Semantics between cognitive neuroscience and linguistic theory: Guest editor's introduction

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This special issue provides a selection of some current approaches to the cognitive neuroscience of semantic processing. These have been selected with a view to identifying an area of inquiry under the label of “semantics” that allows for a rich interface between neurolinguistics and linguistic theory. A look at these papers makes clear that the term “semantics” as used in cognitive neuroscience covers a wide range of inquiries, encompassing the study of topics as diverse as: perception-based conceptual structures, the impact of specific concepts such as animacy on syntactically determined aspects of sentential meaning, the unification of all incoming information in the construction of a discourse model, and the neural correlates of basic formal operations of sentence-level semantic composition. In this paper, we aim to contextualise the approaches collected here, identify what they are about, and to what extent they are compatible with the aim of delineating commonalities between them and what might be a well-circumscribed area of research in semantic processing in the context of current of linguistic theory over the coming decades.

Keywords: Semantics broad and narrow; Compositionality; Conceptual structure; Deixis.

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SEMANTICS AS A DOMAIN OF INQUIRY

Semantics is arguably the most abstract level of linguistic representation, at a considerable remove from the acoustics and phonology of speech. In speech perception, sound patterns in the form of continuously varying acoustic waveforms are mapped onto discrete phonological representations consisting of segments, syllables, and words in a linear order (Poeppel, Idsardi, & van Wassenhove, 2008). Phonological representations connect with semantic processing by acting as “signals” for meanings, concepts, or thoughts that such signals encode. One of the hallmarks of human language is that this pairing between sound and meaning—the signifier and the signified in de Saussure’s (1916) terminology—is arbitrary and conventional: the phonetic segmentation of the syllable *cat* makes no predictions for what it means.

It is also commonly assumed that translation between languages preserves semantics: that is, while phonology is a major dimension of cross-linguistic variation, semantics is commonly assumed to be universal (see Von Fintel & Matthewson, 2008). In short, the same “thoughts” can be encoded in languages whose phonology, morphology, and grammar are radically different or that even lack a sound system, as in signed languages. How, then, do we access such an abstract domain empirically? How do we experimentally study what words “mean” and what “thoughts” sentences express? One answer is that while the mapping between semantics and phonology (meaning and sound) is arbitrary, as just noted, the mapping between semantics and syntax (meaning and form) is certainly not: semantic structures form a rich interface with syntactic ones, and which meanings are mapped from which syntactic structures is highly systematic and apparently rule-governed. Even this allows for very different forms of inquiry about what is broadly called semantics, and how dependent it is on linguistic form, ranging from the study of conceptual structures that are independent of linguistic form to lexical semantics to compositional semantics (encompassing phrases, sentences, discourse). This special issue illustrates approaches from the whole range of this spectrum.

Cognitive neuroscience experimentation has focused on all these different forms of meaning, generating data from neuropsychological patients (e.g., Patterson, Nestor, & Rogers, 2007; Tyler & Moss, 2001), functional brain imaging (Hagoort, 2005; Price, 2000; Taylor, Moss, & Tyler, 2007; Tyler et al. 2004), and electrophysiological recording (Friederici & Weissenborn, 2007; Hagoort, 2005). We necessarily present a very limited selection of this rich

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1 Due to the foundational problems invoked by this question, the young discipline of semantics has, for the longest time of its history, not in fact been regarded as a part of empirical psychology but as a part of logic instead (see e.g., Davidson, 1984; Lewis, 1970).
body of work, but a selection that we feel represents productive and provocative research programs connecting with linguistic theory.

It is clear that non- and prelinguistic forms of conceptual organisation enter into the meanings that are mapped from input phonological or visual signals. The existence of “nonlinguistic thought” in this sense is by now a commonplace in research on comparative cognition and enters into current studies on the evolution of language in central ways (Hauser, Chomsky, & Fitch, 2002; Hurford, 2007; Spelke & Kinzler, 2007). It is also contended that grammatical organisation is essentially absent in the communication of all nonhuman species. Tomasello (2008) in particular argues for the near-total absence of “relational or grammatical structuring of any kind” in the communications even of the language-trained great apes (Tomasello, 2008, p. 249). The question therefore arises whether the structural impoverishment of nonhuman animal communication reflects a relative impoverishment in the thinking capacity of nonhuman animal as well and correlates with it. Two extreme—and equally implausible—views are possible. At one extreme, other species such as chimpanzees think exactly like us, and the fact that they don’t communicate in a grammatical medium doesn’t matter at all to how they think. At the other extreme, a capacity for grammatical structuring in communicative signals is so vital to the organisation of our thought itself that the lack of such structuring would largely deprive us of the capacity for complex thought. If both of these extremes are implausible, we need to find a middle ground: there must be a level of semanticity and thought that doesn’t depend on having grammar. But it shouldn’t be all of the kind of thought that we express in a grammatical language (Bickerton, 1990; Terrace, 2005). How grammar influences the organisation of semantics must thus be a central question in a science of semantics.

