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Mechanisms of Meaning
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Linguistic meaning and perceptual symbols

Introduction

What underlies the meaning of language in the mind? In cognitive science it has long been assumed to be a Language of Thought (Fodor 1975), an innate variety of first-order logic. Another possibility, which has a longer history, is that perceptual imagery is the main form of mental representation. A recent version of such a theory is the one presented by Barsalou et al. I will first present this theory and then assess whether it can really account for the meaning of language, in light of reflections on symbolic reference.

Perceptual symbols

Barsalou (1999), a target article in the Behavioral and Brain Sciences journal, presents a sweeping vision fully integrating perception and cognition.

Up until the demise of introspectionism it was commonplace to grant a major role to imagery and perceptual representations in the mind. Influential philosophers such as Locke, Hume, Berkeley, and Kant all subscribed to such ideas. However, since behaviorism's rejection of the mental (i.e., any form of mentalism), perception had to go as well. Mentalism returned with cognitivism, which replaces the perceptual and imagistic representations with so-called amodal representations. Amodal representations are like the symbols in logic and programming languages in that they can be operated on without any regard to their content.

Take the example of a chair, cited in Barsalou (1999). A modal representation of a chair is derived from seeing any number of chairs, after which an average chair, or perhaps a silhouette, is extracted. Although this image or image schema of a chair will contain less detail than the original, it will clearly share structural features, such as having four feet.

An amodal symbol, on the other hand, will share no such structural features. There needs to be a translation step, also called transduction, to get from a perception to an amodal symbol such as "chair." The use of an English word here is misleading, because from a symbol system's perspective it might as well have been `G778`, i.e., amodal symbols are arbitrary. This might not seem disconcerting, if only one accepts that natural language semantics works like that of formal languages; that assumption is far from obvious, however. Examples of such amodal representations are feature lists, frames, schemata, semantic networks, and production systems. Clear

advantages of these symbols are their ability to represent propositions and abstract concepts, to recombine productively, and to produce inferences.

Important problems with amodal symbols are the problem of transduction and the grounding problem. The first is about connecting the information from the senses to the internal symbols that are assumed to be the real mental representations of cognition. This problem is usually not dealt with as perception has been viewed as rather separate from the rest of cognition. The second problem is about where the ultimate meaning of symbols derives from. Symbols are of course defined in terms of other symbols, just as dictionary entries contain definitions made up of words. However, some words like 'pain,' 'red' and 'warm' seem to be very experiental in nature and hard to describe or define. This problem can be solved by letting meaning derive from the external world through sensory experience, instead of only from the web of internal relations of symbols; in effect, by allowing for modal information after all.

Another problem with amodal symbols is that there is simply no direct evidence to support them, which is all the more troubling given that they form an unfalsifiable hypothesis which can explain any data as being the result of underlying amodal symbols in a *post hoc* fashion (Barsalou 1999, sect. 1.2.3). The perceptual symbol system hypothesis, on the other hand, makes *a priori* predictions which can be tested.

Perceptual symbols can be both unconscious and conscious, in contrast to the classical empiricist theories which were only about conscious imagery, seen in the mind's eye. Furthermore, perception is often characterized as analogue but also holistic, taking in the whole of a situation without focus on any specific area. If this were true, perception would be like a recording device such as a photo camera or tape recorder, which does not interpret or compress information but reproduces an attenuated copy of experience. This view of perceptual representations as holistic is one of the most important reasons that they are rejected by most cognitive scientists. This leads to a received view where the perceptual and conceptual are mutually exclusive.

Another important point is that perceptual is taken to be rather broad by Barsalou, as it includes not only information from the five senses, but also proprioception (the state of one's body and muscles) and introspection (what goes on in the mind's eye). Together these sources of information are stored and reproduced in simulations, which is a top-down activation of sensory-motor areas to re-enact perceptual experience. Once a particular object has been witnessed repeatedly as being relevant, a simulator is formed. A simulator consists of a frame and simulations associated with the simulator. A frame is what adds structure to a perception. In the case of perceiving cars, subregions may come to be identified, through selective attention, after which doors and wheels may become their own simulators. Each new car that is seen is matched against the existing simulator with the highest activation. This process of framing always happens relative to other

concepts in a situation, in other words meaning is background-dependent.

Up till now perception can be parsed into components, which are integrated into frames. This amounts to a basic conceptual system. A full conceptual system also has (1) productivity, (2) propositions, and (3) abstract concepts.

