Semantic structure vs. conceptual structure:
The nature of lexical concepts in a simulation-based account of language understanding

Vyvyan Evans (v.evans@bangor.ac.uk)
School of Linguistics and English Language, Bangor University, Bangor
Gwynedd, LL57 2DG, UK

Abstract

The recent emergence of simulation-based accounts of language understanding (e.g. Barsalou *et al.* To appear; Zwaan 2004) has provided a promising perspective on the relationship between language and conceptual structure in facilitating linguistically-mediated meaning construction. However, these accounts have tended to largely equate semantic structure—semantic representation associated with language—with conceptual structure. This potentially confuses the respective roles of the linguistic and conceptual systems in meaning construction. The present paper argues for a principled distinction between semantic structure and conceptual structure. The main point of the paper, based on linguistic evidence, is to delineate the nature and key characteristics of semantic structure. I argue that semantic structure is highly schematic in nature, a requirement for being directly encoded in language. Semantic structure contrasts with conceptual structure in that the latter relates to rich aspects of perceptual and subjective experience. The importance of this finding for simulation-based accounts of language is that semantic structure cannot directly give rise to simulations. Rather, the function of semantic structure is to provide a level of schematic structure which provides the necessary 'scaffolding' for conceptual representations, thereby facilitating linguistically-mediated simulations.

Keywords: semantic structure; conceptual structure; language understanding; simulation; lexical concept.

The emergence of simulation models

Over the last decade or so models of the conceptual system, and knowledge representation in particular, have begun to emerge which are grounded in the modal systems of the brain. Notable exemplars include Barsalou (1999), Glenberg (1997) and Gallese and Lakoff (2005); see Barsalou (2008 for a review). Such approaches posit the theoretical construct of *simulation*. Simulation is held to be a general-purpose computation performed by the brain on representations captured in specific modal systems (including sensory-motor and prioprioceptive systems as well as systems that process interoceptive experiences, including affect, and other cognitive states). Simulation allows experiences grounded in the brain's modal systems to become activated for purposes of higher-cognitive functioning thereby implementing a fully-functional conceptual system. For instance, modal-specific experiences are held to become available, via simulation, for a wide range of conceptual functions including recall, inferencing, categorisation, and choice.

More recently, accounts of language processing have emerged that have been influenced by these simulation models. One important reason for this is that there now exists a body of empirical evidence supporting the view that language processing involves the activation of simulations (Glenberg & Kaschak 2002; Kaschak & Glenberg 2000; Pulvermüller 2001; see also Zwaan & Kaschak 2008). From this perspective, language understanding involves the activation of simulations as part of the meaning construction process. A number of theoretical models have been proposed which attempt to account for: i) how linguistic representations interface with the modally-grounded representations in the conceptual system, and ii) how they do this in service of linguistically-mediated meaning construction. Notable examples include Embodied Construction Grammar (e.g. Bergen & Chang 2005), the Immersed Experience Framework (Zwaan 2004), and the Linguistic and Simulation Systems (LASS) approach (Barsalou *et al.* To appear).

The challenge for simulation-based accounts of language understanding

A fundamental challenge for simulation-based accounts of language understanding relates to the respective contributions of linguistic knowledge—*semantic structure*—and the conceptual representations that are stored in the conceptual or simulation system—*conceptual structure*. Put another way, is there a level of semantic representation that is purely linguistic in nature? And if so, in what way does it interface with conceptual representations in order to facilitate a specific simulation?

As with the other simulation-based accounts mentioned above, the LASS approach proposed recently by Barsalou *et al.* (To appear) assumes there is a distinction between knowledge that is purely linguistic in nature, and knowledge that is grounded in the brain's modal-specific systems, which is hence conceptual in nature. That is the LASS approach makes a principled distinction between linguistic versus conceptual representations, each of which are held to inhere in two distinct systems, a linguistic system and a simulation (=conceptual) system.