One traditional view in linguistics has been that the grammatical structuring of a linguistic representation—in particular, the constituent structures that theories ascribe to sentences—enters directly into the meaning or thought mapped from it. Saying that this happens “compositionally” is to say, to start with, that a linguistic signal is organised into parts, and that each part makes a distinctive and independent contribution to meaning (Fodor & Lepore, 2002). The meaning then arises in a systematic fashion from how these parts are combined, and from how operations of syntactic composition are mirrored in operations of semantic composition (Heim & Kratzer, 1998; Montague, 1970). Linguistic meaning, the traditional assumption is, can be tracked independently of various nonlinguistic influences on meaning. *Child bites mom* clearly does not mean the same thing as *mom bites child*, no matter what the nonlinguistic context might be. However, the matter is by no means as clear as that, and the approaches in this special issue document this.
Thus, for example, the operations of semantic composition studied with the methods of neuroimaging (MEG) in Pylkkänen, Brennan, and Bemis (2011 this issue) are narrowly linguistically defined; however, this combinatorics is merely a special case of the generalised operation of Unification studied in Baggio and Hagoort (2011 this issue), which combines and unifies linguistic and nonlinguistic information alike, and is subserved by the inferior frontal gyrus (IFG), which is widely claimed to be nonlinguistically specific. Grammar is just one constraint on semantic interpretation, among many others (cf. Elman, 1990). Paczynski and Kuperberg (2011 this issue), in turn, assume that in linguistic processing there is a strictly combinatorial analysis of the incoming string that can be isolated, by systematically distinguishing experimental tasks in which the output of this computation interacts with and may conflict with other meaning-determining factors, such as a prominence hierarchy affecting the processing of words referring to animate and nonanimate entities, and noncombinatorial, memory-based semantic associations. Taylor, Devereux, and Tyler (2011 this issue), on the other hand, study conceptual structures independently of whether or how specifically grammatical structures encode them. Their processing is suggested to be a consequence of their internal feature compositions rather than grammar.

With regard to the traditional issue of compositionality, then, we already see that current approaches offer no clear-cut, one-size-fits-all picture. They interface with linguistic theory in various ways and at various joints. In the next section, we characterise and contextualise the approaches collected in this issue in some more detail and also indicate some connections with linguistic theory. In the third section, we discuss ways of unifying these approaches and formulate some questions and challenges. In the final section, we discuss some ideas that might help to structure the broad domain of “semantics” and distinguish some narrower inquiries from it, with a view to arriving where the future of a cognitive neuroscience of semantics might lie.

FOUR APPROACHES TO SEMANTIC PROCESSING

The approach of Baggio and Hagoort illustrates that an account of semantic processing in natural language understanding can be combinatorial even if it is not compositional in the traditional linguistic sense. From a processing point of view, the authors argue, a compositional semantic analysis is motivated as a processing strategy only insofar as it provides the advantage of easing the burden of memory/storage and balancing it against the need for novel computation (see also Baggio, Choma, van Lambalgen, and Hagoort, 2010). On this model, while syntax- or language-driven influences on
semantic interpretation are real, they are not processed independently of usage-based semantic expectations, and cannot be tracked independently. Taking a viewpoint opposite to that of Pylkkänen et al. (2011 this issue) in this regard, the authors suggest that compositional semantics viewed as an “autonomous” process has no psychological reality as such.

In terms of the time-course of semantic processing, in particular, nonlinguistic influences from context and world-knowledge shape the construction of meaning concurrently with linguistic influences. All information comes together in a “single unification space” in which linguistic information (phonology, syntax, semantics) and pragmatic information coming from knowledge about the context, the speaker, and states of affairs in the world are handled not serially but in parallel, with the purpose of mapping the linguistic input directly onto an event structure or discourse model. When unification is required over and above lexical retrieval and integration, the memory component located in temporal cortex (MTG/STG) will feed a novel incoming word into the unification component located in frontal cortex (IFG), which will interpret the word as a constraint on semantic unification in the context of what is processed so far, leading to a new stored context, which is then again unified with an incoming new constraint. This leads to a loop, or cycle, which can be mapped to the anatomy of the brain with the traditional N400 (Kutas & Hillyard, 1980; Lau, Phillips, & Poeppel, 2008) indexing the memory component.

