Metaphor as Embodied Simulation:

Psycholinguistic Evidence

Raymond W. Gibbs, Jr.

University of California, Santa Cruz

Teenie Matlock

University of California, Merced

Send correspondences to:

Raymond W. Gibbs, Jr.
Dept. of Psychology
University of California, Santa Cruz
Santa Cruz, CA 95064
gibbs@ucsc.edu
fax: 831-459-3519

Metaphor, Imagination and Simulation: Psycholinguistic Evidence

A person with a sharp eye can find metaphors almost anywhere. A public bulletin board on the University of California, Santa Cruz campus once had a flyer with a picture of a large black boot, typical of those worn by students; with the words *You have feet. Stomp out racism in your scene*, followed by an invitation to attend a campus meeting on the topic. This flyer was notable with the contrast between the picture and the caption, because, after all, one cannot physically stomp out an abstract idea or concept like racism. Of course, racism is manifested in concrete behavior such as language and other acts. But the concept of racism also refers to certain beliefs and attitudes that are distinctly immaterial and cannot be stomped out, regardless of what sort of fashionable boot one is wearing.

When students were asked about their reactions to the flyer and their understanding of *stomp out racism*, they all observed the humor in the juxtaposition of the picture and caption, yet none thought that there was anything unusual about the idea of stomping out an abstract idea such as racism. “It’s sort of a metaphor,” as one woman said, because “you can’t really stomp out racism with your feet, but you can use your efforts to stop racism by finding and killing it, as if stomping out a nasty insect crawling on the ground.” Another student said that he could “think of racism as if it were some object, or a living thing, that does terrible damage and needs to be stopped or squashed, before it hurts other people.” A third student explained, “Racist people have to be stopped. As horrible as it sounds, these people need to be controlled, and destroyed, or at least the beliefs they have. Racism needs to be stopped dead in its tracks.”

These students’ comments reflect their immediate, off-the-cuff imaginative understandings of the phrase *stomp out racism* by conceiving racism as if it was a

physical being or object with the ability to hurt others that must be eradicated by those with the power to do so. Consistent with this figurative reading, people envisioned *stomp out racism* by imagining their bodies in action against the metaphorical object or living entity of racism, which is a specific instantiation of the more general conceptual metaphor AN IDEA IS AN OBJECT OR LIVING ENTITY. We maintain that students' impressions of *stomp out racism* illustrate a fundamental process by which metaphorical language is interpreted. People understand metaphors by creating an imaginative simulation of their bodies in action that mimics the events alluded to by the metaphor. Understanding the word *stomp* in *stomp out racism* is not done by accessing some highly abstract meaning that captures something of all physical and non-physical uses of *stomp*. Interpreting the metaphorical meaning of *stomp out racism* also does not require that the concrete, physical features of *stomp* be completely inhibited or ignored. However, under our view, the physical, embodied meaning of *stomp* makes perfect sense in combination with *racism* when this abstract concept is conceptualized metaphorically.

Much research in cognitive linguistics suggests that many abstract concepts, such as racism, are understood in, at least partly, embodied metaphorical terms (Gibbs, 1994, 2006; Lakoff & Johnson, 1999). For example, understanding the conventional phrase, *Our relationship is at a crossroad* is partly accomplished through the activation of the conceptual metaphor ROMANTIC RELATIONSHIP IS A JOURNEY. This enduring chunk of metaphorical thought has a source domain (e.g., JOURNEY) that is grounded in the pervasive bodily experience, or image-schema, of SOURCE-PATH-GOAL, which together give the idea RELATIONSHIP its embodied character. Psycholinguistic research shows that people appear to access embodied conceptual metaphors in some

form when interpreting why many words and phrases have the metaphorical meanings they do, as well as when they immediately comprehend many verbal metaphors (Gibbs, 1994, 2006a).

