existence at all.

2.2 Are there Particulars in Reality?

To question particulars also seems to be odd at first sight, as everyone is able to identify Barack Obama as an instance of `Man` and the Matterhorn as an instance of `Mountain`. Yet we would have difficulties to draw the exact boundary between the Matterhorn and the adjacent Dent d'Hérens, to name but one example (not to mention the problem of our alien friends to understand the task at all).

If we look for "objective", i.e. non-cognitive realistic, criteria for particularhood, we run into Sorites-like paradoxes. Imagine a person whose body parts are substituted one after another by artificial limbs and organs (even parts of the brain). Is it the same particular person afterwards? If not, when does the change from one particular to another or from an instance of `Man` to an instance of `Robot` happen?[3]

Both decisions cannot be made inside the system (here: reality). Reality therefore does not provide particulars/ instances. Instead our cognitive machinery categorizes aspects of the world at different times as one instance of some type, or as *more than one* instance of possibly different types: "In short, our intuitions about the nature of persisting individuals may derive from the way we experience the world in terms of persisting individuals" (Scholl, 2007, p. 582).

It is interesting to note that the converse also holds: there are (constructed) situations in which two particulars from the point of view of a quasi-objective observer are treated/ perceived as *one* particular by some subject (if the elements are similar and their perception is close in time, so-called "repetition blindness", cf. Kanwisher (1987); see also Chun (1997) to the related "attentional blink").

[3] This scenario is taken from a short story of Polish science fiction author Stanislav Lem (1976), "Do you exist, Mister Johns?", German version "Gibt es Sie, Mister Johns?" in *Nacht und Schimmel*, Suhrkamp Taschenbuch Verlag, Frankfurt am Main. There are corresponding classical puzzles in philosophy, e.g. the "ship of theseus" puzzle of Thomas Hobbes cited in Scholl (2007).

2.3 Distinguishing *Endurants* and *Perdurants*

In DOLCE as well as in other foundational ontologies, there is a basic distinction between `Endurants` and `Perdurants`:

> Classically, *endurants* (also called *continuants*) are characterized as entities that are 'in time', they are 'wholly' present (all their proper parts are present) at any time of their existence. On the other hand, *perdurants* (also called *occurrents*) are entities that 'happen in time', they extend in time by accumulating different 'temporal parts', so that, at any time *t* at which they exist, only their temporal parts at *t* are present (Masolo et al, 2003, their emphasis)

While it is true that certain aspects of the world are differentially *characterized* as being of one or the other type, it is important to realize that there is not necessarily an **objective/real** difference.

There is a set of phenomena that exemplifies the difficulty for a realist dichotomy here. Consider temporally short events like light flashing in the sky (flash of lightning, falling star). Although they are unambiguously perdurants qua being light emitting physical processes, they seem to be *categorized* differently: While flashing/flashes of lightning can have a duration (*The flash lasted for 300ms*), falling stars apparently cannot (?*The falling star lasted for 300ms*; the German translation is out: **Die Sternschnuppe dauerte 300ms*).

Likewise, *persons* have temporal parts, and at any time *t*, one can either be a *baby* or an *old man*. On the other hand, something (like a lamp) *standing on the desk* is *wholly* present at any time which it is present. In other words, development over time is not an exclusive criterion of perdurants as trees and leaves grow and wither, and non-development over time is not an exclusive criterion of endurants as all states are characterized by it.

Yet there is a distinction to be drawn, of course, for example between `Person` and `Being a person`. However, this relates to how we perceive/view/conceptualize aspects of the world, and the question is what the criteria for this cognitive distinction are (cf. also Johansson 2005 for a critical discussion of the endurant/perdurant dichotomy).[4]

2.4 *Stuff*: A Realist's Riddle

It seems quite reasonable[5] to assume a type/universal `Stuff` (or `Substance`) with subtypes `Gold`, `Water` etc., which is distinct from the type `Object`. Both types are disjoint, i.e.

[4] Note also that while there seems to be a correspondence of endurants and their expression as nouns, and perdurants and their expression as verbs, there are also nouns expressing perdurants (*the last ride, too much riding* etc.).

[5] and is, in fact, common practice, cf. e.g. `www.opencyc.com`

a particular instance of one type is not instance of the other. The reason for this is that stuff entities are not countable ("masses"), but objects are. Note that countability co-occurs with **boundedness**: while **one water (in my cellar)* and **big water (in my cellar)* are ill-formed/inacceptable, *three* ***drops*** *of water* and *big* ***drops*** *of water* are well-formed/acceptable.

This scenario poses a problem for the realist ontologist, and, in fact, for existing ontologies. If ontology is perspective-less, then there is no difference between `Stuff` and `Object`, as everything is ultimately bounded (even all the gold or water in the universe). This is in conflict with the type distinction just described. Even if the distinction can be maintained, what would be an instance of `Stuff`? As a particular, it is supposed to be bounded and hence cannot be an instance of `Stuff` but must be an instance of `Object` instead.

What if, as an alternative view, `Stuff` is excluded from an ontology of particulars altogether? This view is clearly dismissed by Laycock (2005b): "[. . .] particularity, to the philosophical mind, tends to be associated firmly with objecthood. In fact, however, 'particularity' is just another word for 'thisness', distinctness or discreteness, the basis of our ability to identify [. . .]". The water denoted by *the water in my cellar* therefore must not only be regarded as an instance of `Stuff` (although it is objectively bounded), but also as an identifiable particular (although it is `Stuff`)![6]

Similar to the `Object/Stuff` distinction is the one between `Event` and `State`. Events (e.g., `Building a house`, `Reaching the summit`) are bounded eventualities/ situations, while states (e.g., `A window being open`) are nonbounded eventualities/situations. However, which state is –objectively– unbounded?[7]

2.5 Plurality (of events)

Evidently, parts of reality (e.g. some (arm)chairs, couches and tables standing around) sometimes can be linguistically addressed/expressed both by singular and plural reference (*these objects*, *this furniture*[8]*, this group of objects, this suite*). What does this tell us about reality and its representation? What does it mean to be a plural entity, and how and why can it simultaneously be (regarded as) a singular entity? (Realist) Ontology seems to be the wrong place when looking for answers to these questions. Correspondingly, ontologies more often than not are simply conceived as divisions of existing individuals into increasingly specific *domains* (e.g., the subclassification of `Entity` into `Physical` and `Abstract` in SUMO[9]).