At the opposite end of the spectrum lies the approach of Pylkkänen, Brennan, and Bemis (2011 this issue), who focus on meaning at the sentence-level only, which they regard as a distinct domain of inquiry that neuroimaging methods can track. As they define the domain of semantics, it “refers to the complex meaning that is computed by combining the meanings of the individual lexical items within the expression”. Assuming not merely combinatoriality but compositionality in essentially the classical linguistic sense, they argue that in sentence-level semantics the least progress has been made within cognitive neuroscience, and that the N400 is crucially not the neural index of semantics in this sense. Indeed there are very few direct studies of compositional semantic processing in this sense (see especially Tettamanti et al.’s 2008 study of negation; and see Steinhauer, Drury, Portner, Walenski, & Ullman, 2010, for evidence that the neural index for compositional semantics is distinct from that for world knowledge violations.) Pylkkänen et al. take this fact to correlate with the almost complete absence of influence of linguistic theory on neuroscience in this area.

Aiming to remedy this situation, they suggest that formal semantic theories such as Heim and Kratzer (1998) should be taken to provide the relevant hypothesis space in psycho- and neurolinguistic experimentation. Indeed
there appears to be sufficient consensus in language research to discern a number of fundamental formal operations coming from formal logic (Montague, 1970; Tarski, 1956) that can be used to model a complex meaning, such as function application and predicate conjunction. Traditionally investigated without any concerns for psychological reality, they become subject to experimental investigation in the present study, where they are also conjectured to operate in isolation from syntactic combinatorics, as for example in complement coercion constructions: for these have been argued to require additional semantic combinatoriality not specified in the syntax (e.g., Pustejovsky, 1995). The authors, based on MEG studies quantifying the anterior midline field, locate the source of these in the ventro-lateral prefrontal cortex, which is thus a potential locus of compositional semantics in the brain, distinct from the medial and superior temporal regions to which N400 effects are commonly traced (Baggio and Hagoort, 2011 this issue). Plausibility-driven world knowledge does not enter into the process in which the application of such formal semantic rules yields systematic semantic effects: in the sense of these authors, I just ate a cloud, for all its implausibility, is semantically well-formed. Indeed, it unambiguously means what it does, and no controversy over its meaning arises.

The third approach, by Taylor et al. (2011 this issue) is partially in line with the first approach above, in that conceptual structure in a nonlinguistic and nongrammatical sense is the focus of study, as in Jackendoff’s work (1999, 2002). It differs from both of the previous two approaches in not laying the focus on combinatoriality (in either the compositional or noncompositional senses): the focus is on single concepts and their meanings, as given by feature collections. In this approach, linguistic and nonlinguistic representations are assumed to access the same meaning structures, as do sensory and motor representations. Ipso facto, there is nothing linguistically specific about these structures and the account makes no reference to narrowly grammatical principles of organisation, assuming the autonomy of conceptual structures in regards to grammatical principles of organisation.

Primarily discussing (lexical size) concepts of concrete objects (“cat”, “tiger”, “table”, etc.), the methodology consists in decomposing such concepts into semantically primitive features (<meows>, <has stripes>, etc.). What accounts for the structures of such feature collections is a statistical analysis of feature distributions. More specifically, two aspects of feature distribution are used to predict their behaviour under normal and abnormal conditions (brain damage): feature distinctiveness (how many concepts are described by it), and the strength of feature correlation (degree of co-occurrence). Crucially for this approach, these two aspects interact with one another and with task-specific demands, in a way that predicts patterns of conceptual processing in both healthy and brain-injured
participants. The approach correctly predicts a pattern we find in brain damage, that the relatively less or more weakly correlated distinctive properties of living things are affected to a greater extent than the relatively more strongly correlated distinctive properties of nonliving things (see also Moss, Tyler, & Devlin, 2002; Randall, Moss, Rodd, Greer, & Tyler, 2004; Tyler, Moss, Durrant-Peatfield, & Levy, 2000).

The last approach, by Paczynski and Kuperberg (2011 this issue), builds on an experimental tradition that investigates the mutual influences of at least four systems that enter into linguistic processing and that seem at least in part separable, both experimentally and theoretically: (1) phrase structural organisation (whether a sentence is in the active or passive voice, or an argument is structuralised as the syntactic subject as opposed to the object, etc.), (2) thematic information (the classification of event participants as Agents, Themes, Goals, etc.), (3) the organisation of concepts into an animacy hierarchy (with animate arguments most prominent and inanimate entities as least prominent), and (4) the degree to which the words occurring in a sentence match semantic memory-based expectations and assessment of plausibility. Different stances have been taken in the experimental literature on the relations of these distinct processing subsystems to one another, for example on whether or not they are sequentially ordered or serial (Bornkessel & Schlesewsky, 2006). Kuperberg (2007) suggested that the process in which a propositional representation is generated on a syntactically determined and combinatorial path is both independent of and in a potential conflict with the result of plausibility-based or semantic-memory based computations, providing a somewhat novel explanation for the distribution of the P600 (see also the so-called error-monitoring approach: Van de Meerendonk, Kolk, Chwilla, & Vissers, 2009).