On the LASS account, linguistic knowledge relates primarily (or solely) to what we might informally think of as 'formal knowledge': knowledge relating to the collocational patterns in which lexical items appear, based on statistical

probabilities.[1] In the LASS approach then, linguistic knowledge does not include what might be labelled 'lexical meaning': the semantic contribution associated with a given word in any specific context of use. Rather, word meaning arises by virtue of a particular lexical item prompting for or provoking a particular re-activation of a specific brain state (i.e. a simulation). Hence, on this account, semantic structure is equated with conceptual structure. The upshot is of this is that there is no independent level of semantic structure. Language solely encodes formal knowledge, and must access conceptual structure in order to derive meaning.

The non-distinctive nature of semantic structure and conceptual structure

Yet there are good reasons for thinking that there is a level of semantic structure conventionally encoded by language, in the linguistic system, which is distinct from conceptual structure in the conceptual (or simulation) system.

Research in the tradition of cognitive linguistics has revealed that linguistic units such as words are associated with semantic content of distinct types, as exemplified, most notably in the work of Langacker (e.g. 1987) and Talmy (e.g. 2000). The two types of content involve what we might refer to as 'rich' content versus 'schematic' content. Moreover, this bifurcation is associated with distinct classes of words. Schematic content is associated with closed-class linguistic units such as prepositions (e.g. *on*) determiners (e.g. *these*, *my*), the copula or 'linking' verb (e.g. *are*) and bound morphemes such as the plural marker (e.g. *-s*), and the progressive marker (e.g. *-ing*). In contrast, rich content is associated with open-class linguistic units such as nouns (e.g. *cowboy*, *flowerbed*) and verbs (e.g. *trample*). These are all illustrated in (1), with the closed-class elements highlighted in bold:

(1) **These** cowboy**s are** trampl**ing on my** flowerbed**s**.

This example illustrates that the open-class words (*cowboy, trample, flowerbed*) relate to rich contentful details, such as the nature of the participants, the nature of action(s) engaged in, and the consequences. In contrast, the closed-class elements provide a crucial level of schematic structure providing a 'scaffolding' or 'skeleton' for the rich content. For instance, if we remove the open-class words in (1) this leaves the following schematic content: 'these somethings are somethinging my somethings', which provides the following information: 'more than one entity close to the speaker is presently doing something to more than one entity belonging to the speaker'. Although this level of semantic representation is schematic in nature, it is meaningful and, in fact, provides rather a lot of information.

In short, linguistic units appear to facilitate activation of two distinct types of content: a rich contentful type, and a schematic type. It is plausible that simulation-based accounts such as LASS, which equate semantic structure with conceptual structure are thinking in terms of the rich content associated with open-class word-forms, rather than the schematic content also associated with lexical items. Schematic content of the sort just discussed is more likely to be the province of linguistic representation rather than conceptual representations, precisely because conceptual structure deals in the relatively rich re-activations of experiences grounded in the brain's modal systems. By definition, these representations are likely to be qualitatively far richer than the semantic representations associated with, for instance, closed-class lexical forms.

That said, there is also reason to think that open-class lexical items also encode schematic content while simultaneously facilitating activation of a simulation, and hence rich content. As an example, consider the following sentences adapted from those used by Zwaan (2004). Our focus here is on the lexical item *red*:

(2) The teacher scrawled in red ink on the student's homework exercises.
(3) The red squirrel is almost extinct in the British Isles.

The distinction in meaning of 'red' across these examples suggests that language has a role in facilitating simulations. After all, the same word form, *red*, gives rise to distinct mental rehearsals (i.e. simulations). The use of *red* in (2) gives rise to the perceptual experience of a bright red hue, while the use in (3) ordinarily gives rise to a dun/browny hue. The fact that the same word is implicated in distinct perceptual rehearsals is suggestive that the same word plays a role in the activation of conceptual (i.e., non-linguistic) knowledge. That is, *red* appears to have a role in the activation of rich content.

Yet *red* must also encode schematic content. Part of our knowledge of this lexical item is that it encodes a quality of some sort, which is why it can modify (syntactically) the noun. Put another way, our knowledge of how words can be arranged comes from knowing how the words combine— their valence—which is a function, in part, of the sorts of schematic meanings they encode. The lexical item *red* encodes a conceptually dependent relation of some sort which we can think of as having a schematic slot for a conceptually independent entity which can complete or, more technically, *elaborate* the slot (Langacker 1987). Simply put, there is schematic content associated with *red* in the same way that there is with closed-class elements. The difference is that *red* also interfaces, in some way to be determined, with the conceptual system allowing the activation of conceptual structure.

