Studies in History and Philosophy of Science xxx (2010) xxx–xxx

Contents lists available at ScienceDirect

Studies in History and Philosophy of Science

journal homepage: www.elsevier.com/locate/shpsa

Language understanding is grounded in experiential simulations: a response to Weiskopf

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ARTICLE INFO

Article history:
Available online xxxx

Keywords:
Language
Comprehension
Embodied cognition
Embodied simulation
Linguistic meaning
Psycholinguistics

ABSTRACT

Several disciplines within the cognitive sciences have advanced the idea that people comprehend the actions of others, including the linguistic meanings they communicate, through embodied simulations where they imaginatively recreate the actions they observe or hear about. This claim has important consequences for theories of mind and meaning, such as that people's use and interpretation of language emerges as a kind of bodily activity that is an essential part of ordinary cognition. Daniel Weiskopf presents several arguments against the idea that experiential simulations play a major role in immediate language use and meaning. We offer several rebuttals to Weiskopf, in which we critique his interpretation of simulation theory, present additional psycholinguistic evidence supportive of the simulation perspective, and suggest that a more traditional theory of linguistic meaning and processing has little psychological and empirical validity.

1. Introduction

Daniel Weiskopf (2010, this issue) has critically reviewed recent research in experimental psycholinguistics supporting the idea that language comprehension makes use of people's ongoing sensorimotor capabilities, and that, more specifically, 'language comprehension operates via processes of "experiential simulation"', a view Weiskopf refers to as 'embodied language comprehension (ELC)'. ELC maintains that during ordinary language understanding 'the comprehender is an immersed experiencer of the described situation, and comprehension is the vicarious experience of the described situation' (Zwaan, 2004, p. 36, as quoted by Weiskopf, 2010, this issue). Weiskopf defends a 'traditional language comprehension (TLC)' view in which 'linguistic comprehension is a process of mapping seen or heard words onto representations of their meaning. The output of the process is a semantic representation that captures the content of the input sentence'.

This contrast between ELC and TLC goes to the heart of contemporary debates in cognitive science on the ways that human thought and language are 'embodied' and not strictly separate, dedicated components, or modules of mind (cf. Fodor, 1983; Gallagher, 2006; Gibbs, 2006a; Johnson, 2007; Lakoff & Johnson, 1999). The study of 'embodied cognition' has given rise to a vast number of empirical findings showing how perception, memory, problem-solving, mental imagery, emotion, and consciousness are fundamentally tied to the particular bodies we have and the ways humans move and act in the world (Gibbs, 2006a). Language use and understanding, despite being traditionally seen as symbolic and disembodied, may have enduring connections to bodily experience, with people imagining themselves as participating in the actions language describes, even in cases where the actions depicted are abstract and physically impossible to perform (Gibbs, 2006b).

However, Weiskopf rejects claims that 'experiential simulation' is fundamental to language comprehension, due to his re-analysis of the psycholinguistic evidence, his characterization of 'simulation' as it relates to language processing, and his adoption of the traditional supposition that a dedicated language system operates prior to any putative simulation processes during linguistic understanding. We maintain that Weiskopf incorrectly describes the empirical data in favor of ELC, presents an impoverished view of 'experiential simulation', and more importantly embraces a

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0039-3681/$ - see front matter © 2010 Published by Elsevier Ltd.
doi:10.1016/j.shpsa.2010.07.004

traditional perspective on the distinction between linguistic meaning and the consequences of language use that does not reflect the psychological reality of immediate language experience, and which has no empirical foundation within experimental psycholinguistics.

2. Problems with Weiskopf's view of experiential simulations

One of the main bodies of evidence supporting ELC, which Weiskopf briefly describes, comes from psycholinguistic studies demonstrating the 'action compatibility effect'. For example, Glenberg & Kaschak (2002) demonstrate what they call the action-sentence compatibility effect (ACE). In one experiment, participants made speeded sensibility judgments for sentences that implied action either toward or away from the body (e.g. 'Close the drawer' implies action of pushing something away from the body). Participants indicated their judgment by use of a button box that contained a line of three buttons perpendicular to their body. Presentation of the sentence was initiated when the participant pressed the center button, and yes or no responses (i.e. sensible or not sensible) were made with the two remaining buttons, requiring action either away from or toward the body. Glenberg and Kaschak found an interference effect, such that comprehension of a sentence implying action in one direction interfered with a sensibility response made in the opposing direction. This effect was interpreted as evidence that understanding language referring to action recruits the same cognitive resources needed to actually perform the action.