The present study continues this line of argument by providing new evidence that, at least in English, animacy affects the processing of arguments that are syntactically direct objects and, hence, come later in the order of the sentence: processing is more difficult, as indexed by a larger N400, when such arguments are animate. Crucially, though, the N400 amplitude reflects no greater ease of processing of animate arguments assigned the Experiencer role, which are usually animate, than those that are Patients, which may or may not be animate. The conceptual feature of animacy thus does not interact with the “thematic” stream that assigns thematic role as part of the combinatorial analysis of the sentence, demonstrating the separability of lexical-conceptual, thematic, and grammatical structure, and the distinct kind of semantic effects driven by each. Also the P600, while modulated by the degree of plausibility of sentences whose semantics is arrived at combinatorially, indexes a process of combinatorial
re-analysis independently of any connection between animacy and thematic role.

Before turning to some questions and challenges for these approaches in the next section, we note that in all four cases, connections with linguistic theory can be quite directly seen. A prominent approach in the background of both the first and the third approach, in particular, is Jackendoff (1999, 2002), who assigns semantics to a level of conceptual structure assumed to be generated independently of and parallel with syntactic structure. As Jackendoff (1999, p. 46) puts it, the “units of CS (Conceptual Structure) are entities like conceptualised physical objects, events, properties, times, quantities and intentions”, which are said to be “language independent”. They provide for the content and format of the messages that languages encode in utterances, as explicitly assumed in Taylor et al. (2011 this issue). Moreover, in this linguistic theory each word is taken to encode a complex conceptual structure and, hence, the distinction between word-level and sentence-level semantics (or lexical and grammatical semantics) is at least partially erased. We return to this distinction in the fourth section. Again this is also a potential implication of Taylor et al.’s conceptual structure approach, even though the latter approach differs from Jackendoffian principles of conceptual structure, which are crucially nonstatistical in character.2

Like Baggio and Hagoort (2011 this issue), Jackendoff also maintains that nongrammatically driven processes (such as nonmonotonic reasoning) enter into the organisation of conceptual structure, as much as syntactic information does. Unlike Baggio and Hagoort, however, Jackendoff argues that constraints on unification are crucially independent ones in the domains of phonology, semantics, and syntax, all of which obey their own generative principles and well-formedness conditions. For Pylkkänen et al. (2011 this issue), in turn, conceptual structure in the above sense is irrelevant to the principles governing sentence-level semantics, which has its independent cognitive reality. Paczynski and Kuperberg’s approach (2011 this issue), finally, in the above regards entails that the broad domain subsumed under the domain “language” includes both elements of conceptual structure (such as animacy), and more narrowly linguistic elements such as thematic roles assigned in particular syntactic positions, which are partially independent.

In the next section we aim to raise some questions for the approaches above which we hope show their inherent interconnections and points of unification.

2 In fact their organisation appears to be essentially phrasal, and mappings from syntactic trees to conceptual structures are quite direct.
SOME OPEN QUESTIONS AND CHALLENGES

One set of unresolved issues concerns the cognitive neuroscience approaches best suited to address the subtle issues of meaning representation and construction. The methods deployed are as heterogeneous as the theoretical approaches (neuropsychological patient data, neuroimaging data, electrophysiological data), and there is not yet consensus on the functional anatomy of meaning (notwithstanding some attempts, e.g., Lau et al. 2008). The work on conceptual semantics (in this volume championed by Taylor et al.) is perhaps neurobiologically the most mature, drawing on data from many methodologies and is associated with significant debates on the neural realisation. For example, some investigators sympathetic to a feature collection model such as the one supported by Tyler and colleagues (e.g., Martin, 2007) suggest that coactivation across sensorimotor areas suffices as a representational infrastructure for object concepts in the brain. Other colleagues (e.g., Lambon-Ralph, Sage, Jones, & Mayberry, 2010; Patterson et al. 2007) favour a “hub and spokes” model, with the anterior temporal lobe, in particular, playing a central role in mediating conceptual coherence at a level beyond modality specific features. In short, at the level of conceptual semantics there exists important, lively, and granular debates about the best cognitive analysis of semantic memory and conceptual structure as well as about the most likely functional anatomic organisation. The areas of main interest include the anterior temporal lobe and the set of cortical regions mediating perceptual analysis (i.e., sensorimotor areas).