But then, how do we distinguish, e.g., between instances of `Furniture` and `Suite` for a given situation? And how do we know where plural entities can appear (and where not)? For example, assuming that there are `Objects` and `Events` in our ontology, why can we talk about *three apples* (a set of instances of `Apple` with cardinality three) but not about **Peter three jumped/*Three Peter jumped/*Peter jumped three* (a set of instances of `Event of Peter jumping in the past` with cardinality three)?

3 What is a "Good Ontology"?

The main reason for Smith to insist on a realist position is the deficiency of existing concept-based ontologies, which leads him to propose to "talk not of *concepts* as linguistic or computer artefacts" (his emphasis) but of universals in reality. He states that "[i]ntuitively, a good ontology is one which corresponds to reality as it exists beyond our concepts" (Smith, 2004, p. 76). This, however, presupposes a structured reality and states that there is a –somehow magical– (analytical) link to its representation (which is required for the construction of ontologies). Both, presupposition and statement are denied here, based on the foregoing discussion.

As an alternative, a "cognitivist" view will be offered that combines different perspectives on ontologies. According to that view the real world exists ($\rightarrow$ realist position), but the objective categories assumed to structure the world do not. Instead they are constructed by the human's cognitive apparatus ($\rightarrow$ constructivist position) as abstract representations of reality. A "good ontology" then is one which carves *the cognitive processing of* nature/reality at its joints. Besides formal ontological considerations, a close look at how we express information linguistically provides an important source of information for establishing such "cognitivist" ontologies[10] – a view shared in the field of *cognitive semantics* (cf. Bierwisch and Lang, 1989; Dahlgren, 1995; Gärdenfors, 1999; Jackendoff, 1983; Lakoff, 1987; Lang, Carstensen, and Simmons, 1991; Langacker, 1987; Talmy, 2000).

Correspondingly, the approach closest to the view taken here is the DOLCE framework, which is described as having a *cognitive bias* (Masolo et al, 2003, p. 13) and which draws its evidence from both philosophical and linguistic considerations. DOLCE is an ontology of particulars whose types are constrained by a set of meta-properties (Guarino and Welty,

[6] The neglected role of `Stuff` in Ontology has been discussed in detail in the work of Henry Laycock, e.g., Laycock (1972).

[7] Note also that `TemporalStuff` can be linguistically expressed, e.g. *too much riding can cause severe back pain*, see also section 7.

[8] This translates to *diese Möbel* ('these [!] furniture') in German.

[9] Suggested Upper Merged Ontology, see `http://www.ontologyportal.org`

[10] Personally, I find "cognitive ontology" the better term (as in "Cognitive Science"). However, as it might be misunderstood merely as an ontology of psychological notions, I do not use it.

2000). It has proven its value as a methodology for judging the well-formedness of proposed ontologies and for sorting ontological types (Gangemi et al, 2001b).

However, as I have spelled out in Carstensen (2007), DOLCE inherits some of the basic assumptions –and problems (e.g., explaining the `Stuff`-riddle)– of realist ontology. It also incorporates the traditional ontological distinction of `Endurants` ("non-temporal particulars") and `Perdurants` ("temporal particulars"), which is well-accepted in the literature but neither explains the commonalities of temporal and spatial expressions in language nor their differences (see for example above, the plurality of objects and events).

In the following I will propose a cognitivist ontology in which both particulars and universals are regarded as human-perspective-based, mental constructions. This ontology will therefore be much more motivated and constrained by aspects of cognitive representation and processing (and therefore by evidence from other disciplines of cognitive science). The ontological types we will be concerned with in the following, namely those corresponding to –but not identical with– the `Endurants` and `Perdurants` of DOLCE, therefore do not only have a *cognitive bias* but also a *cognitive basis*. Most importantly, they will be defined in terms of domain-independent attentional criteria, which reflects the recently acknowledged important role of selective attention within the cognitive system.

4 Foundations of Cognitivist Ontologies

4.1 Prerequisites

The construction of cognitivist ontologies is guided by respecting fundamental aspects (of cognitive processing), some of which are the following:

Biological endowment. "Human perspective" is based on the fact that the senses with which we are endowed qua being human (only) allow us to perceive certain aspects of the world (to the exclusion of some others).

Boundedness. Restrictions on mental storage and processing capacity further restrict what can be perceived and conceived.

Categorical perception. Unlike the aliens mentioned above, humans are able to arrive at qualitative distinctions ("categories") from the perception of continuous differences in the world (Harnad, 2003).

Integration. There is evidence that an important mechanism of complexity reduction is realized by temporal units of different size –and at different representational layers– in which incoming information is gathered ("The reduction of complexity in neuronal systems is for instance, achieved by temporal integration mechanisms which are independent of the content of a percept or a cognitive act but are presemantical operations.", Pöppel 2004, p. 295). Related to this view is the notion of different *buffers* which contain certain information to be integrated and held available for some time in working memory(/ies) (Baddeley, 2000).

Pre-attentive processing. Within these integration "windows", (perceptual) input is parsed, and corresponding features are bundled for being bound together (Treisman, 1988).

Attentional selectivity. After pre-attentive processing, certain information may be selected for further processing. Mechanisms of selective attention cause information that has been pre-attentively computed as "standing out" from the rest –either **bounded featural regions** or **boundaries** of such regions– to be selected as a proto-object to be represented and categorized (Scholl, 2001).

Operation mode of selective attention. Depending on the content of an integration window (e.g., one vs. many salient items), selective attention operates in different modes whose poles are: **focused** vs.**distributed**.

Object representation. Once selection has taken place, the selected information is integrated in a temporary token structure (so-called "object file", cf. Kahneman et al 1992) representing it as an object. These object files are maintained as long as spatiotemporal continuity of the corresponding perceptual information is given, therefore allowing for object persistence, cf. Scholl (2007).[11]

Categorization. Maintaining an object file (or "token") involves matching with existing knowledge structures, which makes it meaningful for higher cognitive processes. This results either in ascribing a type to it ("a bird"), or in identifying it as a known instance in long term memory ("Superman").

From these principles, which reflect current evidence about the role of selective attention in the cognitive system, some fundamental distinctions "of the kinds and structures of objects, properties, events, processes and relations" represented in a cognitivist ontology (*CogOnt*) can be deduced (they will be extended by further *linguistic* evidence below). The resulting *cognitivist ontological notions* are to be distinguished from differentiations of higher-level concepts that are based on further principles concerned with, e.g., *concept induction* (Holland et al, 1986) or *conceptual development* (Keil, 1989), which would lead to ontologies in the conceptualist sense.

