Embodied experience and linguistic meaning

Raymond W. Gibbs Jr.

Department of Psychology, University of California, Santa Cruz, CA 95064 USA

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Abstract

What role does people's embodied experiences have in their use and understanding of meaning? Most theories in cognitive science view meaning in terms of propositional structures that may be combined to form higher-order complexes in representing the meanings of conversations and texts. A newer approach seeks to capture meaning in terms of high-dimensional semantic space. Both views reflect the idea that meaning is best understood as abstract and disembodied symbols. My aim in this article is to make the case for an embodied view of linguistic meaning. This view provides a challenge to traditional approaches to linguistic meaning (although may not necessarily be entirely incompatible with them). I discuss several new lines of research from both linguistics and psychology that explore the importance of embodied perception and action in people's understanding of words, phrases, and texts. These data provide strong evidence in favor of the idea that significant aspects of thought and language arises from, and is grounded in, embodiment.
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1. Introduction

What does embodied experience have to do with linguistic meaning? Most language scholars claim that linguistic meaning is quite divorced from embodiment. For example, the meaning of a simple sentence can be represented by a complex proposition consisting of a predicate with several arguments, including information about the time and place circumstances. Thus, the sentence *Yesterday, Mary inadvertently gave Fred the old book in the library* might be characterized as a complex proposition structured around the predicate GIVE. The arguments of this predicate are the agent MARY, an object BOOK, and a goal FRED. *Inadvertently* acts to modify the main predicate GIVE, while the adjective *old* modifies BOOK. Time and place information are specified by *yesterday* and *in the library*. Longer texts and human knowledge, more generally, are represented in associative networks of propositions (predicate-argument schemas), or as abstract mental models (Fletcher, 1994; Fletcher, van den Broek, & Arthur, 1996; Kintsch, 1988). Little attention is given to the embodied foundation of meaningful propositional representations.

E-mail address: gibbs@cats.ucsc.edu .

Characterizing human language and thought in terms of abstract propositions has been a common theoretical move in cognitive science for several decades. Understanding language is assumed to require breaking down the linguistic code into a language-independent medium that constitutes the "language of thought." The practical difficulties associated with constructing complex hierarchies of proposition structures have led, in part, to the development of several computational tools for text analysis. One method that has attracted significant attention posits that meaning (word, sentence, or text) is represented as vectors in a high-dimensional semantic space (Burgess & Lund, 2000; Kintsch, 1998). Unlike many models of linguistic learning (i.e., propositional, connectionist) the vector representations of high-dimensional semantic spaces need not be specified in advance as they are simply derived from measuring the co-occurrence of words in different texts.

The primary problem with these views is that they conceive of meaning, and human cognition more generally, in terms of abstract and disembodied symbols. This approach to thought and language has indeed been the dominant focus in cognitive science for the past 40 years. But the traditional view ignores the fundamental problem of how meaning is grounded in ordinary experience (the *symbol grounding problem*) (Harnad, 1990; Searle, 1980), especially in regard to how meaningful symbols related to embodiment and real-world referents (Johnson, 1987). Although cognitive neurolinguists examine the neural basis for human linguistic abilities, most research on the links between language and brain functions ignore the importance of people's ordinary, kinesthetic experiences. This neglect has seriously undermined scientific understanding of the relations between mind and body, and, more specifically, linguistic meaning and embodiment.

The purpose of this article is to present the case for an embodied view of linguistic meaning. I will not claim that an embodied perspective on linguistic meaning is necessarily incompatible with the more traditional approaches embraced by most psychologists (and cognitive scientists). There may be ways in which embodied meanings can be explicitly part of propositional and high-dimensional representations of linguistic meaning. The argument here, however, is that these alternative views have not seriously acknowledged the importance of embodiment in accounting for a significant part of language use and meaning.

My strategy in exploring the connection between embodiment and linguistic meaning adopt the *embodiment premise*:

People's subjective, felt experiences of their bodies in action provides part of the fundamental grounding for language and thought. Cognition is what occurs when the body engages the physical, cultural world and must be studied in terms of the dynamical interactions between people and the environment. Human language and thought emerge from recurring patterns of embodied activity that constrain ongoing intelligent behavior. We must not assume cognition to be purely internal, symbolic, computational, and disembodied, but seek out the gross and detailed ways that language and thought are inextricably shaped by embodied action.

The key feature of this premise is the idea that understanding the embodied nature of linguistic meaning demands that we specifically look for mind–body and language–body connections. Sufficient evidence from linguistics and psychology supports the claims that embodiment shapes (a) why certain words and phrases express the particular meanings they do and (b) people's intuitions about, and immediate understanding of, the meaning of various words, phrases, and linguistic expressions. I describe this evidence by talking about two kinds of work that embraces slightly different research strategies.