We claim in this chapter that the recruitment of embodied metaphors in some aspects of verbal metaphor understanding is done imaginatively as people recreate what it must be like to engage in similar actions. The key to this imaginative process is simulation, in this case the mental enactment of the very action referred to in the metaphor. For example, abstract concepts are often understood as physical objects that can be touched, held on to, dropped, and, indeed, stomped on. When hearing *stomp out racism*, listeners imagine engaging in a relevant body action, such as stomping with their feet, that facilitates metaphorical construal of the abstract notion of racism as a physical entity. Although there is no physical action performed, the mental simulation created has embodied elements as people imagine themselves performing the relevant action. In this way, simulating what it must be like to engage in similar actions facilitates the recruitment of embodied metaphors in some aspects of verbal metaphor understanding. Our purpose in this chapter is to make the case for embodied simulation in a theory of metaphor understanding. We do this by describing relevant research from cognitive science on the importance of embodied simulation in cognition and language use. We then discuss current experimental work from psycholinguistics that is consistent with the claim that embodied simulations are created during metaphor understanding.

Embodied Simulation

People simulate all sorts of things in all sorts of ways. Some simulations are physical, and serve a communicative function. Imagine, for instance, that you are sitting in a restaurant in a foreign country. You have long finished your meal and want to pay the bill. Eventually you manage to catch your waiter's attention and pretend to scribble something in the air. In doing so, you are replacing the word *bill,* or its appropriate equivalent, with an iconic gesture that you assume will be familiar to him. The waiter understands and brings you the bill. Imagine next that you have just gotten on a crowded bus and see an old friend outside on the street. She waves and you then hold your hand up to your ear as if you are holding a cell phone. As the bus is pulling away, your friend nods and does the same in return. In both the restaurant and on the bus, you do a physical action that communicates something clear and unambiguous to your interlocutor. You simulate physical actions (signing a bill, making a phone call) that are familiar and grounded in shared knowledge. Such actions are common in everyday situations in which speech may not suffice on its' own, or in which speech is not possible (Bavelas, Kenwood, Johnson, & Phillips, 2002; Clark & Krych, 2004). People typically simulate actions or objects in these situations that are familiar and can readily be understood.

Other physical simulations are not communicative, but are useful to performing various cognitive tasks such as problem solving. Imagine you are learning to play "Tetris," a popular video game. In this game, two-dimensional shapes fall one a time from the top of the screen, landing on the bottom or on top of shapes that have already landed. The object of the game is to fill rows of squares all the way across. Filled rows dissolve and move down, and unfilled rows stack up. The game ends when incomplete rows stack up and reach the top of the playing field. As you decide where to place

pieces, you press keys on a keypad to move them right or left, spin them clockwise or counterclockwise, or suddenly drop them to the bottom. Counter to what would be expected, as you become better at the same, you do more and more seemingly superfluous actions. For instance, you rapidly spin a piece to the right times before dropping it. Such actions might not seem useful while you are playing the game because they are not always necessary and take extra time. Yet they are useful because they allow you to simulate many possible placements before you move a piece to its final location (see Kirsh & Maglio, 1994). Or imagine you are playing the word game "Scrabble". As you wait for your turn, you move your tiles around before placing them on the board. In doing so, you simulate words to be played by activating new letter configurations that would not be available without moving them around (Maglio, Matlock, Raphaely, Chernicky, & Kirsh, 1999). Using physical actions to simulate future actions or states is not limited to playing games. It's part of everyday reasoning. Imagine that you are presented with two glasses of water. Both glasses are the same height and both are half full, but one is thin and one is wide. You are asked whether water will pour from the thin glass or the wide glass first if the glasses are tilted at the same rate. Like most people, you are likely to give an incorrect answer if you make this judgment on the fly. However, if you are asked to pretend that you are tilting the glass, you are more likely to provide a correct answer (that the wide glass will pour the water first) (Schwartz & Black, 1999). The role of physical actions or imagined physical actions in all these cases is important. In reasoning about everyday events and actions, people frequently engage in physical simulations as a way of "offloading" mental computation into the world, which makes problem solving much easier (Clark, 1997).