4.2 Basic *CogOnt* Distinctions

The entities in *CogOnt* we are interested in –i.e., the equivalents of the `Endurants` and `Perdurants` in DOLCE– are

[11] The illustrating example Kahneman et al. give is the well-known reaction of onlookers watching the approaching superman: "It's a bird; it's a plane; it's Superman!". They refer to a persistent object, although both perceptual features and attributed types change.

always `Entities-from-a-human-perspective`. According to the above principles of cognitive processing it can now be stated more clearly that this essentially means "entities categorized wrt. bounded integration sites".

I will use the term ***frame*** as a metaphor for bounding, here in the sense of a "snapshot" of video processing –which is slightly different than its usual interpretation in (computational) linguistics and AI (e.g., in the works of Charles Fillmore and Marvin Minsky). As the notion of bounding is regarded as fundamental in the present approach, I will henceforth call the relevant top node in the ontology `Frame-determined-Entity`. Some of the main distinctions in *CogOnt* are shown in figure 1 and explained in this subsection (for a detailed discussion and refinements see the next sections).

A `Frame-determined-Entity` (`FDE`) is categorized wrt. a single frame or wrt. more than one frame. Categorizing wrt. a single frame means that attention is directed to (patterns of) pre-attentionally processed information *within* a frame. This information is integrated into a `FDE` token (a generalized object file) or leads to the establishment of such a structure. Categorizing wrt. multiple frames, on the other hand, means that attention is directed to salient aspects of a frame *sequence* based on the information given in its frames.

Within a **single frame** (`SFDE`), the principles of attention give us two qualitative options: either there are salient boundaries / bounded regions on which attention is focused. This defines the corresponding proto-object as a `Focused-Attended-Entity(FAE)`. Otherwise attention is distributed and directed towards some content in the frame categorized as –nonbounded– `NFAE`. It is quite evident that `FAE` corresponds to the usual notion `Object` (although it is a bit more general). It is less apparent that with `NFAE`, *CogOnt* distinctions have led us to the equivalent of `Stuff`: as there is no proto-object to be individuated, there must be a more or less homogeneous distribution of features in the frame. Thus, particulars of type `NFAE` come to be represented as nonbounded entities although they might be bounded in reality (cp. the above *water-in-the-cellar*).[12]

Categorization wrt. **multiple frames** (`MFDE`) always involves a succession of frames. Distinctions can be made as to whether there are **boundaries** (here: salient *changes* in the stream of frames) or not, as these represent salient perceptual situations. `Event` and `Process/Activity` are corresponding nodes in this part of the ontology.

In *CogOnt*, therefore, the distinction between `SFDE` and `MFDE` makes explicit what is implicit in the endurant/perdurant distinction: "Wholly presence" of the above definition of endurants corresponds to being defined wrt. a single frame, and "extending in time ..." corresponds to being defined wrt. multiple frames. Note that what it means to be present and what it means for an eventuality to have temporal parts is given an explicit cognitive basis, too.

Having motivated the main distinctions in *CogOnt*, let us now take a closer look at the subdistinctions of `FDE`.

5 The Subtypes of `Single-Frame-determined-Entity`

5.1 Laycock, Jackendoff, and Talmy

Laycock (2005a) starts his discussion of the distinction between `Stuff` and `Object` with an analysis of count and non-count nouns. Using two binary features, $\pm$*singular* and $\pm$*plural*, mass nouns are classified as both non-singular and non-plural (see (1)). He points out that this classification of nouns is a *semantic* one, therefore only partially reflecting the ontological kinship of plurals and mass terms because of their being non-singular (to the extent that –in his opinion– there is no *ontic* contrast between *clothes* and *clothing*).

(1)

	1. Singular ('one')	2. Non-singular ('not-one')
Plural ('many')		'things', 'apples', 'clothes'
Non-Plural ('not-many')	'thing', 'apple', 'piece of clothing'	'stuff', 'water', 'clothing'

There is an apparent gap in the table due to the inconsistency of something being both singular and plural. Because of this, *collections* like *team* or *committee* –although somehow fitting in that slot– are not classified according to their ontic structure.

Jackendoff (1991) also uses two binary, conceptual features, $\pm$*bounded*($\pm$b) and $\pm$*internal structure*($\pm$i), to cross-classify expressions of entities/particulars.[13] (2) shows that this leads to the remedy of the just mentioned shortcoming.

(2)

	+b(ounded)	-b
+i (internal structure)	*committee*, *team* (group)	*apples*, *clothes*, *cattle* (aggregate)
-i	*apple*, *piece of clothing* (individual)	*water*, *clothing* (substance)

Interestingly, Jackendoff assumes that his features also apply in the domain of eventualities/perdurants, or, to put it

[12] To my knowledge, there is no comparable approach viewing `Stuff` like this. Usually (cf. e.g. vanMarle and Scholl, 2003), `Stuff` is equated with `Amount of stuff` (`Amount of matter`), which, being of type `Object`, is a different thing.

[13] It is important to point out here that the author and the authors cited are aware of the fact that there is no simple word-to-ontological category mapping (cf., e.g., Jackendoff, 1996), see also section 8.

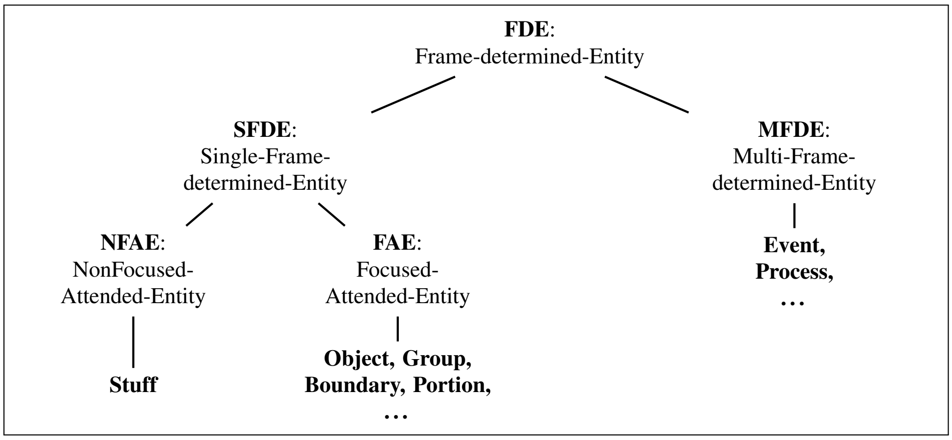

Fig. 1 A preliminary view on main *CogOnt* distinctions

differently, both in the spatial and temporal domain.[14] (3) shows his eventuality crossclassification with the examples from Jackendoff (1991, p.20).