2. Embodied understanding

Several psychologists have begun to explore how people interpret utterances that may, or may not, closely represent ordinary embodied actions. For instance, one account of embodiment in language processing emphasizes the importance of "perspective-taking" (MacWhinney, 1999). This view proposes that the embodied production and comprehension of language demands that speakers and listeners create construals of the different perspectives, and shifts of perspective, of the objects and actions described by language. Four perspectival systems underlie how people create embodied understanding of linguistic meaning: (1) affordances, (2) spatial reference forms, (3) causal action frames, and (4) social roles. These four perspectival systems interact in important ways during our understanding of language.

Consider the sentence *As far as the eye could see, stalks of corn were bending as waves under the battering force of a surging curtain of rain* (MacWhinney, 1999). How might we construct a meaningful interpretation of this sentence? One could argue that we comprehend this sentence by simply creating a picture of a heavy rain pouring down on a large corn field. But this characterization under-determines the embodied richness of what people normally understand from this sentence. A more embodied view of understanding claims that we adopt different perspectives to make sense of the complex actions described in the sentence. Thus, we might first adopt the perspective of *the eye* and imagine scanning the scene from the foreground to the horizon. This spatial perspective provides an interpretation of the phrase *As far as the eye can see*. The spatial perspective required to imagine *stalks of corn*, necessitates a shift from our point of view as we understand the corn stalks to be a distributed figure located across the vast ground. We next view the stalks as bending, which arises from the secondary spatial perspective suggested by *under the battering force*, and then elaborated upon our shift of perspective by the *surging curtains of rain*. Each perspective shift, therefore, is guided by specific words, like *as far as* and *under*. In general, our embodied comprehension of this sentence requires a shift across four perspectives: *eyes*, *stalks of corn*, *battering force*, and *curtain of rain*. Note that the syntactic form of the sentence, emphasizing *corn* as the subject responding to an external force, shapes the dynamic character of sentence processing as a series of embodied perspective shifts.

Consider now a different sentence, this one with a metaphorical content: *Casting furtive glances at the seamstress, he wormed his way into her heart* (MacWhinney, 1999). We first adopt the perspective of the implied subjects and imagine him casting glances at the seamstress. After this, we shift to the subject's embodied action of worming (i.e., moving as if a worm), yet soon recognize that the action here is not literal but metaphorical in the sense of the subject trying to place himself inside the seamstress' heart. Even here, we soon comprehend that by metaphorically inserting himself into the seamstress' heart, he has really placed himself closer to the seamstress' emotions and affections. The embodied action of worming, again, suggests a slow, deliberate process of becoming emotionally closer to the seamstress, which she implicitly accepts, allowing the suitor to enter into her affections. The different spatial perspectives readers adopt as they comprehend the sentence gives rise to a rich, embodied interpretation.

The claim that embodiment underlies people's understanding of language is more fully developed in the *indexical hypothesis* (Glenberg, 1997, 1999; Glenberg & Robertson, 2000). This view assumes that three major steps occur when language is understood in context. First, words and phrases are indexed to objects in the environment or to perceptual symbols in long-term memory. Second, the affordances structures (i.e., the possible actions that can be done to an object by a person) are derived for each object in the situation. Third, the listener must combine or "mesh" the affordances according to the constraints on embodied possibilities in the

real-world. For instance, the affordances of a chair include those of sitting on, or using to hold off a snarling lion, but they cannot ordinarily be meshed with the goal of propelling oneself across a room. This constraint on the meshing of embodied affordances predicts that people will have an easier time understanding a sentence like *Art used the chair to defend himself against the snarling lion* than to interpret the sentence *Art used the chair to propel himself across the room.*

One empirical test of the indexical hypothesis asked people to judge the meaningfulness of afforded (i.e., with coherent mesh) and nonafforded (i.e., those without coherent mesh) sentences, such as those shown above (Glenberg & Robertson, 2000). The results, not surprisingly, showed that people judged the afforded sentences to be significantly more sensible than the nonafforded sentences. Furthermore, a second study measured the speed with which people read these two types of sentences. This study showed that nonafforded sentences took significantly longer to comprehend than the afforded sentences. These psycholinguistic findings highlight the importance of perceptual, embodied information when people combine conceptual representations during ordinary language understanding.

Readers also appear to construct fairly elaborate, embodied microworlds when comprehending literary stories (Zwaan, Magliano, & Graesser, 1995). One study had college students read short literary stories to determine whether readers automatically imagine different possible dimensions of the microworld, including information about the characters, temporality, spatiality, causality, and intentionality (i.e., the characters' goals and plans). Examination of the time needed to read portions of these stories revealed increased reading times for sentences when a new character entered the microworld, when there was a significant gap in the story's time line (e.g., flash forwards and flash backs), when the spatial setting changed, when a story action was not causally related to the prior context, and when a character generated a new plan or goal. These data support the idea that readers actually "flesh out" important embodied characters of the stories they read which take varying amounts of cognitive effort.