Productivity can be seen as reverse of the just sketched symbol formation process. Given a number of distinct simulators, a complex simulation can be formed, such as the plane flying next to a cloud in Barsalou (1999, sect. 3.1). On the one hand productivity relies on schematization, where perceptual input is filtered out to arrive at a more general concept; on the other hand it relies on the complementary notion of specialization, where for example the concept of 'ball' can be specialized into 'red ball.' Aside from filling in schematic features, structures can also be transformed, replaced and deleted. Productivity explains the power of imagination to surpass experience.

Once there is productivity, there can be propositions that conceptualize a situation in a certain way. To form a proposition is a creative act, because it is one of an infinity of possible construals. The simplest type of proposition is a type-token mapping, such as "that is a car" when recognizing a car, where a certain simulator produces a simulation matching a situation. With the help of productivity, propositions can become arbitrarily complex.

An important feature of propositions is that they should have intentionality, in other words they should have the ability to be about something. Intentionality for perceptual propositions is determined through both the content and external factors such as causal relationships, whereas for amodal symbols it can only be through external factors related through form, since they are arbitrary symbols and thus have no content. Since the content of perceptual symbols plays a role they can be recognized with heuristics, such as noting a resemblance; however, content is neither necessary nor sufficient for establishing a referent.

The fact that perceptual symbols can work with analogical reference implies that embodiment is crucial to their functioning. The result is that different perceptual systems also lead to different conceptual systems, a phenomenon referred to as variable embodiment.

The final feature of a full conceptual system is its ability to represent abstract concepts. An approach popular in cognitive linguistics, with a similar emphasis on the sensory-motor system, argues that all abstract thought derives from metaphors (e.g., Lakoff & Jonhson 1980). Barsalou argues against this on two grounds. Using the example of 'anger' with the purported underlying metaphor 'liquid exploding from a container,' he argues that this cannot form a sufficient representation for the concept of 'anger,' because it does not supply a direct, underlying concept; this concept should firstly supply a basic understanding of the domain, and secondly it should guide the mapping to concrete domains such as the exploding liquid in this example. Another issue is that in frequently used metaphors it is very reasonable

to suppose that they function through polysemy, rather than through a metaphorical mapping. This last point reveals the tension between conceiving of metaphor as conceptual versus linguistic. In the example of anger this would mean that "he exploded with anger" is no longer metaphorical, but instead relies on an emotional sense for "exploded."

Barsalou's proposal of representing abstract concepts is to do it directly with perceptual symbols. The proposal has three features: (1) an abstract concept is framed against a background of a simulated event sequence, (2) selective attention highlights the core content, (3) introspective states play a central role, especially in the formation of a propositional construal.

According to these three features the formation of an abstract concept in a perceptual symbol system can be explained. The concepts of truth and disjunction are explained in this manner (Barsalou 1999, section 3.4.3–3.4.4). For the concept of truth this proceeds as follows. In one situation an agent simulates a balloon above a cloud, perhaps after hearing someone talk about it. Then this simulation is mapped to an actual scene that is perceived, and a correspondence of a balloon actually being above a cloud is noted. After repeated occurrences of such a sequence, an abstract concept of truth can emerge; at least the everyday sense of truth.

Language and Situated Simulation

In Barsalou et al. (2008), the perceptual symbol system hypothesis returns in extended form. The principal difference is the introduction of a separate language system responsible for shallow processing of word forms. This allows for explaining differences in reaction times in priming effects with words and pictures. The language system is described as a distributional semantic model (DSM), which can generate associated linguistic forms for a given word.

Language comprehension is equated with the construction of a perceptual simulation. The words are taken as instructions in guiding the construction of the simulation. The resulting conceptualization then functions as the gist of the sentence. The gist is what people remember after the exact formulation of the sentence has been forgotten.

The language and simulation system act in parallel, though not in the matter of independent modules but with extensive interaction. To produce an utterance for a situation in mind, the situation is scanned for particular regions which can be categorized, after which associated linguistic forms are activated; finally these are integrated and translated into a motor program to pronounce the utterance.

Barsalou et al. (2008) note the following on the relation between language and thought:

> Whereas simulations represent the content of thought, words

> provide tools for indexing and manipulating this content [...].
>
> In general, we assume that linguistic forms provide a powerful means of indexing simulations (via simulators), and for manipulating simulations in language and thought.

It is clear that the role of language in the LASS theory is a rather shallow one, and most of the work is assumed to be done by simulations. On top of that it is puzzling why attention should be restricted to linguistic forms. Additionally, it is unfortunate that seemingly all of the empirical evidence relates to single words, without any strategy to generalize to sentences. Thus it seems to be rather presumptious to use the term "language system," when actually the results seem to be restricted to "a system of word forms."

Criticism of perceptual symbols

The two core properties of perceptual symbols are:

- neural representations in perceptual systems (sect. 2.1)
- schematic perceptual symbols (sect. 2.2).