(3)

	+b	-b
+i	*The light flashed until dawn* (bounded process)	*The light flashed continually* (process)
-i	*John went to the store* (accomplishment)	*John slept* (state)

Talmy (Talmy, 2000, pp. 58f) also presents a feature set that applies both to spatial and temporal entities (in his terms, to the domains of *matter* and *action*). He proposes a 5-element classification which is based on three oppositions/features: plexity (uniplex vs. multiplex), boundedness and internal segmentation (see (4)).

(4)

uniplex	multiplex		
		+b	-b
(a) tree/ bird (to) sigh	+i	*(a) grove/ family (to) molt*	*timber/ furniture (to) breathe*
	-i	*(a) sea/panel (to) empty*	*water (to) sleep*

However, it may be wondered whether the qualitative distinction made here between *tree/bird* and *sea/panel* is justified. Furthermore, although the idea of generalizing over different domains is congenial to the *CogOnt* approach, we will later present a slightly different picture of (the relation of) endurants and perdurants.

[14] Cf. Krifka (1989) for a formal approach on what he calls the relation between nominal reference and temporal constitution.

5.2 Motivating *CogOnt* distinctions within `SFDE`

Is there a cognitive basis for the four-valued feature combination just presented? How can we motivate corresponding *CogOnt* distinctions underlying different subtypes of of `SFDE`? Note that the $\pm$i feature is only descriptive in that it is not "grounded" in cognitive mechanisms. What we would be looking for, then, is some evidence for a cognitively represented combination of plurality and singularity in cases where one "global" entity consists of identifiable, "local" entities, therefore being an instance of `Group`.

Actually, there is such evidence resulting from neuroscientific/psychological investigations in the context of the so-called "Global/Local perception"-paradigm. In these investigations (e.g. Navon, 1977; Bihrle et al, 1989; Stiles et al, 2005), subjects usually have to process hierarchical patterns like a (global) letter consisting of (smaller, local) letters (so-called Navon figures).

Data across different research methodologies (drawing tasks, reaction time experiments, brain scans etc.) and subject groups (healthy subjects, subjects with brain injuries or degenerative syndromes) show that the global and local aspects of `Group`-processing can be dissociated. They support an assumption that this can be attributed to a hemispheric asymmetry in the processing of such figures. According to this assumption, the left hemisphere is biased towards processing local elements while the right hemisphere is biased towards processing global elements. This is directly shown in the brain scans of healthy subjects, and indirectly by the performance of subjects with specific brain injuries.

Most explicit is the dissociation when comparing the task performance of subjects with Williams Syndrome (WMS) and Down Syndrome (DNS). The systematic result patterns of these groups are depicted in figure 2 (adapted from Bellugi et al, 2001).

These data show that selective attention operates on two levels simultaneously. Rather than assuming a one-tiered en-

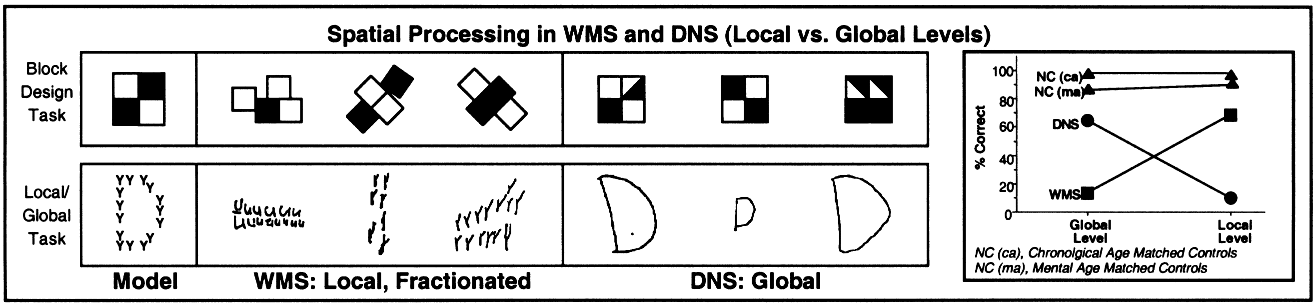

Fig. 2 Experimental evidence for global/local level `Group` dissociation (Bellugi et al, 2001, used with permission)

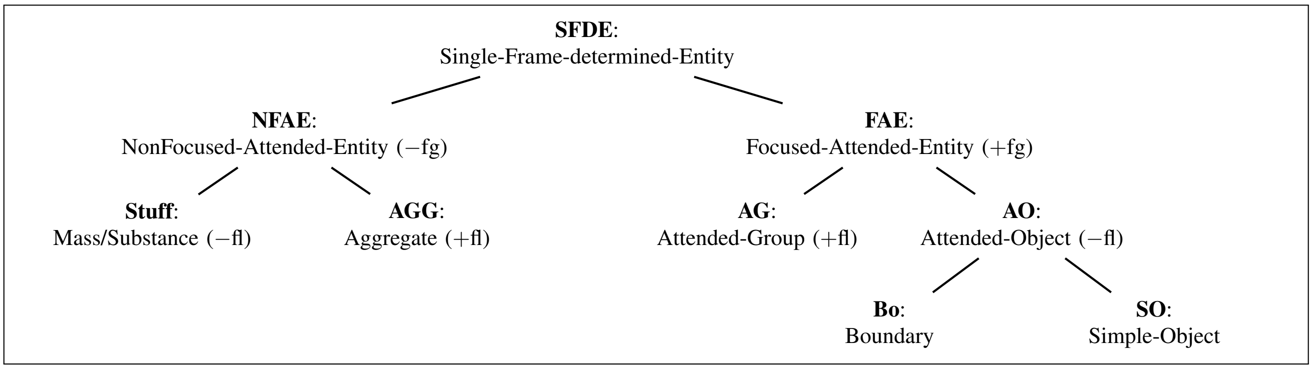

Fig. 3 Refined `SFDE` part of upper ontology

tity representation, it is therefore reasonable to postulate a two-tiered entity representation reflecting aspects of both local and global levels of processing. Thus the above principles of cognitive processing are to be understood as operating on two levels. Correspondingly, Jackendoffs features ±b and ±i will be reinterpreted/redefined as ±*focused attention on global level*(±fg) and ±*focused attention on local level*(±fl), respectively. Figure 3 shows the modified *CogOnt* core for `Single-Frame-determined-Entity`.