Empirical research also indicates that readers use spatial perspective to construct mental models of narrative texts. One study asked participants to first memorize the layout of unnamed rooms in a building, along with objects in the rooms (Morrow, Bower, & Greenspan, 1989). Afterward, participants read a story describing a person's movements throughout the building. At various points when reading the story, participants were asked to judge the location of specific objects. The result showed that people were quicker to make these judgements when the objects were located in rooms visited by the protagonist. Thus, participants constructed a spatial model of the narrative by adopting the embodied perspective of the person in the story, and not by simply creating an objective sketch of the rooms and the objects in them.

There is other work showing that readers construct mental models for narrative by adopting the perspective of the protagonist. Participants in one study read texts describing a protagonist and a target item, such as a jogger and sweatshirt (Glenberg, Meyer, & Linden, 1987). The protagonist and target item in one experimental condition were spatially linked (e.g., the jogger put on the sweatshirt before jogging), while in a different condition, the two were dissociated (e.g., the jogger took off the sweatshirt before jogging). After reading the main part of the story, participants judged whether they earlier read the word *sweatshirt*. The results showed that people were faster to make this judgment in the linked, or associated, condition than when the protagonist and target were dissociated. Thus, readers appear to create mental models for narrative in which spatial information (e.g., the location of the sweatshirt) is tied to the story's characters and their embodied actions.

Finally, other experiments show that people assume the perspective of the protagonist when reading narratives. Thus, participants in one study were faster to

pronounce the single *sat* having just read *After standing through the three-hour debate, the tired speaker walked over to his chair* than when they just read *The tired speaker moved the chair that was in his way and walked to the podium to continue the three-hour debate* (Keefe & McDaniel, 1983). Notice, again, how different aspects of an object's (e.g., chair) affordances become prominent depending on the type of body action the protagonist was likely to perform (i.e., sitting). Readers' creation of embodied representations not only influence their understanding of a protagonist's actions, but also shapes their understanding of the orientation of objects (Sanford & Moxey, 1995).

There appear to be limits, however, on the extent to which embodied representations are created by readers during text comprehension. One set of studies investigated the type of inferences people construct when reading (Graesser, Singer, & Trabasso, 1994). Although readers easily draw inferences about why actors/events take place, and why the writer included something in a text, people do not ordinarily draw inferences about how some action/event occurred. For example, when readers saw *The cook tripped the butler*, they immediately inferred something about why the cook did what he did (e.g., for "revenge"), but readers did not draw specific embodied inferences about how an event occurred (e.g., the cook used his "foot" to do the tripping). Readers appear to construct embodied representations for text only to the extent those inferences enable them to understand the plot and the writer's rationale for including something in the text. Narrative texts might be easier to understand than expository texts, precisely because the events in narratives are more action-driven and embodied allowing them to track protagonists' goals than are seen in expository writing.

The psycholinguistic studies reviewed thus far provide evidence that people's understanding of meaning is centrally constrained by their embodied recognition of affordances and how these may be combined, or meshed, to form coherent narratives. As such, this work is clearly consistent with the embodied view of linguistic meaning. But the above research has not specifically, and independently, examined people's kinesthetic actions to see how embodiment gets mapped onto linguistic representations. The next two sections describe empirical research that attempts to provide evidence on the mapping of embodiment onto linguistic meaning.

3. Cognitive linguistic evidence

The second kind of evidence supporting the embodied view of linguistic meaning arises from the important developments in cognitive linguistics. A significant part of this work on embodiment in language and thought focuses on metaphor. Consider the following excerpts from a college student's narrative describing the last time she felt very angry:

> Being angry is such a complicated emotion. At first, angers burns in my chest, makes my stomach queasy, and makes me tense.... I felt very uncomfortable because my stomach hurt, and the anger just boiled inside me. I wanted to grab my boyfriend by his shirt, pin him up against the wall, and yell at him for being so stupid.... Simply telling him that I was upset made my anger fizzle out a little. As we talked, my anger slowly melted away.

This woman's narrative reveals that she talks about, and perhaps thinks of, her anger in terms of various metaphorical ideas. Much of her anger talk fits nicely with other conventional expressions that people use to describe their anger experiences, such as:

> I blew my stack when I heard the news. John exploded when he failed his exam. Mary flipped her lid over Bush becoming President. Bill got hot under the collar during the argument. It made Sally s blood boil whenever she saw litter. Jane hit the ceiling when Rick cheated on her.

Why are each of these expressions acceptable ways of talking about, and understanding, anger? Cognitive linguistic research analyzes systematic patterns of conventional, and novel, linguistic expressions to uncover patterns of metaphorical thought (i.e., conceptual metaphors) that give rise to such language (Gibbs, 1994; Lakoff & Johnson, 1980). For instance, all of the above phrases used in talking about anger cluster together under one basic metaphorical system of understanding: ANGER IS HEATED FLUID IN A CONTAINER. This conceptual metaphor involves understanding one domain of experience, anger, in terms of a very different, and more concrete domain of experience, heated fluid in containers. There is a tight mapping according to which entities in the domain of anger (e.g., the person who gets angry, what happens to them, and the consequences of their being angry) correspond systematically to entities in the domain of a heated fluid in the container (e.g., the cause, intentionality, manner, and consequences of the fluid being heated).