Both of these are problematic. The first because it violates the personal-subpersonal distinction (as noted by Dennett in the peer commentary). On the one hand there are subpersonal neurons, wired together in intricate patterns and firing according to the laws of causality. On the other hand there is the personal level at which meanings play a role and people report on thoughts.

The second point refers to the claim that perceptual symbols consist of schematized perceptions. The question is, what grounds are there to call them 'symbols,' if they are merely schematized associations — in other words signs correlated with objects. This is problematic because in that case symbols cannot rise above the level of indexical reference to the level of conventional and arbitrary reference. Arbitrary reference can be viewed as a *symbolic leap* (more on this in the next section), when one can summarily declare "from now on this squiggle will stand for [...]."

Tomasello (2003) makes this point by arguing that what distinguishes linguistic symbols is that they are intersubjective and perspectival. His hypothesis is that communication and cognitive representation are closely interrelated:

> As the young child internalizes a linguistic symbol or construction — as she culturally learns the human perspective embodied in that symbol or construction — she cognitively represents not just the perceptual or motoric aspects of a situation, but also one way, among other ways of which she is also aware, that the current situation may be attentionally construed by "us," the users

> of the symbol. The intersubjective and perspectival nature of linguistic symbols thus creates a clear break with straightforward perceptual or sensorimotor cognitive representations.
> – Tomasello (2003)

This interpersonal aspect of symbols is completely neglected by Barsalou. The productivity of perceptual symbols in imagination allows for displaced reference — an oft cited feature distinguishing human from animal communication. However, the perspectival and intersubjective nature presents a much bigger challenge. For example, to represent a situation with multiple participants, first person perceptual experience is not enough; to represent a concept such as "hide and seek" requires a combination of first and third person perspective so that each role can be envisioned. Sensory-motor interactions with the world undoubtedly form the bedrock for cognitive development. However, for higher cognition and especially language, social interactions appear to be crucial as well.

That every abstract concept must derive from perceptual content seems to me an unnecessary dogma. The explanations of how truth and disjunction derive from perceptual experience seem similar to Lakoff & Johnson's (1980) insistence that abstract concepts must derive from bodily metaphors such as 'more is better.' Such explanations are *ad hoc* at best. The main problem is that they both rely on the inventors of the theory to come up with plausible stories for each concept, because it is not at all obvious how it is supposed to work. Although there is the advantage that there is a lot of literature on the sensory-motor system,[1] the thesis that cognition is perceptual all the way down seems even more implausible than the idea that language-like symbols underlie all of cognition. A better theory should combine the grounding in perception with definitions in terms of other symbols.

The triadic theory of symbols

Deacon (1997) presents an account of the co-evolution of language and the brain. Compatible with Barsalou's emphasis on the use of the sensory-motor system, he argues that the brain evolved to deal with concrete sensory-motor tasks (recognizing enemies, acquiring food, etc.). In contrast to Barsalou, however, he stresses the special nature of language in contrast to other forms of cognition. Although language and the brain co-evolved in parallel, the evolution of language occurs at a cultural-historical pace (as opposed to phylogenetic or ontogenetic). This implies that it is very likely that language is thoroughly adapted to suit to human brain, as opposed to the other way around. This explains why the attempts to isolate a language module or a

[1] "Much more is known about how brains implement perception than about how they implement cognition." (Barsalou 1999, sect. 4.3)

Language Acquisition Device (LAD) have failed, and also why human brains are structurally so similar to those of other primates.

The two areas that are often cited as the language areas, Broca's and Wernicke's area, are not the sites of concrete features of language such as grammar or semantics, because often patients recover and the symptoms of brain damage to these area differs greatly depending on the language of the patient (e.g., inflected versus analytic). Deacon notes that a better explanation of these areas is that they serve as two bottlenecks of language, speech production and perception, respectively. Instead of looking in the brain and mapping specific language functions to it, we should be trying to map language functions on existing brain functions. This idea seems very compatible to Barsalou's framework in which the perceptual is the groundwork for all cognition, except that Barsalou does not grant a special status to words — it seems he views them as mere labels to summon, index and manipulate simulations.

Deacon argues that the most important feature that sets humans apart from other primates is symbolic reference. Symbolic reference is more than just an association of a word and an object (or concept). Such an association would need to be maintained by reinforcement continually, say a dog that expects to eat when it hears the phrase "let's eat." If the phrase would be uttered in other situations, it would start to lose its 'meaning.' For humans, the phrase is *understood*, whether it is applicable to the current situation or not. Another distinguishing feature of symbolic reference is that it is indirect, mediated by a web of other symbols.