Other simulations are purely mental. If you close your eyes and imagine your house right now, you can "see" various objects and rooms. You can visually scan from one object to another, or "walk" from one part of the house to another. In doing so, you are constructing a spatial mental model from your memory of a place that shares certain attributes with that actual physical space (Bower & Morrow, 1990). As you "go" through the house, you can imagine moving quickly or slowly (Morrow & Clark, 1988). You can keep track of where objects are or where they once were by anchoring them to other objects (Morrow, Bower, & Greenspan, 1989). You can change your perspective from a subjective viewpoint to more objective one, such as from your own perspective as the mover to a bird's eye perspective (Tversky, 1996). You can also construct a spatial mental model when reading a description of a scene, or seeing a graphical depiction, such as a map (Denis & Cocude, 1988). In all cases, when you imagine yourself or another person going through a house or any other spatial environment, you are simulating motion, and to some extent that motion shares properties with actual movement in the world, either perceived or enacted (Tversky, 2000; Zwaan & Radvansky, 1998.)

One of the interesting elements of embodied simulations is that people engage in these processes not only when motion is explicitly mentioned (e.g., when imagining stomping out something or moving through a house), but also when motion is to some degree implicit. For example, studies show that people infer the presence of motion when they read handwriting (Babcock & Freyd, 1988) or view a series of photographs where motion between the events depicted is implied (Freyd, 1983). Thus, people perceive handwriting displays based on the gestures that produced them, and not just the static features of the letters. Neuroscience research reveals that brain areas associated with

visual processing of motion are active when people see both pictures depicting real and implied motion (Kourzi & Kanwisher, 2000). These findings suggest that processing implied motion in static scenes is very similar to perception of real motion.

All of these different studies suggest that people can readily, and mostly unconsciously, create simulations of real-world events as they communicate with others, hear stories, solve problems, and even perceive motionless displays. Psycholinguistic studies also demonstrate the importance of embodied simulations in ordinary language understanding. For instance, reading sentences with visual semantic components can selectively interfere with visual processing. Thus, participants in one study took longer to perform a visual categorization task in the upper part of their visual field when they heard sentences depicting upward motion such as *The ant climbed* (Richardson, Spivey, McRae & Barsalou, 2003). When people perform physical actions such as forming a fist or moving a lever toward the body, they were slower to verify as meaningful sentences that described unrelated actions, such as *aim a dart* (Klatzky, Pelligrino, McCloskey, & Doherty, 1989), and *close the drawer* (Glenberg & Kaschak, 2002). Moreover, performing a simple physical action such as rotating a knob in a clockwise direction can interfere with people's speed comprehension of statements like *Eric turned down the volume*, which describes a scenario where a person moves their wrist in a counterclockwise manner (Zwaan & Taylor, 2006). In general, these psycholinguistic studies demonstrate that people's understanding of linguistic descriptions of action mentally simulate the action. As such, there is significant psycholinguistic evidence consistent with the broad claim that language use is closely tied to embodied imagination.

Many cognitive scientists, especially philosophers, describe cognitive simulations as conscious, deliberative acts of pretense (Gordon, 1986; Harris, 1989; Goldman, 2001). But simulation processes that are critical to language processing are different from engaging in pretense (Currie & Ravenscroft, 2002), and are likely automatic, unconscious, and pre-reflexive (Gallese, 2003). Thus, one pretends to do something (e.g., talking on a telephone) by performing some other, somewhat analogous, action (e.g., holding your hand in a particular shape by your ear). On the other hand, most imaginative simulations are mental actions where one is not doing one thing to stand for another, but where one mentally engages in actions similar to those overtly referred to. For instance, when Ray imagines what it feels like to kick a football, he does not engage in some other action, such as kicking a cantaloupe. Instead, he mentally constructs a scenario of his own body kicking a football. This simulation is not abstract in the way, for example, that a computer simulation of a hurricane mimics abstract elements of how a hurricane moves. Embodied simulations often have a bodily feel to them, in the way that a person may experience sensations of movement when flying an aircraft simulator (Gibbs, 2006). People may not necessarily be aware of these sensations, as demonstrated by research on ideomotor actions indicating that people often unconsciously move in similar patterns to others around them (Knuf, Aschersleben, & Prinz, 2001). Embodied simulations are imaginative acts that are intimately involved with subpersonal processes, (Currie & Ravenscroft, 2002) and in most cases are performed automatically without significant conscious reflection.