Why do people conceive of an abstract concept, such as anger, metaphorically in terms of a specific idea, such as heated fluid in a container? There is a large body of work in cognitive linguistics suggesting that much metaphorical thinking arises from recurring patterns of embodied experience (Johnson, 1987; Lakoff, 1987; Lakoff & Johnson, 1999). For example, central to our understanding of the conceptual metaphor ANGER IS HEATED FLUID IN A CONTAINER is the embodied experience of containment. People have strong kinesthetic experiences of bodily containment ranging from situations in which bodies are in and out of containers (e.g., bathtubs, beds, rooms, and houses) to experiences of bodies as containers in which substances enter and exit. An important part of bodily containment is the experience of our bodies being filled with liquids including stomach fluids, blood, and sweat. Under stress, people experience the feeling of their bodily fluids becoming heated. These various, recurring bodily experiences give rise to the development of an experiential gestalt, called an image schema, for CONTAINMENT (Johnson, 1987).

Cognitive linguistics has documented several dozen image schemas and shown that these embodied patterns are pervasive throughout spoken and written language. Image schemas cover a wide range of experiential structures that are pervasive in experience, have internal structure, and can be metaphorically elaborated to provide for our understanding of more abstract domains (Gibbs & Colston, 1995; Johnson, Lakoff, 1987).Our CONTAINMENTschema, for instance, is metaphorically ted to explain some of the complex ways that we structure single abstract concepts. For instance, the conceptual metaphor ANGER IS HEATED FLUID IN A CONTAINER takes the image schema for CONTAINMENT as part of its source domain and maps this image-schematic structure onto anger, which gives rise to a number of interesting entailments. Thus, people know that when the intensity of anger increases, the fluid in the container rises (e.g., *His pent-up anger welled up inside of him*), people know that intense heat produces steam and creates pressure on the container (e.g., *Bill is getting hot under the collar*, *Jim's just blowing off steam*, and *He was bursting with anger*), and people know that when the pressure of the container becomes too high, the container explodes (e.g., *She blew up at me*).

4. Psychological studies on metaphoric image schemas

Many cognitive psychologists are critical of the claim that systematic patterns of conventional language, novel extensions, or polysemy, actually reveal that people ordinarily think about many concepts in terms of metaphor or image schemas (Glucksberg, in press;Glucksberg & Keysar, 1990; Murphy, 1996).They argue that

the linguistic data per se does not prove that metaphorical mappings get computed automatically and effortlessly during metaphor understanding.

But there are several studies from cognitive psychology that support the idea that people's embodied experiences give rise to their metaphorical structuring of abstract concepts, which, in turn, constrains speakers' use and understanding of language. The research projects described below are similar in that each attempts to characterize something of what motivates ordinary speakers' intuitions about linguistic meanings. These experiments first attempt to study people's intuitions about aspects of their embodied experience which might possibly motivate word and phrasal meaning, before asking them to provide their judgments about the meanings of these words and expressions. In this way, the following studies differ, to a significant extent, from the recent psychological work on embodied understanding, described in the previous section, and the work of cognitive linguists, each of whom examined people's judgments of linguistic meaning without independently looking at people's relevant embodied experience.

One relevant research project focused on how people understand idiomatic phrases (Gibbs, 1992). The traditional view of idiomaticity assumes that expressions, such as *blow your stack*, *flip your lid*, *hit the ceiling*, are "giant lexical items" whose meanings result from "dead" metaphors. But cognitive linguistic research (Lakoff, 1987) and psycholinguistics studies (Gibbs, 1994) demonstrate that idioms are not simple, "dead" metaphors, but actually retain a good deal of their metaphoricity because they arise form conceptual metaphorical mappings between embodied source domains and more abstract target domains. For example, the figurative meanings of *blow your stack*, *flip your lid*, and *hit the ceiling* are specifically linked to two independently existing elements in our conceptual system—MIND IS A CONTAINER and ANGER IS HEAT IN A PRESSURIZED CONTAINER. Notice how the idea of pressurized heat in a container arises, partly, from people's experiences of their own bodies under stress, such as when they feel very angry. Thus, the source domains in many conceptual metaphors are rooted in sensorimotor experience.

Psycholinguistic studies have examined how people's intuitions of their bodily experiences of containment, and several other image schemas, to see whether these are employed in interpreting idiomatic meaning. These studies were designed to show that the specific entailments of idioms reflect the embodied source to target domain mappings of their underlying conceptual metaphors (Gibbs, 1992). Most importantly, these metaphorical mappings preserve the cognitive topology of these embodied, image-schematic source domains.

Participants in a first study were questioned about their understanding of events corresponding to particular bodily experiences that were viewed as motivating specific source domains in conceptual metaphors (e.g., the experience of one's body as a container filled with fluid). For instance, participants were asked to imagine the embodied experience of a sealed container filled with fluid, and then they were asked something about causation (e.g., *What would cause the container to explode?*), intentionality (e.g., *Does the container explode on purpose or does it explode through no volition of its own?*), and manner (e.g., *Does the explosion of the container occur in a gently or a violent manner?*).