But Weiskopf disputes this interpretation of the Glenberg and Kaschak findings through discussion of the following two statements: (a) 'I give Josh the notebook', and (b) 'Josh gave me the notebook'. By the action compatibility effect, sentence (a) primes a response away from the subject's body, whereas sentence (b) primes motion towards the subject's body. Weiskopf wonders why (b) would not also prime motion away from the body, because, he argues, if simulating the action of the sentence, the experimental participant should simulate reaching out to take the book. However, by asking this question, Weiskopf demonstrates his misunderstanding of embodied simulations. The ELC view maintains that a person simulates the meaning of the sentence (i.e. 'an immersed experiencer of the described situation' of the sentence), not how that person may possibly respond to the meaning of the sentence once it has been interpreted. The simulation of afforded responses may follow later as an ordinary aspect of language understanding, but some understanding of the salient event expressed by the sentence clearly must come first.

For instance, according to the principles of cognitive grammar (Bergen, 2005), in the ditransitive construction of 'Josh gave me the notebook', the agent 'Josh', as the grammatical subject, is profiled as the most prominent participant in the event. Furthermore, the verb 'gave' profiles the transfer of the notebook from Josh's perspective as the agent. Alternatively, the 'me' experiencer could have been profiled along with first person active participation in the event by a different verb 'take' and the transitive construction, as in 'I took the notebook from Josh'. From the perspective of the TAKE event, the first person takes on the role as agent—the active initiator of the event—and his role is made prominent by being the grammatical subject. For this reason, a simulation of 'Josh gave me the notebook' involves action away from the body, as Weiskopf mistakenly attributed to the original sentence perspective of 'Josh gave me the notebook'. It is important to notice that 'Josh gave me the notebook' and 'I took the notebook from Josh' reflect different perspectives on a single event. The choice of verb and grammatical construction used to describe the event creates different construals and decidedly different simulated conceptualizations of the notebook transfer between Josh and me.

Weiskopf's misunderstanding of ELC, as suggested above, is also exposed by his consideration of the sentences 'The man stood on the corner' versus 'The man waited on the corner'. He argues that simulations cannot distinguish between the meanings of these statements because they perceptually appear to look the same. However, this argument fails to understand the full-bodied complexity of simulation processes, which are not restricted to perception of outer, visual appearances. Experiential simulations involve the engagement of full-body loops (i.e. the continual interaction of body, brain, and world) (Damasio, 1999) and, depending on the situation, may include, as in this case, a sense of the man's intentions, expectations, and even emotions as he either 'stood' or 'waited' on the corner. These full-bodied simulations gives rise to a feel of what it is different about 'waiting' for something (i.e. having the definite expectation of something that should soon be happening), compared to the standing there without necessarily having any such expectations and emotions. Thus, ELC provides very different interpretations for 'The man stood on the corner' and 'The man waited on the corner', contrary to Weiskopf's claim.

3. Some ways that experiential simulations guide language understanding

The idea that hearing or reading a sentence creates an experiential simulation of the situation described suggests to some that perceiving, acting, and language use are all rooted in the same representational code (Borreggine & Kaschak, 2006). Indeed, there is now a large body of work from cognitive neuroscience showing that there are shared motor representations, seen as activation of 'mirror neurons' in cerebral cortex, for action, observation of another person's actions, and imitation and mental simulation of action (Decety & Grezes, 1999). Moreover, areas of motor and pre-motor cortex associated with specific body parts are automatically activated when people hear language referring to those body parts. Listening to different verbs associated with different effectors (i.e. mouth/'chew', leg/'kick', hand/'grab') leads to different firing rates in different regions of motor cortex (i.e. areas responsible for appropriate mouth, leg, hand motions exhibit greater activation) (Hauk et al., 2004; Pulvermuller et al., 2001).

It is difficult to imagine how the TLC view, which Weiskopf advocates, would be able to account for the automatic activation of mirror neurons if only disembodied propositional structures were created during online language comprehension. But the TLC account runs into even more significant problems in explaining the role that embodied activity appears to play in people's understanding of abstract and figurative language, including expressions that are literally anomalous (e.g. 'John could not grasp the concepts of calculus'), which are ubiquitous in everyday speech and writing.