Turning to sentence level research, there is implicit consensus that electrophysiological methods are, for the moment, the most fruitful. It is no accident that the papers here, Baggio and Hagoort, Pyllkänen et al. and Pazcynski and Kuperberg, all build their central arguments on well-established electrophysiological responses such as the N400 and P600. The temporal resolution afforded by EEG and MEG is well paired with online sentence processing paradigms; furthermore, detailed models about what type of information is available when it is best scrutinised in electrophysiological paradigms. That being said, here, too, there is a wide set of options. The N400 and P600 are broad (and late) neural response patterns associated with rather different processes; and the anterior midline field argued for by Pyllkänen and colleagues is relatively novel. The responses used to test theories are themselves complex, presumably reflecting many underlying computational operations. Are these the only response patterns available? Are there additional recording or analysis possibilities? The “lens” through which we are viewing semantics from a neuroscience methods point of view remains rather restricted, and applying novel metrics may open the door to new and different insights.
Looking at the larger picture, it is somewhat disappointing that practically every cortical region associated with any aspect of language processing has been implicated in semantics. From the inferior frontal gyrus to parietal areas to superior and middle temporal to anterior temporal areas, every region has been suggested to critically underlie semantics. While this may be true, it is not a satisfying answer, since that does not represent compelling progress regarding which areas contributes precisely which set of primitive operations underlying the semantic question at hand. If there were emerging consensus across theories about what constitutes the elemental operations, that might provide an additional way to fractionate the neurocomputational system. This could be an operation of the type “concatenate features”/“link features” (for conceptual semantics) or “apply function” (for compositional semantics). Perhaps the identification of a set of operational primitives could generate some new experimental paradigms that more explicitly link across the domains ranging from concepts to discourse.

Let us turn to the question of possible convergence. One question that arises upon comparing the contributions of Baggio and Hagoort and Pylkkänen et al. is the following: Could both be right? How might this be the case? One could concede that the process in which compositional semantic effects arise from the syntactic combination of lexical items indeed doesn’t interact with (or is independent of) the meanings that are assigned depending on nonlinguistic world knowledge and expectations. In short, the sentence I ate a cloud means what it does, no matter how implausible it may be when uttered in the present state of the universe. However, the two types of meaning construction could be processed concurrently, consistent with the “Immediacy Principle” of Hagoort and van Berkum (2007), according to which “knowledge about the context, knowledge about concomitant information from other modalities, and knowledge about the speaker are immediately brought to bear on utterance interpretation, by the same fast-acting brain system that combines the meanings of individual words into a larger whole” (Hagoort and van Berkum, 2007, p. 509). In short, even if discourse- and context-based processes act extremely fast—150 ms after word onset according to Van Berkum, Zwitserlood, Hagoort, and Brown (2003)—this is not evidence that compositional processes can be dispensed with, or do not run concurrently as well, possibly even involving the distinctive and nonprobabilistic logical rules of Pylkkänen et al. (2011 this issue).

To take a famous, even if worn-out example, transitional probabilities may enter, in a semantic memory-based stream of processing (Kuperberg, 2007), at every word-to-word transition in the gradual computation of a sentence like Colourless green ideas sleep furiously or He spread his bread with socks, making the probability of the truth of the sentence computed ever more
unlikely as it goes to completion. If so, this seems orthogonal to the compositional meaning that this sentence has, about which there has never been any doubt (clearly it refers to a certain action of sleeping, for example, which happens in a particular way, namely furiously, etc.; and the sentence certainly doesn’t mean what the sentence *Furious ideas sleep colourlessly* means, which has a completely different semantic composition).

In online linguistic processing, then, compositional semantic effects might be difficult to isolate, independent of assessments of plausibility—yet this would not mean they don’t exist. The approach of Paczynski and Kuperberg demonstrates that we can experimentally distinguish combinatorial-syntactic semantic effects from other kinds of semantic information. It is also important to remember that syntax-driven compositional semantic effects are independent of variation in the understanding of lexical items that fill particular syntactic slots. As an anonymous reviewer of this paper points out, for a sentence like “Bond likes blondes”, the interpretations that hearers will construct can always differ: the speaker may refer to the character in the spy books, to the character in the James Bond movies, to the actor who plays James Bond in the movies, to one of these actors (say, Sean Connery) but not another (e.g., Roger Moore), and so on. Similarly, it is a matter of context whether “blondes” refers to women with blonde hair, women who dye their hair blonde, women who used to have blonde hair, men with blonde hair, waitresses with blonde hair, and so on. In other words, though the contribution of the *grammar* in all of these cases is identical, the *lexical information* will always cause variation in the meaning of the proposition computed. Is this an argument against compositionality being psychologically real? No. Compositionality is defined as independent of lexical semantics: a compositional semantic process as defined in, say, Heim and Kratzer (1998), begins once a lexical interpretation function is fixed. The claim is that insofar as the meaning is compositional, the meaning of a sentence follows purely from its structure—once we know what lexical items refer to.