Overall, the participants were remarkably consistent in their responses to the various questions. To give one example, people responded that the cause of a sealed container exploding its contents out is the internal pressure caused by the increase in the heat of the fluid inside the container. They also reported that this explosion is unintentional because containers and fluid have no intentional agency, and that the explosion occurs in a violent manner. These brief responses provide a rough, non-linguistic profile of people's understanding of a particular source domain concept

(i.e., heated fluid in the bodily container). These profiles are rough approximations of what cognitive linguistics and others refer to as the *image-schematic structures* of the source domains (Gibbs & Colston, 1995; Lakoff, 1990; Turner, 1991).

These different image-schematic profiles about certain abstract concepts allowed me to predict something about people's understanding of idioms. My idea was that people's intuitions about various source domains map onto their conceptualizations of different target domains in very predictable ways. For instance, people's understanding of anger should partly be structured by their folk concept for heated fluid in the bodily container as described above. Several studies showed this to be true (Gibbs, 1992). Not surprisingly, when people understand anger idioms, such as *blow your stack*, *flip your lid*, or *hit the ceiling*, they inferred that the cause of anger is internal pressure, that the expression of anger is unintentional, and is done in an abrupt, violent manner. People do not draw these same inferences about causation, intentionality, and manner when comprehending literal paraphrases of idioms, such as *get very angry*.

More interesting, though, is that people's intuitions about various source domains map onto their conceptualizations of different target domains in very predictable ways. For instance, several later experiments showed that people find idioms to be more appropriate and easier to understand when they are seen in discourse contexts that are consistent with the various entailments of these phrases. Thus, people find it easy to process the idiomatic phrase *blow your stack* when this was read in a context that accurately described the cause of the person's anger as being due to internal pressure, where the expression of anger was unintentional and violent (all entailments that are consistent with the entailments of the source to target domain mappings of heated fluid in a container onto anger). But readers took significantly longer to read *blow your stack* when any of these entailments were contradicted in the preceding story context.

These psycholinguistic findings provide additional evidence that people's metaphorical concepts underlie their understanding of what idioms mean in written texts. Moreover, they provide significant experimental evidence that people's intuitions about their embodied experiences can predict something about their use and understanding of idiomatic meanings.

A different series of experiments demonstrates that people appear to compute or access embodied representations during their immediate understanding of idioms like *blew his stack* (Gibbs, Bogdonvich, Sykes, & Barr, 1997). In these studies, participants read stories ending with idioms and then quickly gave lexical decision responses to visually presented letter-strings that reflected either something about the conceptual metaphors underlying these idioms (e.g., *heat* for ANGER IS HEATED FLUID IN A CONTAINER having just read *John blew his stack*) or letter-strings that were unrelated to these conceptual metaphors (e.g., *lead*).

There are two important findings from this study. First, people were faster to make these lexical decision responses to the related metaphor targets (i.e., *heat*) having just read idioms than they were to either literal paraphrases of idioms (e.g., *John got very angry*) or control phrases (e.g., phrases still appropriate to the context such as *John saw many dents*). Second, people were faster in recognizing related metaphorical targets than unrelated ones having read idioms, but not literal paraphrases or control phrases. This pattern of results suggests that people are immediately computing or accessing at least something related to the conceptual metaphor ANGER IS HEATED FLUID IN A CONTAINER when they read idioms. In another experiment, participants were faster to make lexical decision responses to metaphor targets (e.g., ''heat'') having read an idiom motivated by a similar conceptual metaphor (e.g., *John blew his stack*) than an idiom with roughly the same

figurative meaning but motivated by a different conceptual metaphor (e.g., *John bit her head off* which is motivated by the conceptual metaphor ANGER IS ANIMAL BEHAVIOR). Again, it appears that people compute or access the relevant embodied metaphor for an idiom during some aspect of their processing of these phrases.

A different research project on embodiment in linguistic meaning looked at people's interpretations of metaphorical expressions about human desires (Gibbs, Lima, & Francuzo, in press). Consider how one American college student, Margo, refers to her desires as hunger in the following narrative:

> Back in high school, I had this HUGE crush on this guy, James, who was a total hunk. He would flirt with me when we'd talk, but I didn t get a chance to know him very well, nevermind ever be alone with him. I was dying to get closer to him, and felt starved for his attention. I walked around for over five months feeling silly and empty because I wanted him so bad. I wanted to eat him alive! He was yummy!

Margo fluently refers to what must be a highly correlated experience for people of all cultures, namely, the correlation between hunger and desire. Asserting this metaphorical relationship is not just a conventional or arbitrary way of speaking about desire, because there appears to be rich, systematic correspondences between feeling hunger and feeling different aspects of desire.