First, significant findings in cognitive linguistics strongly show how people understand many abstract concepts in embodied metaphorical terms (Gibbs, 2006a; Lakoff & Johnson, 1999). For example, abstract ideas, such as 'justice' (e.g. 'the balance of justice') are structured in terms of metaphorical mappings where the source domains are deeply rooted in recurring aspects of embodied experiences (i.e. ACHIEVING JUSTICE IS ACHIEVING PHYSICAL BALANCE BETWEEN TWO ENTITIES). Embodied metaphors appear to underlie people's conceptions of abstract ideas from numerous, diverse domains (e.g. time, causation, spatial orientation, political and mathematical ideas, emotions, the self, concepts about cognition, morality), across languages and cultures (Gibbs, 1994, 2006a; Kövecses, 2002; Lakoff & Johnson, 1999; Yu, 1999).

Second, psycholinguistic research has extended the findings on literal speech understanding to show that experiential simulations

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motivate people's use and understanding of many kinds of metaphoric language (Boroditsky & Ramscar, 2002; Gibbs, 2006a,b; Gibbs et al., 2006; Wilson & Gibbs, 2007). These experimental studies indicate that people's recurring embodied experiences often play a role in how they tacitly make sense of why many words and expressions have the specific meanings they do, as well as in people's production and processing of some verbal metaphors. More importantly, these studies demonstrate that people appear to simulate the actions described in metaphorical sentences, even when these actions are physically impossible to perform. Gibbs et al. (2006) demonstrated how people's mental imagery for metaphorical phrases, such as 'tear apart the argument', exhibit significant embodied qualities of the actions referred to by these phrases (e.g. people conceive of the 'argument' as a physical object that when torn apart no longer persists). Wilson & Gibbs (2007) showed that people's speeded comprehension of metaphorical phrases like 'grasp the concept' are facilitated when they first make, or imagine making, in this case, a grasping movement. Bodily processes appear to enhance the construction of simulation activities to speed up metaphor processing, an idea that is completely contrary to the traditional notion that bodily processes and physical meanings are to be ignored or rejected in understanding verbal metaphors. Furthermore, hearing fictive motion expressions, implying metaphorical motion, such as 'The road goes through the desert', affects people's subsequent eye-movement patterns while looking at a scene of the sentence depicted (Richardson & Matlock, 2007). This suggests that the simulations used to understand the sentence, in this case involving a particular motion movement of what the roads does, interacts with people's eye movements.

Experimental findings like these emphasize that people may be creating partial, but not necessarily complete, embodied simulations of speakers' metaphorical messages that involve moment-by-moment 'what must it be like' processes, such as grasping, that make use of ongoing tactile-kinesthetic experiences (Gibbs, 2006b). These simulation processes operate even when people encounter language that is abstract, or refers to actions that are physically impossible to perform, such as 'grasping a concept', because people can metaphorically conceive of a 'concept' as an object that can be grasped. One implication of this work is that people do not just access passively encoded conceptual metaphors from long-term memory during online metaphor understanding, but perform online simulations of what these actions may be like to create detailed understandings of speakers' metaphorical messages (ibid.).

The process of constructing embodied simulations is constrained similarly as are other fundamental cognitive operations in the pursuit of meaning. People will create simulations rich enough to enable them to infer sufficiently relevant meanings and impressions, while also trying to minimize the cognitive effort needed to produce meaningful effects. In some cases, the meanings, emotions, impressions one infers when understanding a speaker's utterance will be relatively crude, primarily because this set of products will be 'good enough' for the purposes at hand. At other times, people may engage in more elaborate, even highly strategic, simulation processes as they tease out numerous meanings and impressions from an utterance in context, such as when reading novel metaphors in poetry. But our argument, in general, is that experiential simulation processes are automatically engaged in a wide variety of human cognitive activities, including language understanding. Although we do not, as yet, have a firm idea on all of the constraints on simulation processes, and the extent to which they create simplified, as opposed to complex, meanings, we are sure that these processes include aspects of full-bodied experiences, and are critical to understanding the minds of others.

4. Is simulation just an add-on to linguistic meaning?

How rich is linguistic understanding? Weiskopf writes, 'The debate over embodied linguistic understanding is, then, fundamentally a debate over how rich a notion of linguistic competence we ought to adopt'. Weiskopf posits that understanding a linguistic expression fundamentally begins with some recovery of the minimal truth-conditional meaning that may, under some circumstances, be elaborated upon by additional simulation processes.