There are two other, more anecdotal, but nevertheless suggestive reasons for thinking that semantic structure and conceptual structure are wholly distinct types of representation.

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[1] For instance, it is well known from corpus-based research in linguistics that language users must represent complex statistical patterns as to the collocational patterns associated with words and other linguistic units, such as grammatical constructions (e.g. Gries 2006; Gries & Divjak To appear)

Firstly, it can often be difficult to express a particular thought, idea or feeling in words. That is, there is a mismatch between conceptual and semantic representational possibilities. One manifestation of this is that there exist concepts for which we don't have specific lexical items, such as the place on the face above the lips where a moustache is located (See Murphy 2002, and Langacker 1987 for related points).

Second, recent research suggests that there are commonalities across the conceptual capabilities, and hence conceptual systems of cognitively modern humans and primates, and indeed other species (Barsalou 2005; Hurford 2007). Yet none of these other species have language. This is suggestive that the nature of the representations in the linguistic system are of a wholly distinct kind from that of the conceptual system. If they were commensurable, it is conceivable that other species would have evolved language, given that other species have various albeit limited forms of non-linguistic communication. The thrust of my argument is that an important part of linguistic representation is semantic structure. From this it follows that other species have conceptual structure, but not semantic structure, and hence no language.

The relationship between semantic structure and conceptual structure

My general proposal is that the schematic content associated with both open and closed-class forms constitutes a level of semantic structure which is specialised for being directly encoded in the time-pressured symbolic representational format provided by language. This level of representation is wholly distinct from the conceptual representations, grounded in the modality-specific systems of the brain. Representations of the latter sort are, in relative terms, far richer in terms of the nature of the content involved, which can give rise to re-activations (=simulations) of modality-specific experience.

My specific proposals are as follows. i) All linguistic units (open and closed-class lexical forms) encode schematic content: semantic structure; ii) nevertheless, semantic structure takes a representational format (detailed in later sections) which is language specific. Specifically, as it is specialised by being directly encoded in language, it is highly schematic in nature; in addition, iii) open-class lexical items (but not closed-class lexical items), facilitate access to the conceptual system. Each open-class lexical item has an *access site*—a specific point in the conceptual system, discussed later—to which it facilitates access; and finally, iv) the 'formal' knowledge such as collocational patterns, for example as ascribed to the linguistic system by Baralou *et al.* in their LASS approach, is a type of semantic knowledge. Hence, formal linguistic knowledge, including collocational and word order information (what we might think of as 'syntax'), also forms part of semantic structure.[2]

I model semantic structure in terms of the theoretical construct of the *lexical concept*, which I detail below.[3] Figure 1 captures the way in which open-class (but not closed-class) lexical concepts facilitate access to conceptual structure.
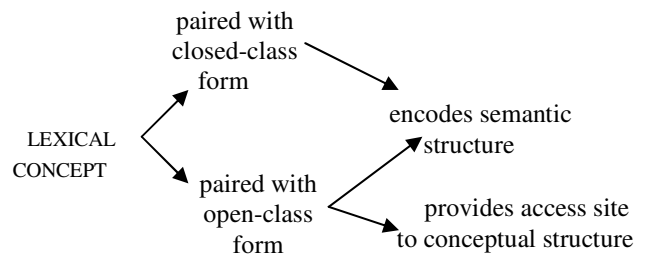

Figure 1: The distinction in content associated with lexical concepts.

Characteristics of semantic structure

A lexical concept constitutes a unit of semantic structure. It represents the informational form that conceptual structure takes for *direct* representation *in* language. Put another way, semantic structure takes a form that can be encoded in a format that is externalised in an auditory stream (or a manual gestural stream in the case of signed language), which is time-pressured. Such a format requires filtering out the complexity associated with the range of rich sensory-motor, proprioceptive and subjective/affective experiences, and so forth, encoded by conceptual structure. Hence, a lexical concept can be thought of as a 'bundle' of different types of highly schematic content which is thereby specialised for being encoded in language.