What is the relationship between people's embodied experiences of hunger and their concept of desire? Gibbs et al. (in press) investigated whether university students in two cultures, the United States and Brazil, metaphorically understand different desires in terms of their embodied experiences of hunger. Our analysis of American English and Brazilian Portuguese reveals that both "hunger" and "thirst" are frequently used to describe different desire experiences. Thus, American English speakers often talk of abstract desires in terms of:

He hungers for recognition—He thirsts for recognition.
He hungers for adventure—He thirsts for adventure.
He had a hunger for power—He was thirsty for power.
He hungers for revenge—He thirsts for revenge.

Gibbs et al. (in press) specifically examined the hypothesis that if there is a strong positive correlation between desire and hunger in people's ordinary experience, there should be convincing evidence of people thinking about, and talking about, many aspects of desire directly in terms of hunger. Our research strategy was to next examine people's embodied experiences of hunger, apart form their understanding of hunger in talk of desire. We expected that some bodily experiences of hunger would be far more prominent than others across both American English and Brazilian Portuguese speakers. If hunger and desire are highly correlated, and if people metaphorically make sense of their desires partly in terms of hunger, then these more prominent parts of their hunger experiences should be invariantly mapped onto their different concepts for desire. Thus, people should subsequently view certain ways of talking about desires in terms of specific hunger experiences more acceptable than less prominent aspects of feeling hunger.

A first study presented American and Brazilian college students with three types of symptoms that may possibly result from a person being hungry (these were translated into Brazilian Portuguese for the Brazilian participants). Local symptoms referred to specific parts of the body, general symptoms referred to whole body experiences, and behavioral symptoms referred to various behaviors that may result as a consequence of a person being hungry. Each of these three symptoms included items that we presumed may be closely related to the experience of being hungry, items possibly being related, and items not at all related to hunger. An analysis of

these ratings showed that both English and Portuguese speakers gave similar ratings to the different items. For example, the two groups of participants agreed that strong effects of hunger on the human body include the stomach grumbles, thought of food makes one's mouth water, one has a stomachache, and one has a headache (local symptoms); feel discomfort, becomes weak, become dizzy, gets annoyed, and have an appetite (general symptoms); and person feels out of balance, person becomes emotionally fragile, and person becomes very anxious (behavior symptoms). The two groups of participants also agreed on those items that were not related to their hunger experiences. Examples of these items include: the knees swell, the feet hurt, the hands itch, and the fingers snap (local symptoms); wants to run, does not wish to see anyone, becomes talkative, and gets a fever (general symptoms); and the person behaves normally and the person can work well (behavior symptoms). Overall, these findings indicate significant regularities in people's embodied experiences of hunger, at least as suggested by speakers from these two different cultures.

A second study examined whether people's folk knowledge about hunger is correlated with their understandings of difference experiences of desire. To do this, we asked English and Portuguese speakers from the same populations sampled in the first study to give their intuitions about two types of questions. The first set of questions focused on how people's bodies felt when experiencing three types of desire: love, lust, and the desire for things other than human beings, such as fame, adventure, and money (the "other" category). Participants were asked to read each question and then rate the relevance of various bodily experiences (e.g., becomes dizzy, weak, annoyed, talkative) when that person was in love, lust, or experiencing some other desire.

The second set of questions focused on people's intuitions about the acceptability of different ways of linguistically expressing desire. Similar to the body questions, half of the items were constructed from strongly (or highly) rated bodily experiences for hunger as shown in the first study, with the other half come from weakly (or lowly) rated hunger items. These linguistic questions were posed for three types of desire (i.e., love, lust, and other) as was the case for the body questions. The participants' task was simply to read each statement (e.g., *My whole body aches for you I have a strong headache for knowledge*, *My hands are itching for you*, *My knees ache for information about my ancestry*) and rate whether it was an acceptable way of talking in their respective language.

An analysis of the mean ratings showed that the findings for both the body and linguistic questions are generally consistent across English and Portuguese for the three types of symptoms for the three types of desire (love, lust, other). For instance, in regard to students' ratings of the acceptability of different linguistic expressions, both the American and Brazilian students viewed *I have a great appetite for money* and *I have a stomach pain for my old way of life* as being reasonable, acceptable ways of talking about different desires. But they also rated expressions such as *I became talkative for adventure* and *My knees swell for information about my ancestry* as being unacceptable ways of talking about desire.

Overall, then, the data demonstrate how knowing something about people's embodied experiences of hunger allows one to empirically predict which aspects of desire will, and will not, be thought of, and talked about, in terms of our complex embodied understandings of hunger. This evidence is generally consistent across two different languages and cultural communities. People use their embodied knowledge as the primary source of metaphorical meaning and understanding. In this way, the answer to the question "where does metaphor come from?" is given by understanding how embodiment provides the foundation for more abstract concepts.

A final set of studies on embodied meaning examined people's understanding of a single word—*stand*. Consider the following sentences:

Please stand at attention. He wouldn't stand for such treatment. The clock stands on the mantle. The law still stands. He stands six-foot-five. The part stands for the whole. She had a one-night stand with a stranger.