5.3 SFDE subtypes

`Simple Object`. Within `Simple Object`, one can distinguish between entities (of type `Object`) which carry an identity condition (Guarino and Welty, 2000), e.g. *cat, dog, mountain, person* and those which do not. The latter are divided into instances of `Amount of Stuff (AoS)` like *drop of water, piece of chalk* and into instances of `(Arbitrary) Part`, e.g. the pieces of a broken pencil or a shattered glass pane. All of those are dependent on other entities, either on the stuff they are bounding or on the whole object they are part of.

Positive and negative `Simple Objects`. The simple proto-objects to which attention is drawn to can either be figures wrt. some background ("positive" objects like *cat, mountain*) or bounded background ("negative" objects like *hole, scissure, valley*). Negative objects are not restricted to the spatial domain as shown by examples like *pause, intermission, gap*.

`Boundary`. Attention is always drawn to salient items in some representational buffer, either to whole regions or else to boundaries *between/of* regions. The latter case, represented by `Boundary`, includes figural bounding parts (*the edge/border/top/corner/start/end of*) as well as situations with no figural region (*the border between France and Germany*).

`Group`. Similar to `Simple Object`, `Attended-Group` can be subclassified. Groups can be defined by being a bounded plurality of same-type objects (`Unstructured-Group` as in *flock of sheep, swarm of bees, medley*), by having an additional functional structure (`Structured-Group` as in *team, choir, summer olympics, opera*) or by being a bounded plurality of different-type objects (`Arbitrary-Group`).

`Aggregate vs. Stuff`. While `Aggregate`-type entities are collections of simple objects, stuff entities are not, or at least are not perspectivized as such. There are two points to note, however. First, there are different types of stuff: `Homogenous-Stuff` (or `Substance`) as in *water, gold*, where every portion of an entity is of the same type as that entity (so-called *homeomericity*); `Non-Homogenous-Stuff` (or `Mass`) as in *rice, garbage, jewelry*, where homeomericity does not necessarily hold. Second, masses and aggregates are "close neighbours" in cognitivist ontologies. This is most evident in the fact that languages may perspectivize/ categorize the same objective entity differently: for example,

furniture is a mass noun in English, while German *Möbel* is an aggregate noun; English *cattle* is an aggregate noun, while German *Vieh* is a mass noun.[15]

6 The Subtypes of `Multi-Frame-determined-Entity`

6.1 Steedman's temporal ontology

Steedman (2005) contains a state-of-the-art classification of eventualities (see (5)). Steedman adds the punctual-event type `Point`[16] (*knock, blink*) to Vendler's classical four-part distinction of aspectual categories. The features subclassifying events refer to the involvement of change ($\pm$*telic*) and to the complexity of the category's instances ($\pm$*composite*)[17]: An achievement represents a change of state (*enter, arrive*); an accomplishment is a combination of an achievement and an activity. The complexity of an activity/process (note that "activity" can be substituted for "process" and vice versa) is best described in Jackendoff (1996, p. 316): "Process (P): a sequence of events identifying the same semantic expression".

(5)

	Events		States
	-composite	+composite	
+telic	`Achieve-ment`	`Accomplish-ment`	
-telic	`Point`	`Activity`	

Masolo et al (2003) elaborate on the similarity of processes and states. They are similar in that both are *cumulative*: The combination (mereological sum) of two connecting or overlapping instances of one of them is again an instance of it. They are different in that only states are *homeomeric*: every part of some state is again a state of the same type (for processes, there may be parts which are not of the same process type).

Linguistically, there are indicators for the type of eventuality a sentence expresses. Both states and processes allow bounding specifications (BS) like duration adverbials ("for X") or boundary adverbials ("until Y") but no temporal frame specifications (TFS) like frame adverbials ("within Z") (*He ran/ stood there for 20 minutes/*within 20 minutes*). Accomplishments allow TFS but no BS (*He built a house within 2 weeks/ *for two weeks*, achievements and points allow neither BS nor TFS. Events can be repeated, which is indicated by adverbials of cardinality and frequency (*He visited her three times / every second month*, cf. Hwang and Schubert 1994).

Current proposals are insufficient in their subclassification of eventualities, which is most obvious in the incongruity of Steedman's, Jackendoff's, and Talmy's classification (the latter depicted in (3) and (4)). Although their feature sets seem compatible, Jackendoff lacks the category `Point` and is unclear about the position of `Achievement` in his scheme (it gets the same feature combination *+b-i* as accomplishments, compare Jackendoff 1991, p. 39). Steedman, on the other hand, does not capture the commonalities of activities/processes and states and also does not talk about the status of bounded processes/states, while Talmy brings in the uniplex/multiplex distinction.

6.2 Motivating *CogOnt* distinctions within `MFDE`

According to Jackendoff, it is common in the literature to analyze processes as a "series of snapshots". He rejects this view, one reason being a supposed problem with the process of *motion*: "[...this view] does not distinguish its chosen sequence of subevents as motion: it just specifies a sequence of momentary states. It does not say that in each of these snapshots the object is moving,[...]" (Jackendoff, 1996, p. 317). However, he himself notes a rare case in the neuropsychological literature where a patient was not able to perceive motion/movement (so-called "motion blindness") but only saw successive scenes of an object appearing at different places.

For the *CogOnt* approach, this is therefore a prime example for `Multi-Frame-determined-Entity(MFDE)`. It is based on the assumption that the stability of our perception is to a large part a matter of *construction* (e.g., a coherent unit out of discrete parts).[18] With respect to the similar topic of change perception (and the corresponding "change blindness") (Turatto and Mazza, 2004, p. 107) write: "[...] the general conclusion that the increasing bulk of evidence on change blindness suggests is that we see much less than we think we see." The perception of the *persistence* of an object and the *continuity* of some motion are cases in point for that.

`MFDE` are therefore based on a **succession of frames** and thus are temporal in a very basic sense.[19] They can be assumed to derive from processing the (dis-)continuities defined by certain patterns of frames in the *episodic* buffer (Baddeley, 2000), resulting in analogues of object files (*event files*). In addition to that, `MFDE` may become represented as temporal proto-objects in a single frame, so that they can be attended and categorized as instances of `SFDE`. For example, an appropriately attended instance of `MFDE:process of riding` (e.g., *Mary rides through the woods*) can be categorized as an instance of `Stuff:riding` (e.g., *This riding*

[15] The corresponding linguistic test here is asking *how many / wie viele* (aggregate) or *how much / wie viel* (stuff).