But the idea that people ordinarily, automatically parse a speaker's utterance into some initial truth-conditional, propositional, semantic representation has virtually no empirical support within experimental psycholinguistics. There is simply no evidence that people first create some logical form, guided by their understanding of truth-conditional semantics, before richer conceptual and pragmatic information is brought to bear. One arena in which the claim that some initial semantics or literal meaning is first analyzed during linguistic processing is the large literature on people's understanding of indirect and figurative meaning (Gibbs, 1994, 1999).

For example, early philosophical accounts of interpreting indirect speech acts (e.g. 'Can you pass the salt?' meaning 'Pass the salt') and many kinds of figurative language (e.g. 'You're a fine friend' implying the sarcastic remark 'You're a bad friend') assumed that people, indeed, created context-free, semantic, literal representations of utterances, then analyzed and rejected these minimal meanings as contextually inappropriate, before deriving a speaker's intended interpretation given their knowledge of pragmatics (e.g. the rules of speech acts, or conversational norms) (Searle, 1975; Grice, 1989). Under this view, people should always take longer to interpret indirect or figurative meanings than straightforward literal ones, given the additional mental effort to elaborate upon the inappropriate literal meaning for indirect speech.

But the results of dozens of experimental studies over twenty-five years have demonstrated that this traditional account has no psychological validity (Gibbs, 1994, 1999). People appear to interpret speakers' utterances, word-by-word, using enriched pragmatic knowledge very early on in the understanding process. Once again, there is no evidence that people automatically create literal, semantic, purely propositional representations for sentences (i.e. a 'sentence meaning') before elaborating on these representations to infer speakers' and writers' broader communicative messages (i.e. a 'speaker meaning'). None of this implies that people do not sometimes draw inferences about what a speaker implies from something he or she said. For instance, asked if he has children, John may reply, 'I have three boys' to imply that he does, indeed, have children. But the online interpretation of what John said by 'I have three boys' immediately includes enriched pragmatic knowledge so that a listener does not infer 'John has at least three boys and may have more than three' (i.e. a truth-conditional reading of the sentence). Instead, people quickly infer that John most likely has three, and only three, boys (Gibbs & Moise, 1997). As the psycholinguistic literature has long shown, people are continuously using enriched conceptual and pragmatic knowledge in the online processing of language such that distinct 'semantic representations' of either words or entire sentences are not automatically computed (Chambers et al., 2004; McDonald & Seidenberg, 2006; Zwaan & Rapp, 2006).

Weiskopf acknowledges that 'It is even possible that something like utterance meaning is primary, in the sense of being the kind of content that is routinely computed in the process of comprehending language', But he immediately goes on to say that 'All that I require is the claim that having the *capacity* to understand a sentence, for the traditional view, is a matter of being able to compute

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its semantic representation'. For him, this 'capacity' still seems to be primary and 'should be separated from capacities to imagine described situations', per the view of ELC. For instance, 'we shouldn't confuse the enactive simulation of these scenarios and our responses to them with actually grasping the information conveyed by the sentence itself'. Even if TLC would not deny that 'language is tightly integrated with other cognitive faculties', as claimed by ELC, there remain the problem of there being no substantial experimental evidence for Weiskopf's main assumption that language understanding 'fundamentally relies on prior processing of a dedicated system'.

There have been proposals in the long history of psycholinguistics, following work in both philosophy and linguistics, suggesting that language understanding operates in a linear, stage-like manner where context-free, disembodied semantic representations are constructed (Forster, 1979; Fodor, 1983). But contemporary psycholinguistics generally rejects this view, given the extensive evidence showing the continuously available impact of higher-order conceptual and pragmatic information in the early parsing of sentences (Chambers et al., 2004; McDonald & Seidenberg, 2006; Spivey, 2007). This conclusion is contrary to the most basic tenet of TLC that there exists an encapsulated process that provides the representational content of sentences, and is consistent with ELC's argument that experiential simulation processes are not optional, after-the-fact interpretation activities. Instead, people engage in simulation processes from the earliest moments of linguistic understanding, which is also consistent with how people make sense of a wide range of human actions in terms of experiential simulations.

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