As closed-class forms are hypothesised to encode semantic structure without facilitating access to conceptual structure, an examination of the range of information conventionally encoded by closed-class forms provides an index as to the nature and extent of semantic structure. Hence, content that is not encoded by closed-class forms (yet which is accessible via open-class forms) cannot be, from this perspective, encoded in semantic structure. Accordingly, we can build up a taxonomic picture of the nature and make-up of semantic structure by examining closed-class forms.

Parameters

One way in which knowledge can be represented is in terms of richly inflected nuances that serve to reflect the complexity of experience. An alternative way is to 'compress' such fine distinctions into two, three or more, much broader, and hence, far more general distinctions. These I refer to as *parameters*. Semantic structure encodes

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[2] In this I am assuming a constructional perspective (see Evans To appear for details).

[3] The lexical concept is a central theoretical construct in a larger theoretical framework termed the Theory of Lexical Concepts and Cognitive Models (or LCCM Theory). LCCM Theory attempts to develop a cognitively realistic account of lexical representation and semantic composition (Evans 2006, To appear).

content by adopting the latter strategy. Parameters are hence part of the bundle of information that a lexical concept encodes.

To illustrate this notion, consider the complex range of expressions that a language user might employ, in English, in order to 'locate' themselves with respect to time, thereby facilitating time-reference. Any one of the following open-class forms could be used, depending on context: *today, January, 2009, the day after yesterday, the day before tomorrow, this moment, now, this second, this period, the 8th day of the month, this era, this millennium*, and so on.

In contrast, paramaterisation functions by dividing all the possible permutations relating to a given category, such as time-reference, into a small set of divisions: parameters. Such parameters might distinguish between the past, for instance, and the non-past. Indeed, this is the basis for the tense system in English, as illustrated by the following:

(4) a. He kick**ed** the ball   Past
    b. He kick**s** the ball   Non-past

English encodes just two parameters that relate to Time-reference: Past versus Non-past, and thus manifests a binary distinction. Some languages, such as French, have three parameters: Past, Present and Future. Some languages have more than three parameters, distinguishing additionally remote past from recent past, for instance. The language with the most parameters thus far reported is an African language: Bamileke-Dschang with eleven. Crucially, parameters are encoded by specific lexical concepts, and thus form part of the knowledge bundle that constitutes a lexical concept. For instance, the parameter Past is encoded, in English, by the lexical concept associated with the *–ed* form in (4a). However, other lexical concepts also include the parameter Past such as the lexical concepts associated with the following forms: *sang, lost, went*, etc.

A key feature of semantic (as opposed to conceptual) structure is that it encodes knowledge in parametric fashion. Parameterisation is a highly reductive form of abstraction: it serves to abstract across the complexity exhibited by a particular category. In consequence, the parameters encoded by semantic structure 'strip away' most of the differences apparent in the original experience, thereby reducing it to a highly limited numbers of parameters.

The non-analogue nature of semantic structure

As conceptual structure, in a simulation account, relates to records of multimodal states captured directly from a variety of experience types including sense perception, proprioception and subjective experience, it therefore consists of multimodal states recorded in analogue fashion: in a format that is similar to the modality-specific experiences that gave rise to them (see Barsalou 1999).

In contrast, schematic structure is so highly schematic in nature that it is *non-analogue*: it takes a format that is not analogous to the perceptual and subjective experiences that it is a schematisation of. Hence, due to the reduction of rich modality-specific information to highly impoverished parameters, this gives rise to a qualitatively very different type of information from the kind captured by conceptual structure. To illustrate, re-consider the parameters Past and Non-past discussed with respect to example (3). These parameters are highly schematic abstractions drawn from the complex range of temporal relationships that hold between our experience of past, and our experience of now: our temporal location as experiencing centres of consciousness. Temporal experience, a form of subjective experience, is extremely rich in both perceptual and phenomenological terms (Evans 2004). Yet the parameters Past and Non-past are not rich in these respects at all.

In sum, parameters encode highly schematic aspects of experience abstracted from far richer multimodal experiences, as recorded in the conceptual system, and provide a means for encoding recurrent 'digitised' dimensions of humanly relevant experience in an efficient way. In contrast, conceptual structure which is accessed via open-class lexical concepts, gives rise to perceptually and phenomenologically rich aspects of experience.