We could allow, then, for Pylkkänen et al.’s claim that the N400 indexes world knowledge more than compositional semantics, and that the N400 is not the neural signature of a linguistically informed semantics. But this does not mean that the compositional construction of meaning is not a part of the kind of loop from temporal to frontal areas that Baggio and Hagoort argue for. Nor is there any conflict with Kuperberg’s “dynamic” analysis of P600 effects.

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3 On the other hand, some combinatoriality seems to be indexed by the N400 as well, and indeed this has been precisely argued for the cases of complement coercion constructions that Pylkkänen investigates, such as “The journalist began the article”. A larger N400 is evoked by such examples in comparison to ones where the action is explicitly specified (e.g., “The journalist wrote the article”; see Baggio et al. 2010; Kuperberg, Choi, Cohn, Paczynski, & Jackendoff, 2010).
according to which, “in parallel with a full, syntactically-driven combinatorial analysis, there are continuous attempts to match semantic relationships in the input against stored semantic associative and featural relationships at various grains of representation, i.e., semantic memory-based processing” (Kuperberg, 2007). The conceptual structures that Taylor et al. argue for, in turn, come into play exactly at the lexical level, being a source of possible variation there, while leaving the grammar-based semantic process untouched.

On this view, there would not be competition but complementarity between compositionality, on the one hand, and the conceptual structure account, on the other. This would be a good result: It has long been argued that, unlike grammar-based meaning construction at the sentence-level, the kind of feature decompositions that account for the meaning of words (lexical meaning) on a conceptual structure approach is not compositional. This is exactly what Taylor et al.’s approach predicts, which (unlike Jackendoff, as noted) offers statistical rather than constituent-structure based decompositions of concepts or word meanings. If so, we expect that the meaning of a word should not be compositionally determined on the basis of the meaning of its parts (features) and the way they are combined structurally. Hence the meaning of words, while decomposed, should not be compositional. Compositionality would be exactly the watershed between a grammar-based and a nongrammar-based semantics. Indeed, the distinction between statistically determined versus principled, formal relationships is receiving increased attention in the cognitive sciences literature on concepts (e.g., Prasada & Dillingham, 2006).

A DISTINCTION FOR FUTURE RESEARCH

The conceptual structure account of Taylor et al. (2011 this issue) does not depend on language and its specific combinatorics, and it is thus conceivable that the concepts investigated by this approach are shared with other animals. “Semantics” thus doesn’t begin with language, exactly as the conceptual structure approach would predict. Jackendoff (2002, ch. 5) argues that prelinguistically available conceptual structures explain why human language, in evolution, took the format it did: the structures in question placed relevant constraints on what needed to be expressed through linguistic forms, explaining the format that these forms took.

Even if we grant that a concept like our concept of animacy is available in animal cognition, however, questions arise as soon as some sort of structure is

4Making the hypothesized statistical structure of a concept relevant compositionally has proved very hard and remains controversial (see Gleitman, Connolly, & Armstrong, in press; Hampton & Jönsson, in press).
imposed on such concepts: the animacy hierarchy, say (nonanimal < animal < human), as studied by Paczynski and Kuperberg (2011 this issue), is presumably not present in the nonlinguistic mind. The question may not even make sense, for the animacy hierarchy is precisely visible in regards to how different argument positions in a sequential string are preferentially processed. The more the structure imposed on concepts is a grammatical one, the more unlikely it becomes that animals will be able to grasp the relevant concepts. Again, that they think exactly like us seems unlikely. So grammar makes some difference for what concepts we can grasp, and one research question for the future must be what that difference is. How, in short, does grammatical organisation contribute to the organisation of meaning or the concepts in which we think? No ghost of “Whorfian” linguistic relativity needs to appear on the horizon here: all that this possibility would mean is that apart from aspects of human cognition that are shared with nonhuman animals, there are other aspects that reflect a species-specific format in human thought in which knowledge is encoded. This knowledge can be as universal as the grammatical structures that, on this view, are required for it.

We close this introduction by suggesting one specific idea about where the difference in question might lie. Let us begin by supposing, with Taylor et al. (2011 this issue), that the kinds of concepts that human words encode (“cat”, “meows”, “animate”, “food”, etc.), while expressed in language, are not linguistically specific, and have their internal structure and content independently of language. As such they could be equally encoded in the calls of nonhuman animals or the symbolic communication of language-trained apes (Tomasello, 2008). We note that one crucial difference would then remain between these concepts and human words: every single human word carries a syntactic category; and presumably, no human concept does.