Studies on Metaphorical Simulation

The research from cognitive psychology and psycholinguistics suggests that people can easily simulate motion, especially relevant to bodily movement, when they were engaged in various cognitive tasks, including non-metaphorical language understanding. But do people simulate motion in situations that are physically impossible to do, such represented by metaphorical phrases like *grasp a concept* and *stomp out racism*? The studies described below ask people to do different things in experimental situations that tap into various conscious and unconscious mental processes, such as imagining metaphorical actions and answering questions about their images, draw maps depicting metaphorical events, making appropriate responses to metaphorical statements, reading metaphorical phrases after performing, or imagine performing, different bodily movements, and walk while thinking about the meaning of metaphorical narratives.

Some of these experiments examined the products of metaphor understanding (i.e., the meanings people inferred), while others investigated the processes by which people construct these products. One must be careful to not draw unwarranted conclusions about the processes of linguistic understanding from an examination of products alone, or assume that fast-occurring mental processes necessarily reflect much about the eventual products of those interpretation processes (Gibbs, 1994). Yet the experimental examination of both the processes and product of understanding are useful to demonstrate different aspects of how people's automatically construct imaginative understandings of metaphors that are closely tied to their mental simulating the actions referred to by these expressions. Metaphorical simulations are not abstract, or amodal, but are created in terms of "as if" bodily action, where people imagine moving their

bodies in ways specific to their metaphorical understandings of the abstract concepts noted in metaphorical statements, such as *grasp a concept*.

Many psycholinguists studying metaphor use do not endorse our claim that metaphors are understood in terms of embodied simulations. These scholars suggest that many of the types of metaphorical expressions studied in the research described below are not actually metaphors, or understood by processes linked to bodily processes related to mental simulations. Although it is quite possible that different theoretical accounts may be needed to explain various kinds of metaphorical language (e.g., "A is B" metaphors vs. metaphors arising from correlations in experience), we will argue later on that embodied simulations may be required to understand even classic "A is B,' or resemblance, metaphors. For the moment, the research described below examines different aspects of how embodied simulations enable people to make sense of various metaphorical expressions, draw specific inferences about theirs meanings, and immediately comprehend these expressions in certain experimental situations. We suggest as a methodological imperative that one cannot dismiss the idea of embodied simulations as being critical to metaphor interpretation unless one has explicitly looked for such evidence and failed to find it. However, much current psycholinguistic research indicates that positive evidence in favor of the simulation account can be readily observed as we now report.

Imagining Impossible Actions

Asking people to describe their understanding of *stomp out racism* reveals that people can easily imagine ways that an abstract idea like racism can be physically stomped out. For some, this ability to concretely imagine physically impossible events

may seem odd. But people's pervasive schemes of metaphorical thought, in which abstract concepts are often metaphorically understood in concrete ways, enables them to imagine the impossible, and make it seems quite plausible.

There have been a many experimental studies investigating people's abilities to form mental images for metaphorical phrases (Gibbs & O'Brien, 1990; Gibbs, Strom, & Spivey-Knowlton, 1997), which reveal that conceptual metaphors constrain the kinds of images people have for expressions like *spill the beans* and *don't put all your eggs in one basket*. These metaphorical expressions, however, may be easy to imagine because they are sensible when used concretely, because one can, for instance, literally spill the beans in some situations. But can people's form mental images for physically impossible actions that express metaphorical meaning, such as *stomp out racism* or *grasp the concept*? If so, might these imaginative creations arise as a result of embodied simulations?