Topological reference

A further consequence of the highly reductive nature of the parameters encoded by lexical concepts is that they provide *topological reference* rather than *Euclidean reference* (cf. Talmy 2000). Semantic structure encodes schematic (i.e., topological) aspects of sensory-motor, proprioceptive and subjective experience, while conceptual structure relates to precise, metric (i.e., Euclidean) distinctions.

To illustrate consider the closed-class lexical concepts associated with the demonstrative forms 'this' and 'that'. The lexical concepts associated with these forms encode a distinction between an entity construed as proximal to the speaker. This distinction is illustrated by (5):

(5) "Sit on this chair not that one!"

In this utterance, the chair that the addressee is being asked to sit on is the one closer to the speaker: 'this chair' as opposed to 'that one'. Nevertheless, the distinction between 'this' versus 'that' does not rely upon precise metric details such as the exact distance from the speaker, in terms of metres, centimetres and so on. After all, it is immaterial how far the chairs are from the speaker (within reason), as long as one is closer to the speaker than the other. In other words, closed-class lexical concepts are *magnitude neutral*, where magnitude has to do with metric properties relating to distance. This is what it means to say that closed-class lexical concepts provide topological reference.

In contrast, the open-class lexical concepts, in addition to encoding semantic structure also, additionally, facilitate access to conceptual structure, and hence can be employed to express metric details of distance giving rise to Euclidean reference. This is illustrated by (6):

(6) "Sit on the chair 2.54 metres away from me!"

A restricted set of domains and categories

A consequence of parameterisation is that the range of *domains*, and the member *categories* that populate them, are highly restricted in terms of their encoding as parameters in semantic structure (cf. Talmy 2000). The term *domain* here denotes a large-scale and coherent bodiy of conceptual knowledge such as: TIME, SPACE, COLOUR, MOTION, FORCE, TEMPERATURE, MENTAL STATES, and so on. By *category* I mean the member notions that populate a particular domain. For instance, in the domain of TIME, categories consist of notions such as Punctuality, Durativity, Sequentiality, Simultaneity, Synchronicity, Boundedness, Time reference (e.g. Past, versus Non-past etc.), Time-reckoning (e.g. 10.05pm, etc.), and so forth. While *all* the domains of the sort just mentioned, and the categories which populate them, are evident at the conceptual level, only a restricted subset are encoded in semantic structure.

For instance, some domains to which open-class lexical concepts facilitate access, such as COLOUR, are not encoded at all by closed-class forms in English or other languages. That is, there appear to be no parameters that relate to this domain. From this we can conclude that the domain COLOUR is not directly encoded in semantic structure. This does not mean that language cannot facilitate access to knowledge relating to COLOUR. However, this is achieved by open-class lexical concepts interfacing with conceptual structure giving rise to a simulation, as in the example involving *red* discussed earlier.

The finding that semantic structure involves a restricted set of domains (e.g., it excludes COLOUR) may follow as many domains do not relate to experience that can be straightforwardly parameterised in a humanly relevant way. There is at least one likely explanation for this. The nature of the domain in question may not lend itself to being 'reduced' to highly schematised digitised parameters: the format required for encoding in semantic structure. After all, the reduction to content that does not directly give rise to simulations results in a reduction that, for some domains such as COLOUR, may eliminate the essential character of the information thereby making it un-interpretable.

Referentiality

The final aspect of semantic structure that I consider here is *reference*. Referentiality takes a number of different forms, one of which is illustrated below. However, the defining feature is that lexical concepts serve to encode an intention that a particular entity is being indexed or, more informally, 'pointed to'.

One type of reference is *contextual reference*. This involves reference to an entity that is present in the linguistic or extra-linguistic discourse context. Hence, contextual reference involves the encoding, by a lexical concept, of an intention to refer to an entity that the addressee can recover from context.

One type of contextual reference is *textual reference*. One form of textual reference involves reference to an entity already mentioned, traditionally termed *anaphora*. Textual reference that relates to an entity yet to be mentioned is termed *cataphora*. Examples of textual reference are in (7).