Following Peirce's triadic theory of signs, there are three levels of reference:

iconic: relies on similarity to referent (analogical)

indexical: a physical or temporal correlation

> An index is an association of two icons, for example sound images of a word and percepts of an object (Saussurean signs).

symbolic: conventional and arbitrary

> A symbol arises from a web of indexical relations to other symbols; similarly, the system of symbols bears an iconic relation to the collection of relationships among the objects symbolized.

None of these modes of reference is causal, rather they arise when something is interpreted as a sign. Thus not everything with a resemblance to something is automatically an icon, it is only when a sign is designed or clearly used that way that it is an icon. Also, while some gestures in American Sign Language (ASL) may seem 'merely' iconic, they actually function symbolically. The triadic account of reference represents *levels* of interpretation, each building upon the previous one hierarchically.

However, to cross the symbolic threshold requires unlearning indexical correlations (e.g., expecting to see an apple upon hearing the word 'apple'),

and integrating a large number of relations into a coherent web of signs and relations. Crossing of the symbolic threshold is described by Deacon as as symbolic insight in which previously learned indexical relations are restructured after they are seen in a new light. Once a pattern is discovered lots of individual correlations can be reduced to a single symbolic meaning, in effect it is about discovering a more efficient representation. The so-called critical period of language acquisition could be viewed as a period of receptivity to the patterns implicit in the vocabulary of natural languages, presumably because the prefrontal cortex, which is associated with abstract thought and inhibiting behavior in adulthood, is idle and available to detect these patterns at this time.

What emerges is a system of signs whose reference is not determined directly but derived "from combinatorial possibilities and impossibilities" (Deacon 1997, p. 83). Because of this words only have meaning in context, in utterances. Both learning and use depend on combinations of words. On this view syntax and semantics are inextricably linked. What the brain has co-evolved for is not a language module but the ability of symbolic reference, driven by the great advantages conferred by bigger brains capable of handling more complex language.

Synthesis

Barsalou argued that there is simply no evidence for amodal symbols. Does this mean that Deacon's symbols cannot exist, because they are not directly associated with perceptual experience? I think not. To cross the symbolic threshold surely requires grounding in perceptual experience, but crossing it results in qualitatively different forms of reference.

On the one hand there is the position that there is a continuum from concrete to abstract, which allows abstract concepts to be derived from concrete ones through gradual abstraction. On the other hand there is the more orthodox position that there is a categorical difference between concrete and abstract, e.g., perceptual versus propositional representations. I believe that Deacon's account shows that these positions need to be synthesized. Abstract concepts and other symbols are grounded in concrete ones, but only indirectly through a web of relations to other symbols that are collectively linked with a web of signifiers. Yet still, because of the distinction between indexical and symbolic relations, there is a break along this continuum where further abstraction yields new properties, which explains why language yields so much cognitive benefits (Clark 1998; 2006, Schaller 1995).

This break thus hints at a distinction between linguistic meaning and other conceptual representations, or at least a special way in which linguistic meaning is mediated to produce Barsalou's simulations. As Clark (1999) suggests in a position paper on the relation of language and thought, it is

very likely that the features of particular languages determine semantic representations, such as through mandatory grammatical markings; but when not using language, we should not be so constrained, for example imagination and memory probably do not require language. It is plausible to assume that general conceptual representations are universal (or at least not influenced by the particular language we speak), but that semantic representations differ for each language. Conversely, any given utterance will only have a single semantic representation (or a few in case of ambiguity), yet the simulations it evokes in hearers might be as unique as snowflakes. Although I believe simulation is constitutive of linguistic understanding, I disagree with Barsalou that a simulation *represents* linguistic meaning of an utterance or text (Barsalou 1999, sect. 4.1.6).

Thus, *pace* Barsalou who posits that in language comprehension an utterance leads directly to a simulation, or to the construction grammarians who similarly believe that linguistic understanding is conceptualization, there must be an intermediate level of semantic representation. This level is intimately linked with word forms, which themselves form a web such as that of a distributional semantic model — the difference is, though, that at the same time the semantic representations are grounded in something like Barsalou's perceptual symbols.

Conclusion

The general idea that perception and cognition should be more integrated seems to have merit and much plausibility. However, that all of meaning and especially abstract concepts can be explained as implemented by perceptual symbols seems problematic. There seems to be a clear break between the general sensory-motor cognition shared with other animals, and the linguistic cognition based on symbolic reference. This symbolic reference calls for a triadic theory of signs in which symbols represent a distinct level from perceptual associations, while still being grounded in such perceptions. In sum, the perceptual symbols and simulations seem to be a necessary component of meaning; however, neither the language system of language and situated simulation, nor perceptual symbols seem to be sufficient to explain language, because of the qualitative difference between non-symbolic and symbolic reference.

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