These sentences represent just a few of the many senses of *stand* that are common in everyday speech and writing. Some of these senses refer to the physical act of standing (e.g., *Please stand at attention*, *The clock stands on the mantle*, *He stands six-foot five*), while others have nonphysical, perhaps figurative, interpretations (e.g., *We stood accused of the crime*, *The part stands for the whole*, *He wouldn't stand for such treatment*). Why is it reasonable to use *stand* when talking of nonphysical events, as in *He wouldn t stand for such treatment*?

Following several cognitive linguists' suggestions that the meanings of many polysemous words can be characterized by metaphor, metonymy, and different kinds of image schemas (Lakoff, 1987; Johnson, 1987; Sweetser, 1990), Gibbs, Beitel, Harrington, and Sanders (1994) attempted to experimentally show that the different senses of the polysemous word *stand* are motivated by different image schemas that arise from our bodily experience of standing.

A first study experiment sought to determine which image schemas best reflect people's recurring bodily experiences of standing. A group of participants were guided through a brief set of bodily exercises to get them to consciously think about their own physical experience of standing. For instance, participants were asked to stand up, to move around, bend over, to crunch, and to stretch out on their tip-toes. Having people actually engage in these bodily experiences facilitates participants' intuitive understandings of how their experience of standing related to many different possible image schemas. After this brief standing exercise, participants then read brief descriptions of 12 different image schemas that might possibly have some relationship to the experience of physical standing (e.g., VERTICALITY, BALANCE, RESISTANCE, ENABLEMENT, CENTER–PERIPHERY, and LINKAGE). Finally, the participants rated the degree of relatedness of each image schema to their own embodied experience of standing. The results of this first study showed that five image schemas are primary to people's bodily experiences of standing (i.e., BALANCE, VERTICALITY, CENTER–PERIPHERY, RESISTANCE, and LINKAGE).

The second experiment in this series examined the relationship between the five image schemas for the physical experience of standing and the various senses of *stand*. Once again, participants were first asked to stand up and focus on different aspects of their bodily experience of standing. As they did this, the participants were presented with verbal descriptions of the five image schemas BALANCE, VERTICALITY, CENTER–PERIPHERY, RESISTANCE, and LINKAGE. Afterward, the participants were given a list of 32 senses of *stand* and asked to rate the degree of relatedness between each sense and the five image schemas.

The rating data from this study enabled us to construct an image schema profile for each of the 32 uses of *stand*. For example, *it stands to reason* and *as the matter now stands* both have the same image schema profile (in their rank-order of importance) of LINKAGE–BALANCE–CENTER/PERIPHERY–RESISTANCE–VERTICALITY. The expressions *don t stand for such treatment* and *to stand against great odds* are both characterized by the image schema profile RESISTANCE–CENTER/PERIPHERY–LINKAGE–BALANCE–VERTICALITY.

A third experiment investigated people's judgments of similarity for different senses of *stand*. The participants sorted 32 different senses of *stand* into five groups based on their similarity of meaning. An analysis of these groups revealed that participants did not sort physical senses of *stand* separately from the nonphysical or figurative senses. For example, the physical idea of standing in *to stand at attention*

was often grouped with the metaphorical senses of stand in *let the issue stand* and *to stand the test of time*.

The primary goal of this study, though, was to assess whether the senses of *stand* seen as being similar in meaning were reliably predictable from the image schema profiles obtained in this study. Statistical analyses showed that knowing the image schema profiles for different senses of *stand* allowed us to predict 79% of all the groupings of *stand* in Experiment 2. These data provide very strong support for the hypothesis that people's understandings of the meanings of *stand* are partly motivated by image schemas that arise from their bodily experiences of standing. A fourth study showed that participants' sorting of *stand* in different groups can't be explained simply in terms of their understanding of the contexts in which these words appeared. Thus, people did not sort phrases, such as *don't stand for such treatment* and *to stand against great odds*, because these phrases refer to the same types of situations. Instead, it appears that people's similarity judgments are best attributed to their tacit understanding of how different patterns of image schemas motivate different uses of the polysemous word *stand*.

None of these findings implies that image schemas capture the complete meanings of words, or phrases. But image schemas certainly appear to be a significant part of the foundation for linguistic meaning. At the same time, this experimental research does not imply that people automatically access some specific pattern of image schemas each time they encounter a particular use of a word. But some work points to a way to examine the possible role of embodiment in immediate linguistic understanding. This research demonstrates that embodiment influences symbolic or semantic judgments. In these studies, participants were first asked to make hand shapes corresponding to verbal descriptions such as *pinch* and *clench* (Klatsky et al., 1989). Following this, the participants made speeded judgments on the sensibility of 1 phrases such as *aim a dart* (sensible) or *close a nail* (not sensible). In general, embodied action relevant to the phrases facilitated people's speeded verifications of these phrases. For instance, the hand shape for "pinch" speeded the sensibility judgments for *aim a dart*. Interestingly, when participants were asked to make verbal responses (but not hand shapes) to the nonverbal prime (e.g., say the word *pinch* when shown the nonverbal signal for pinch), the priming effect was eliminated. It appears that the sensibility judgments require a type of mental simulation using an embodied, motoric medium. One may possibly adopt the Klatsky et al.'s methodology in some way to assess the role of image schemas in people's immediate understanding of individual words and phrases in different contexts.