(7)   a. <u>John</u> is smart. **He** had a reading age of 14 by the time **he** was just 8.
      b. I want to say just **this**: <u>I love you</u>.
      c. <u>The new target to reduce carbon emissions by 20% by 2020</u> will be a tough **thing** to achieve.

In the examples in (7), the lexical concepts associated with the forms *he*, *this* and *thing* are specialised for referring to other entities (underlined) in the text.

Interaction between the linguistic and conceptual systems

A key feature of knowledge representation in humans is that the linguistic system interacts with the conceptual system in order to facilitate access to conceptual knowledge. Indeed, as philosopher Jesse Prinz (2002: 14) has observed:

> Concepts must be capable of being shared by different individuals and by one individual at different times...it is almost universally assumed that concepts play a pivotal role in linguistic communication.

While the human conceptual system evolved for purposes of perception and action in the world, a fundamental design feature of human cognition, I argue, is that linguistic representations provide an indexing and control function, greatly increasing the range of uses and flexibility of the human conceptual system (see also Barsalou *et al*. To appear).

The primary way in which the representations inhering in the linguistic and conceptual systems interact is by virtue of access sites. An access site is a theoretical construct (Evans To appear) which represents a composite of the range of *association areas* that hold between an open-class lexical concept—recall that lexical concepts conventionally associated with open-class forms facilitate access to conceptual structure—and the conceptual system. An association area is a location in the conceptual system with which a specific lexical concept is associated. In other words, an association area provides a point of convergence between the two systems facilitating interaction between content from both. As a given lexical concept has typically many association areas, an access site constitutes the set of association areas for a given lexical concept. For example, the lexical concept for *red* is associated with many representations for individuals and types, each with its own distinctive hue, throughout the conceptual system. All the association areas collectively comprise the access site for this lexical concept. Moreover, it is precisely because an access site consists of a large number of association areas that open-class words, such as *red*, can facilitate distinct simulations, as we saw in the discussion earlier.

What then is the role of semantic structure in facilitating a linguistically-mediated simulation? Recall that semantic

structure constitutes a highly schematic type of content, which is directly encoded in language and which does not directly facilitate access to the conceptual system. It is characterised as i) consisting of parameters, ii) being non-analogue in nature, iii) encoding topological as opposed to Euclidean aspects of experience, iv) encoding a restricted set of domains and categories, and v) encoding reference. I argue that role of semantic structure, in facilitating simulations, is as follows. It provides the necessary schematic template that allows identification of a specific association area for a given open-class lexical form. For instance, *red* involves a vast number of association areas in the conceptual system: it can potentially give rise to a vast range of different sorts of simulations. The semantic structure encoded by the open and closed-class lexical concepts that make up the sentences in (2) and (3) provides a means of 'tying down' precisely which association areas are to be activated, giving rise to a simulation. Simply put, the semantic structure encoded in language provides the basis for narrowing down which aspects of conceptual structure are simulated in language understanding.

Conclusion

Simulation-based accounts of language understanding (e.g. Barsalou *et al.* To appear; Zwaan 2004) have provided a promising perspective on the relationship between language and conceptual structure in language understanding. However, such accounts have tended to largely equate semantic structure with conceptual structure. This potentially confuses the respective roles of the linguistic and conceptual systems in meaning construction. I have argued that while conceptual structure relates to rich aspects of perceptual and subjective experience, semantic structure is highly schematic, and is directly encoded in language. The importance of this finding for simulation-based accounts is that semantic structure cannot directly give rise to simulations. Rather, the function of semantic structure is to provide schematic structure which gives the necessary 'scaffolding' for conceptual representations, thereby facilitating linguistically-mediated simulations. This is achieved as semantic structure allows linguistic representations to pinpoint the precise conceptual representations to be activated by open-class lexical concepts in the conceptual system. This gives rise to the 'correct' simulation. I have argued that studying the semantic properties associated with closed-class forms provides a methodology for identifying the nature of semantic structure. The findings presented here will assist, it is envisaged, the development of simulation-based accounts of language understanding by providing a firmer footing for distinguishing between the nature and respective contributions of the linguistic and conceptual systems in language understanding.

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