[16] `Point` instances are also called "semelfactives".

[17] These features obviously correspond to $\pm$b and $\pm$i.

[18] This corresponds to evidence for micro-scale motion detectors whose input is glued together in a larger-scale motion area.

[19] This is in line with "the idea that time-sensation derives, specifically, from perceiving the changes [...] entailed by the activity of *attention*" (Marchetti, 2009, p. 33, his emphasis).

may cause some annoying back pain). Likewise, one can talk about the eventualities of Peter's, Paul's, and Mary's first riding a horse through the woods (MFDE), and can then state that *These three rides (SFDE) cost 15 dollar each* (see section 7 for further discussion of the MFDE/SFDE relationship).

Again it must be emphasized that the *CogOnt* approach abstracts from different cognitive domains in that frames represent integration windows of different time scales and at different cortical locations. Furthermore it generalizes over stimulus-induced (*exogenous*) temporal phenomena and non-stimulus-induced (*endogenous*) "atemporal" changes of attention between objects.[20]

6.3 MFDE subtypes: overview

While SFDE represent snapshots of attentional engagement to frame content within a *single* frame, MFDE represent either *repetitions*, *changes*, or *transitions* wrt. one, two, or three sequences of type-identical frames, respectively. Changes and transitions involve *boundaries*, while repetitions do not. In simple terms, changes *are* "temporal boundaries", transitions "temporal blobs", and repetitions "temporal stuff".

The detection of a change requires two successive frame (sequences)s ($\boxed{X}^+ \rightarrow \boxed{Y}^+$)[21] that are categorized differently (hence, Frame Change Entity (FCE)). The detection of a transition involves three frames with the characteristic pattern $\boxed{Y}^+ \rightarrow \boxed{X}^+ \rightarrow \boxed{Y}^+$ (Frame Transition Entity (FTE)). The detection of repetition involves a succession of *type-identical* frame instances ($\boxed{X}^+$, Frame Repetition Entity (FRE)). The main subtypes of MFDE are depicted in figure 4 and explained in the following.

6.4 FCE

FCE partially corresponds to Vendler's Achievement for change-of-state verbs like *arrive, finish, die, enter*, but is more general in two respects. First, as Jackendoff notes (Jackendoff, 1991, p. 40), there is a converse type (called *inception* by him) underlying verbs like *start, commence, leave*. Achievements and inceptions then describe constellations in which a state does not hold in the first frame sequence but in the second, and vice versa. Second, while both event types highlight one state as a *figure* X in contrast to the *background* NON-X, there are changes of state which lack such a figure-ground asymmetry, simply involving different values in some dimension (like color, sound, position, as in *The light changed from green to yellow*).

[20] This correlates with the distinction of having to represent changes in the world (*conceived time*) and changes in cognitive processing (*processing time*) in Langacker (1987). Note that although these aspects can be dissociated, both can cooccur.

[21] The Kleene plus in the following depictions is to be interpreted as 'one frame or more of type X/Y'.

6.5 FTE

FTE[22] can be subclassified by the figure-ground asymmetry: If the middle frame $\boxed{X}^+$ is characterized by a condition 'Y+Z', then it is a figure and defines a *positive* FTE. If it is characterized as 'Non-Y', then it is background and defines a *negative* FTE.

Typical examples of FTE entities' expressions are *jump, knock* (positive) and *break, intermit, pause* (negative). Yet although some of these correspond to Steedman's punctual events, FTE is much more general than his Point. First, punctuality in its zero-dimensional sense is too restrictive for capturing relevant situations. For example, it is doubtful whether a jump of Bob Beamon can be called "punctual". Second, FTE includes *extended but bounded* states/processes (e.g., *run for a while*)[23]. Third, FTE includes accomplishments. These are seen here primarily as bounded activities (building, walking), where the bounding is realized by a developmental/changing condition (including a final state of an existing house in *build a house*, a final state of being at the store in *walk to the store*, or corresponding examples with initial states, e.g. *destroy the house, walk away from the house*). Fourth, arbitrary parts of complex events (*phases*) belong to this type.

It is not clear whether there are endogenous FTE subtypes. Maybe noticing something as *standing out* or *missing* are pertinent examples.

6.6 FRE

FRE-entities can be categorized according to the type of their repeated frames. If *none* of them involves any (perceived) change, the entity is a State as in *being dark, having a headache, sit, stand, believe, hope, see*. If *everyone* of them involves some change, it is a Process. Processes differ according to the change involved. They can be divided into exogenous processes of continuous perceived change, and endogenous processes of continuous change of perception.

Exogenous processes involve for example changes of some SFDE's quale (*the light is dimming*), of the position of an object's part (Motion as in *flow, flicker, tremble*[24]), of an object's position (*drive through the tunnel, walk along the river*) or activities of differing complexity (*push, argue, discuss, think*).

[22] As mentioned, a FTE entity somehow is a "transitional blob" (or mostly: "temporal blob") as the middle frame "stands out" wrt. to its surrounding frames.

[23] They are sometimes called "pofective" (Herweg, 1991). Note that a bounded process (or state) is neither an accomplishment nor a "punctual" event and hence a gap in standard classifications.

[24] This includes the characteristic motions of movement verbs. Note that one can run/walk on the spot.