One set of experiments explored these questions by comparing people's mental images for concrete (e.g., *chew on the gum*) and metaphorical (e.g., *chew on the idea*) phrases (Gibbs, Gould, & Andric, in press). Unlike imagining nonmetaphoriocal action statements (e.g., *chew on the gum*), where people's images should focus on the procedural characteristics of the concrete actions (i.e., moving their mouths as they chew the gum), people's mental images for metaphorical phrases should show an analogical understanding of how abstract domains, such as ideas or concepts, can be actively structured in terms of embodied source domains (i.e., chewing on something to get more out of it).

Participants were first presented specific phrases that were either metaphorical or nonmetaphorical, given ten seconds to form a mental image of that action, and asked, "What is particularly noticeable in your image?" People's responses could be roughly divided into two groups. The first set of answers made some specific reference to the participants actually participating in the action mentioned in the statement. For example, "My jaw goes up and down as I chew," was one response given to "chew on the idea." People gave far more of these specific references to participating in the action responses for the nonmetaphors (63%) than to the metaphors (29%).

But for the metaphors, people gave significantly more conceptualized descriptions of the action (71%) than they did for the nonmetaphors (37%). For instance, for the metaphor *stretch for understanding*, one person said that the most noticeable thing in his image was "there is much stretching going in both in terms of the ideas being stretched out to see if they are true and me stretching to better see of examine the idea." The participant essentially noted that IDEAS ARE OBJECTS which can be physically inspected by stretching them out to more effectively examine them, and that UNDERSTANDING IS GRASPING enables the person to extend his or her body to better control the object, and thus better understand it. This response concretely illustrates how embodied metaphors constrain the mental images people construct when interpreting metaphorical action statements.

Participants were also asked, "Why is this concept (e.g., idea) sometimes associated with this action (e.g., chewing)?" Once more, people could give a concrete explanation of the relevant process or action, such as "That is what you do with gum-chew on it" for *chew on the gum.* But for the metaphors, people specifically provided

analogous, conceptual explanations as to why some concept was sometimes associated with some action or process. For example, for the metaphorical phrase *chew on the idea*, one person said, "Chewing is related to a slow methodological activity and it could be related to turning something over in your mind to better understand it." Overall, people gave analogous, conceptual explanations far more often to the metaphors (77%) than to the nonmetaphors (36%), showing that people's mental images for metaphorical action phrases are constrained by their embodied, metaphorical understandings of the target domains referred to in these expressions (e.g., ideas, concepts, feelings).

If people understood metaphors by engaging in embodied simulations, then moving their bodies in ways relevant to the actions mentioned should enhance the creation of these simulations. A second study again presented people with different metaphorical and nonmetaphorical expressions, formed mental images for these phrases, and then answered a series of questions about their images. In Experiment 2, however, people also participated in one of three enactment conditions in which they first did one of three things: (a) watched the experimenter make a bodily action relevant to the main verb in each statement (e.g., making a stretching motion before forming a mental image for the phrase *stretch for understanding*), (b) watched the experimenter make a relevant bodily action, which they then imitated, before being given ten seconds to form their mental image for a phrase, or (c) watched the experimenter make a relevant bodily action, then imagined themselves doing the same action, before forming a mental image for the phrase. These three experimental treatments were referred to as the watching, imitating, and imagining conditions, respectively.

This study showed, once more, that across all three enactment conditions, 78% of these referred to additional bodily actions and consequences of these actions related to the main verb in each metaphorical phrase. For example, when one participant was given the phrase *put your finger on the truth* (in the imagine condition), she replied, "I guess being able to touch the truth is an important thing, being able to relate to it, being able to actually see that it is a physical thing and can be examined." This evidence shows how moving the body in relevant ways enhances the creation of embodied simulations, compared to Experiment 1 where no movement was performed. These actions enabled people to more easily construct embodied simulation that made these impossible actions, like *grasping the concept*, plausible and meaningful.