5. Conclusion

The research discussed in this article illustrates how linguistic meaning may have close links to embodied experience. Most of the scholars whose work I summarize embrace the strong claim that linguistic meaning is inherently embodied, not only in terms of where meaning comes from, but in regard to how people ordinarily use and understand language. These advocates of the embodied basis of linguistic meaning adopt different strategies in pursuing their research agendas. My personal view is that scholars should try to independently assess people's ordinary kinesthetic, embodied experiences, and their intuitions about those experiences, before attempting to make experimental predictions about people's embodied understanding of language (i.e., the *embodiment premise*). Similarly, critics of embodied meaning need to first construct studies that explicitly seek out embodiment in linguistic understanding, and then fail to find such evidence, before dismissing embodied accounts of

language and thought. Part of the problem with the controversy over embodied cognition and language is that too much of the debate focuses on general arguments and not enough on actual empirical work seeking to uncover the dynamics of embodiment in linguistic meaning.

The arguments in favor of embodied meaning do not constitute a single theoretical or empirical claim. There are, at least, three broad hypotheses that need to be explored. First, embodied experience plays a major role in why certain words and expressions emerge in language. Second, embodied experience plays a role in people's intuitions about why words and phrases have the particular meanings they do. Third, embodied experience, including people recognition of affordance structures, plays a role in people's immediate, on-line processes in learning, speaking, and understanding language. Each of these hypotheses requires different empirical methodologies to appropriately evaluate. Thus, the first claim demands detailed diachronic and synchronic linguistic evidence, such as that offered in cognitive linguistics (Gibbs, 1994; Gibbs & Steen, 1999; Lakoff & Johnson, 1999; Sweetser, 1990). The second hypothesis requires systematic empirical examination of people's intuitions about linguistic meaning, such as offered by various psycholinguistic evidence discussed above (Gibbs, 1992; Gibbs et al., 1994, in press). Finally, the third hypothesis requires more sophisticated online methods, including neurolinguistic techniques, to assess people's fast, unconscious processing of linguistic meaning (Gibbs et al., 1997; Glenberg & Robertson, 2000; Klatsky et al., 1989).

An embodied view of linguistic meaning conceives of meaning as what people do with language, and their intuitions about language use. Meaning is not simply reduced to a purely hypothetical construct (i.e., semantics) that must be studied from a formal objectivist perspective. One way of thinking about linguistic meaning, under the embodied view advocated here, is as the study of "experiential semantics". But how might embodied experience be part of the mental representation of linguistic meaning? One reply to this question is to emphasize that language understanding does not simply result in an internal representation of some text for archival purposes, but prepares people for situated action (Barsalou, 1999a). Under this view, processing linguistic meaning is not a matter of understanding what words mean, but includes the perception of physical objects, physical events, the body, and other people in interaction. The meaningful representation of language includes both a depiction of what has happened and potential perceptions and embodied actions that may take place in the future. Linguistic meaning, therefore, is inherently embodied, not only in the sense of what has happened, but in the sense of what is likely to occur next in a discourse situation.

Barsalou (1999b) presents a theory of perceptual symbol systems that captures something about the embodied cognitive mechanisms supporting language understanding. Thus, during perception of the real-world, people selectively attend to specific, relevant aspects of experience, including shapes, colors, sounds, smells, movements, and emotions. Associative areas in the brain represent these patterns of activation in sensorimotor cortex, as well as areas responsible for introspective states. Most importantly, these perceptual, embodied representations are partially reactivated in the absence of perceptual input, such as when one is reading a story or listening to a speaker. In this way, perceptual symbols operate to simulate the experience of what some linguistic description refers to. This is why people, perhaps, embodied representations become especially activated when understanding language referring to embodied action.

These ideas about the perceptual, embodied representation of linguistic meaning are somewhat preliminary (but see Barsalou, 1999b). At the very least, people's

understandings of linguistic meaning incorporate aspects of their afforded, image-schematic structures combine, or mesh, to form higher-level representations of meaning remains an important challenge for future research. As suggested in the Introduction, alternative views in psychology and cognitive science have not explicitly explored the embodied foundation of linguistic meaning. I acknowledge that these traditional propositional and high-dimensional approaches to semantics may not be entirely incompatible with an embodied meaning perspective. But the challenge is for these theories to explicitly account for the embodied foundation for many aspects of linguistic meaning (and see Lakoff & Johnson, 1999; and Lakoff & Nunez, 2000; for further discussion of the embodied nature of highly abstract concepts, such as the self, truth, and mathematics). It is now clear that significant aspects of meaningful symbols in language and thought are, indeed, grounded in pervasive patterns of embodied experience. No theory of linguistic meaning should ignore this fundamental fact.

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