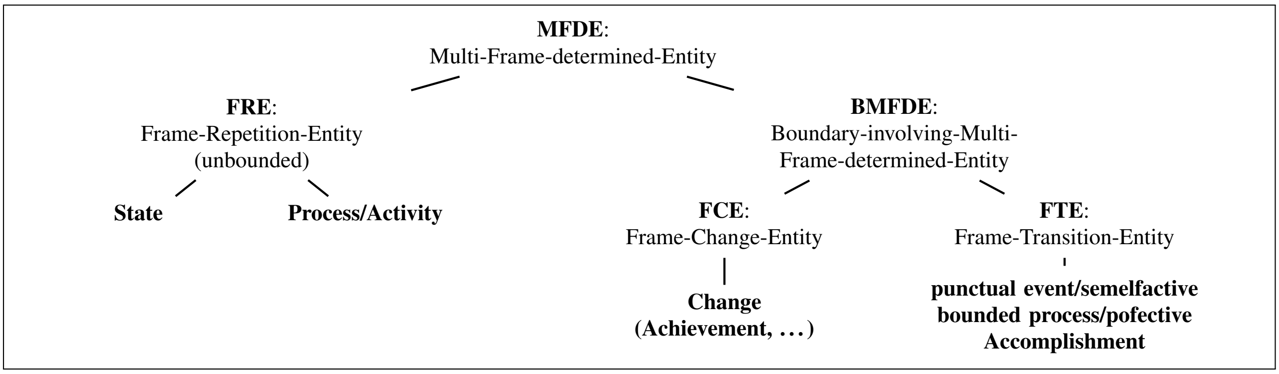

Fig. 4 Refined MFDE part of upper ontology

Endogenous processes correspond to acts of attentional scanning wrt. a static scene. For example, there is ample evidence from psycholinguistic investigations, e.g. Clark et al (1973), showing that the use of dimensional adjectives requires scanning an object's extent along the dimension in question (length, height etc.). Furthermore, there are verbs which express the extension of an object in some dimension (*protrude, rise, stretch* as in *the skyscraper rises into the sky*) or more complex scanning patterns as in *the road follows the coast line* (cf. Carstensen, 1995).

7 On the commonalities and differences of SFDE and MFDE, or: why there are no pluralities of events

Recall that Jackendoff and Talmy propose feature sets that characterize both spatial and temporal entities, so that the SFDE and MFDE structures should be isomorphic. However, a close look at the figures 3 and 4 reveals that this is not the case: There is no 'aggregate'- or 'group'-type (+fl) node in the MFDE branch of *CogOnt*, and hence only a correspondence between MFDE entities and −fl SFDE entities (that is, between BMFDE and Attended-Object, and between FRE and Stuff, respectively).

Why is that? Consider the following fictive excerpt of a language technology poster:

(6) Delivering information in the EU produces enormous costs: *One single part of a minister's speech may be translated multiply, many times, and at many different places, with up to 20 different translation(event)s on the whole.* It is easy to see that machine translation can be of tremendous cost-reducing help here.

"multiply" (manifold) in this scenario means that there are translations into different languages (even simultaneously and at a single place), "many times" that they might happen live or afterwards (for the news or for media storage), and "at many places" that translators may be located in different capitals/institutions of the EU. Accordingly then, there seems to be a plurality of the MFDE of translating a speech, which can –at least in German– be also expressed using a deverbal nominalization (a *conversion* from verb to noun) as in (7). There are two things to note, however.

(7) Das mehrfache/ mehrmalige [/vielerorts
'The multiple/ many-time [/many-place
stattfindende] Übersetzen einer Rede . . .
happening] translating of a speech' . . .

First, (8) and (9) show that although the verb of a sentence expressing a MFDE can be nominalized, the allegedly existing event plurality cannot be quantified if expressed as a verb, no more than as such a nominalization.

(8) a. *One single part of a minister's speech may be translated many/ up to 20
b. *One single part of a minister's speech may be many/ up to 20 translated

(9) *Das viele/ bis zu 20 Übersetzen . . .
*'The many/ up to 20 translating . . . '

Second, this contrasts with the use of another type of nominalization (so-called *derivation*) which appear as lexicalized nouns (here *translation*) and which allow for quantification expressions (cf. (10)).

(10) Die vielen/ bis zu 20 Übersetzungen . . .
'The many/ up to 20 translations . . . '

Wrt. some situation, we then apparently have to distinguish between its representation as MFDE entity which may be expressed either as verb or conversional nominalization, and its (secondary) representation as SFDE entity that must be expressed as a derivational noun (whereby such a noun may denote an entity different from the event itself, e.g. the result (cf. (11))) .

(11) a. The translation was listened to by many people [result]

b. The translation took longer than the original speech in each case [event]

Note that a MFDE entity can also be expressed by a derivational noun (although this seems to be less done and accepted by speakers). Even if it expresses a plurality of events, however, the noun still appears linguistically in *singular* number (cf. (12) and (13))!

(12) Die mehrfache Übersetzung kostet eine Menge
'The multiple translation costs a lot'

(13) a. Maria's triple childbirth this year ...
b. *Maria's triple childbirths this year ...

It follows from these considerations that –even if there are multiple instances of an event, with their situational aspects recorded in some working memories– there are no pluralities of events in the multiframe context. One can suspect that this restriction derives from the inherent constraints of the MFDE buffer. Consequently, there can only be one MFDE entity constructed and attended to in a multiframe context, and if there are individual tokens of a MFDE entity, they are constructed in a different representational context/area. This representational situation presents a problem to the cognitive system if it wants to convey the information that a certain number of events happened. According to the linguistic data we have observed, it can compensate for that in two different ways, though.

Either it *relates* each MFDE instance of some type to corresponding SFDE tokens in different representational (spatial, temporal) maps, these tokens being instances of TIME/TIMES and PLACE/PLACES (which again are subtypes of AO/AGG each). *Quantification* is the means to express multiplicity without plurality (see (6)).

Or it *binds* the MFDE entity together with each of its spatiotemporal features into separate tokens and categorizes these items in a single-frame context as SFDE entities (this corresponds to cases like (10)). This is a double-edged sword, however. On the one hand, *all* instances of a situation type can be expressed (see the use of the lexicalized nominalization in (6)). On the other hand, the specific information about the (spatiotemporal) distribution of these instances gets lost.

Interestingly, there seems to exist a separate representational map for 'plexity', that is, for the representation of bare individuality or instantiation[25]. On the one hand, this map allows for the representation of a multiplicity of events *at the same time and place*, that is, with respect to variation in the involved action (see the use of "multiply" in (6)). On the other hand, the number of tokens on the plexity map may encompass the distribution/variation in the spatio-temporal maps (see (14) for the situation described in (6)).

(14) Das zwanzigfache Übersetzen der Rede ...
'The twenty-fold translating of the speech ...'

To conclude, "plurality" only exists in and derives from the two-level representation of SFDE entities. If there is a multiplicity of an event type's instances, then it is not visible in the MFDE buffer but only inferrable from the working memory for these instances (what has been called "plexity map" here). Correspondingly, the MFDE entities denoted by verbs/sentences (contra Jackendoff/Talmy) lack a plurality level and must be described as $\pm$b$-$i (that is, $\pm$fg$-$fl, if these SFDE features are used). Processes therefore correspond to masses (not to aggregates)[26], and states correspond to substances (not to stuff)!