By a syntactic category we mean labels such as N (for “Noun”), V (for “Verb”), D (for “Determiner”), C (for “Complementiser”), and so on. Categories in this sense have one crucial function in language: unlike substantive lexical content (CAR, HOUSE, DINOSAUR, etc.), they govern the combinatoriality of language. We know, say, that when we have generated a complex verb phrase, such as “has been going shopping”, this syntactic object can be combined grammatically with anything that is a Noun Phrase, no matter what it means (“Tom”, “the man”, “every teddy bear”, “no dinosaur”, etc.). The grammatical machinery, in short, “sees” N, V, etc.—distinctions it is primarily sensitive to when it combines syntactic objects into meaningful sentences. It doesn’t see “dinosaur” as opposed to “teddy bear”, say.5

If so, a crucial question arises of what the combinatoriality of concepts, which do not have syntactic categories, should be based on.
Apart from formal categories governing combinatoriality, there is another crucial fact about words as opposed to concepts. The same concept can be expressed by words that have a different category in the above sense. For example, the concept SMILE can be expressed through the verb “smiles” as in “Mary smiles” and the noun “smile” as in “Mary’s smile”. This is a grammatical difference—a difference related to the occurrence of words in certain phrases—and there is good evidence that the processing of Nouns and Verbs in the brain indeed precisely depends on their grammatical functioning in this sense (Tyler, Randall, & Stamatakis, 2008). The grammatical difference in question does not affect which concept is being referred to: the same concept SMILE is involved in both cases. The difference, we propose, is one of deixis, or how it is used to refer: where nonlinguistic acts do not suffice to express communicative intentions, speakers use words to refer to things, and grammar allows them to direct a hearer’s attention and awareness away from the Self, Here, and Now of the speaker, to the Other, Then, and There. In the verbal case above, in particular, the speaker will use the word in question to refer to a smile as a kind of event and present it as taking place at the Here and Now of utterance and as ongoing at this point. In the other case he will refer to the same concept as if to an object, which need not be present at the utterance time and doesn’t have the aspectual feature of “going on”. In short, temporal and aspectual information is different or missing in this case, and the act of deixis differs accordingly.

The grammaticalisation of concepts as parts of speech, then, has important direct effects in terms of combinatoriality and deixis, and we are led to the conclusion that a creature that had concepts but did not grammaticalise them as words would lack this particular capacity. This would entail no deficiency at all in conceptual understanding, but only in how we can refer to the world in a communicative context, and under what kind of perspectives. For this we need words, and if we wish to distinguish between reference to events and to objects, no lexicon—no lexical semantics—will do. A grammatical semantics is needed (Tyler et al. 2008). It wouldn’t do in particular to encode the event-character of the denotation of the above verb as a further lexical feature (so that, apart from <pleasant>, <radiant>, etc., SMILE would obtain the feature <eventive>). For in “Mary’s smile” the concept is not used so as to refer to an event as opposed to an object; and conceptually or lexically, even Mary’s smile is an event. Hence, an “event-feature” postulated in the feature decomposition of SMILE would not distinguish between the semantic behaviour of these two words as occurring in the relevant constructions.

Grammar, then, at the level of the parts of speech (Nouns, Verbs, etc.), makes a difference to deixis but not to semantics per se, in the sense of lexical
content. But a differentiation between objects and events is, of course, only a beginning. We also distinguish propositions from events. Thus, the proposition *that Mary smiled* involves an event (of Mary smiling). We thus see that more generally, as grammar combines words and creates ever larger structures with changing syntactic categories, new kinds of referential perspectives arise: not new lexical meanings, but novel grammaticalised ways of deictic signalling.

This account gives an answer to the question we posed: which principled difference grammar makes to the organisation of semantic information. Adapting a distinction introduced by Hauser et al. (2002), we could now call semantics that involves forms of grammatical organisation and many other linguistic and nonlinguistic constraints, “semantics in the broad sense”. In this domain, which forms the primary subject of study in an approach such as Baggio and Hagoort (2011 this issue), contextuality will be extensive: the construction of a meaning in this sense is not merely the result of a single system but of many interacting ones. There is a narrower domain of inquiry, however: “semantics in the narrow sense”, which would describe semantics that doesn’t exist in the absence of grammatical forms of organisation. It depends on the presence of syntactic categories, and ways of combining them that exploit narrowly grammatical notions, such as “subject” and “predicate”. To illustrate, let us return to an example mentioned earlier: complement coercion, as in *Mary finished the book*. Hagoort and van Berkum (2007, p. 805) argue that “the meaning of the verb phrase ‘finished X’ differs, based on our world knowledge, for ‘Mary finished the book’ and ‘the goat finished the book’”. Now, in our above terms, while this is perfectly true as far as broad semantics goes, it is false for narrow semantics: the grammatically determined compositional meaning arguably remains the same in the above interpretations. Suppose, in particular, that the syntactic structure is the following:

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   finish
   /   \
V---- the book
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Here V stands for a position that is lexically variable, except that it is constrained to be filled by an action with a verbal character. The compositional meaning of this construction, read off from the syntax, now is: for some contextually specified action performed on the book in question, Mary finished doing this action. There is no indication here, and no need to assume, that the lexical meaning of “finish” differs depending on what is replaced for V in a particular context of speech. Neither is the
compositional semantics—the meaning that is read off from the grammar—ever different.6

In short, from the viewpoint of narrow semantics, the meaning of “Mary finished the book” is always the same; it will always be mapped compositionally from the structure above. On the other hand, and as our earlier example about Bond illustrates, at the lexical level there will always be leeway, and compositionality has no grip on which meaning exactly is assigned here. So the compositional meaning, as determined by the grammar and as an effect of narrow semantics, stays the same throughout: there is some action, X, enacted and completed by Mary, and performed on a book, in such a way that the claim that this is so can be either true or false. Where semantics is in a grammatical straightjacket, it is compositional and invariant; where grammar gives out, meaning becomes more contextual and noncompositional.

The distinction between narrow and broad semantics leaves other questions to be adjudicated. For example, whether thematic roles are parts of the grammatical process or rather an extra-grammatical element of conceptual structure to which grammar is merely linked, is a question yet to be decided. Even the number of “thematic roles” is an open issue in linguistic theory. The same applies to the animacy hierarchy, as noted, and various notions that are grouped as “pragmatic”, but some of which may well be part of the grammar (e.g., “old” vs. “new” information, presupposition, etc., some aspects of which may be syntactically encoded and, hence, be systematic and structure-dependent). More generally, our viewpoint suggests that syntactic organisation in human language is not autonomous or arbitrary but feeds directly into semantics—or one kind of it, namely narrow semantics, which is inherently grammatical. This is not commonly how syntax is looked at, at least in the generative tradition. The task now becomes to identify exactly which grammatical relations establish which semantic relations, and whether there are any aspects of syntax left that have no effect on narrow semantics at all.

The distinction we have suggested thus poses a number of challenges and opportunities to both linguistic theory and neuroscience. As for the latter, the prediction is that certain distinctions crucial to grammatical semantics—like that between nouns and verbs, or, related to that, between objects and events, or between events and propositions—should not be systematically available

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6 From the viewpoint that the semantic combinatorics can be independent of the syntactic one (Pylkkänen et al., 2011 this issue), one might argue that the above syntactic analysis is wrong and there is no ‘V’-node in the syntax (see Pylkkänen & McElree, 2006, for a review). On an alternative view, on which the syntactic and the semantic combinatorics always align (Hinzen, 2006, 2007), the V-projection will be necessary: it will guide the semantics to insert, contextually and on a noncompositional basis, a suitable lexical interpretation for “V”. But perhaps the semantic hypothesis that “some action needs to be inserted” is even conceptually indistinguishable from the structural hypothesis that “some V” needs to be inserted.
to the mind at a level of lexical or conceptual processing only. The task is to experimentally determine which aspects of semantics belong to grammatical semantics and which to lexical semantics. On the proposal briefly outlined here, the former should be intrinsically linked to the deictic use of language in discourse, which we have suggested is the central function of grammar, following the tradition of Ross (1970) and Buehler (1934); see also Crow, 2010. Whatever semantic tasks cannot be performed in the absence of lexical items occurring in certain grammatical configurations will allow us to properly demarcate what conceptual structures are available to the mind/brain independently of grammar.

Overall, there appear to be three distinct levels at which meaning is organised and forms a system: first, the perceptual classification of experiential objects and the statistical processing of their feature decompositions; second, lexical semantics, which exhibits lexical items in hierarchical relations of hyponymy and hyperonomy (as when a car is classed as an artefact, and an artefact as a physical object, say); and third, grammatical semantics, which, if we are right, governs the deictic use of lexical items in discourse. These levels are asymmetrically ordered in respect to one another, and no semantics gets off the ground without the first level.

CONCLUSION

While the papers collected in this special issue seem diverse at first sight, there are many unifying themes. There is something to be said in favour of the claim that the organisation of meaning may be different on the lexical and the grammatical levels, and that categorically different—in particular less contextual and more compositional—effects on meaning construction arise at the level of sentences and what we have called grammatical semantics. We hope that our distinction between broad and narrow semantics helps to sharpen the domain of inquiry in the field of “semantic” processing, perhaps leading to new cognitive neuroscience experiments that aim to untangle this rich and exciting domain of language processing.

REFERENCES