I take this as an important discovery about cognitive/cognitivist ontologies per se. Apart from that, however, it is also relevant for the current discussion about linguistic pluractionality markers (which signal plurality of the action expressed by a verb). It shows that these cannot be analyzed by reference to a plurality of events –as is proposed by some authors– but must be analyzed quantificationally (cf. Bittner and Trondhjem, 2008, for a corresponding account).

8 General discussion

Usually, ontologies are conceived as "sorting" things into different domains. Bittner (2006), for example, assumes a 7-sorted ontology of `worlds`, `times`, `places`, `events`, `states`, `animates`, and `inanimates`. More sophisticated (upper) ontologies have a tree (Masolo et al, 2003) or lattice (Lenat and Guha, 1990) structure, in part depending on the phenomena represented (*Cyc*, for example, tries to provide a solution to the stuff-riddle).

In *CogOnt*, `times` and `places` (as well as the others) receive no special status. That is, domain information is not used solely or primarily for sorting[27]. Instead, it is only one of the basic (cognitive) ontological distinctions in categorizing the world (the other being the system of attentional distinctions presented here). In this respect, *CogOnt* is quite similar to the *Kind Types (KT)* system of Dahlgren and McDowell (1986). (15) presents the distinctions to be made on the highest level in this cross-classification system: Entities are described by two choices, the first between being abstract or real, the second between being an individual or a collective.

[25] Similar, but not identical to, the FINSTs ("fingers of instantiation") of Pylyshyn (2009), and quite probably at a higher level of representation. Similar, if not identical to, Talmy's plexity.

[26] This is corroborated by the observation that one has to use *much* for the modification of the process verbs used in (3) and (4): *much/*many flashing/breathing*.

[27] For example, there are at least countable objects (*a time*), aggregates (*many times*) and stuff (*much time*) in the time domain.

(15) Entity → (Abstract ∨ Real) &
(Individual ∨ Collective)
[*KT* highest level]

(16) Entity → Domain &
Attentional perspectivation
[*CogOnt* highest level]

As (16) shows, this somehow corresponds to the upper level distinctions of *CogOnt*, where "Attentional perspectivation" is an alias for `FDE`. The `Individual/Collective` dichotomy is more restricted than the distinctions within `FDE`, and according to Dahlgren (1995) even inadequate, as `Collective` conflates stuff, aggregates, and groups. Both the similarities and dissimilarities to the *KT* system therefore support the *CogOnt* approach.

The separation of domain and attentional perspectivation structure has an additional value: It permits a domain-*independent* sorting of entities into classes with distinctive features relevant for language (technology). Main examples are quantifiability (`NFAE`), aggregability (`FAE`), countability (`AGG`), measurability (`Stuff`), repeatability (`BMFDE`) and boundability (`FRE`). Practically, such a sorting may lead to more transparency for and to more acceptance in ontological engineering (see the negative example in the introduction). Theoretically, it may also serve as an ontological basis for the count/mass-distinction in linguistics, which is notoriously difficult to make: For example, many nouns can have both count and mass senses (*three chicken* (count) vs. *there's chicken in the soup* (mass); *much beer* (mass) vs. *three beer, please* (count)). According to the *CogOnt* approach, "countable" can be identified as a feature of a noun that, in some context, denotes entities which are either $+fg$ or $+fl$. This leaves $-fg-fl$ for the entities expressed by nouns with a "mass" sense, which is the defining criterion for `Stuff`.

In other words, the *CogOnt* view of ontologies is that they should not be regarded as a unique representation of a structured world, but as plurirepresentational reflections of how our mind structures the world in different ways. Linguistic terms may express / indicate a certain attentional perspective taken on a certain aspect of the world: languages may then differ in perspective taking, simply by having or not having an expression for a perspective, or by using them differently (see the *furniture/Möbel* examples). But even intralinguistically, a word may express different perspectives (as in the count/mass examples) in different contexts.

In the related discussion of linguistic relativity (whether language influences thinking, cf. Boroditsky 2003), the *CogOnt* approach ascribes language therefore a more passive role, as it is primarily the perspectivations predominantly used in a culture that determine (non-)linguistic behaviour. The importance of language can then be acknowledged as a representation of these culture-specific worldviews mediated by semantic/conceptual structures.

9 Conclusion

It was shown that an adequate ontology of the world cannot be some direct reality representation (realist ontology) but must necessarily be conceived of as an ontology of the world *from human perspective*[28]. Motivated by linguistic distinctions and based on some fundamental cognitive principles, the core of such a cognitivist ontology (*CogOnt*) was presented.

The *CogOnt* approach solves some problems of realist approaches by opting for a differentiated picture of spatio-temporal ontologies.[29] According to that picture, there is neither a strict separation of non-temporal and temporal entities (endurants vs. perdurants), nor is there a simple ontological upper structure covering both the spatial and temporal domains like those proposed by Jackendoff and Talmy.

With frames and attention, there are structural aspects of cognitive representation and processing that give rise to an upper ontology which cross-cuts the traditional endurant/perdurant distinction. As a result, differential attention to exogenous or endogenous patterns of frame change is represented as `MFDE` entities, and differential attention to single-frame aspects (including temporal entities) is represented as `SFDE` entities. While typically at least two features are used for the top-level classification of entities, it was shown that wrt. `SFDE` entities, a single principle (the operation of focused vs. distributed attention) working on two levels can be identified as their cognitive pendant. As it turned out, this is different wrt. `MFDE` entities, which depend only on the principle's operation on a single level, explaining the lack of event pluralities. Furthermore, the notoriously neglected category `Stuff` is given a well-motivated place in *CogOnt* as a type representing unbounded particulars based on human perspective.

The present approach is closely related to the cognitive/conceptual semantics positions of, e.g., Jackendoff (1983), Langacker (1987), and Talmy (2000), and to the computational linguistic stances of *Naive semantics* (Dahlgren, 1988) and *Ontological semantics* (Nirenburg and Raskin, 2004). It goes beyond them, however, in emphasizing the role of selective attention in the cognitive system (cf. also Gärdenfors and Kopp, 2002), for the explanation of important conceptual and linguistic phenomena (cf. also Marchetti, 2006, 2010), and for ontology.

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[28] This may well be regarded as some sort of *non-conceptual* representation describing the real world in the sense of Pylyshyn (2009).
[29] Also, more differentiated than the one given in Carstensen (2007).

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