Real and Imagined Bodily Movement Enhances Simulations During Immediate Metaphor Comprehension

The extent to which people ordinarily engage in imagistic processes during immediate metaphor processing that they can consciously reflect on is unclear. But one possibility is that moving the body, or overtly imagining moving the body, in relevant ways facilitates immediate metaphor comprehension. If abstract concepts are indeed understood as items that can be acted upon by the body, then performing a related action should facilitate sensibility judgments for a figurative phrase that mentions this action. For example, if participants first move their arms and hands as if to grasp something, and then read *grasp the concept*, they should verify that this phrase is meaningful faster than when they first performed an unrelated body action. Engaging in body movements associated with these phrases should enhance the online simulations that people create to

form a metaphorical understanding of abstract notions, such as *concept*, even if a *concept* is not something that can be physically grasped.

In fact, a computerized reading-time study showed that participants responded more quickly to the metaphorical phrases that matched the preceding action (e.g., the motor action grasp was followed by *grasp the concept*), than to the phrases that did not match the earlier movement (e. g, the motor action kick was followed by *grasp the concept*) (Wilson & Gibbs, 2006). People were also faster in responding to the metaphor phrases having performed a relevant body moment than when they did not move at all. In short, performing an action facilitates understanding of a metaphoric phrase containing that action word. One possibility is that people's bodily action prompted them to think of the verb in the subsequently presented phrase (e.g., a grasping action led people to think of the word *grasp*). But a control study showed that people were not especially good at thinking of the exact word in the phrase when they just performed the bodily action, and that there was no correlation between successful identification of the actual word and priming effects for that item in the reading time experiment. It appears, then, that moving in an appropriate manner does not activate a lexical item, but enhances how people create a relevant embodied simulation to understand a metaphorical phrase.

A second study asked people to simply imagine specific bodily actions before they made their speeded responses to word strings. Once again, participants were faster to process the metaphors when the act imagined by consistent with the meaning of the phrase than when the imagined act was inconsistent. This result reveals that real movement is not required to facilitate metaphor comprehension, only that people mentally simulate such action. Once again, a control study demonstrated that this finding

was not due to simple lexical associations created from doing or imagining the actions and seeing specific words in the phrases.

Most theories of metaphor understanding assume that people must inhibit the physical meaning of a word like *grasp* in *grasp the concept* to properly infer its abstract, metaphoric meaning (Glucksberg, 2001). This view suggests that having people make a grasping motion before reading *grasp the concept* should interfere with their immediate processing of the phrase. Yet the present studies show this is not the case. Real and imagined body movement helps people create embodied simulations of metaphorical meanings that involve "what it must be like" processes that make use of tactile-kinesthetic experiences. People may not create a complete literal interpretation for a phrase like *grasp the concept*, and reject that in favor of a metaphorical reading. But they do use their embodied understanding of various action verbs to construct metaphorical interpretations of abstract concepts to make meaningful combinations of the physical with the abstract. Of course, the studies discussed here did not examine normal metaphor comprehension in context, and seeing how appropriate discourse situations, where various bodily actions are also performed, affect metaphor understanding is an exciting topic for future psycholinguistic research.

Bodily Imagination in Thinking about Time

Imagine that you have a meeting scheduled for this coming Wednesday when a colleague approaches you and says, *Next Wednesday's meeting has been moved forward two days*. Would the meeting now be held on Monday or Friday of that week? Your answer to this question depends on your interpretation of *moved forward*, which alludes to the fact that people often conceptualize time in terms of physical space. But do people

ordinarily simulate actual movement forward as part of their understanding of time statements such that referring to next Wednesday's meeting? One possibility is that many people's embodied simulations for time concepts depend on their current bodily movements.

Many studies have examined people's experience of time, including the way they talk about time metaphorically. In a series of studies by Boroditsky and Ramscar (2002), students waiting in line at a café were given the statement *Next Wednesday's meeting has been moved forward two days* and then asked *What day is the meeting that has been rescheduled*? (The question was adapted from McGlone & Harding, 1998.) Students who were farther along in the line (i.e., who had thus very recently experienced more forward spatial motion) were more likely to say that the meeting had been moved to Friday. Similarly, people riding a train were presented the same ambiguous statement and question about the rescheduled meeting. Passengers who were at the end of their journeys reported that the meeting was moved to Friday significantly more than did people in the middle of their journeys. Although both groups of passengers were experiencing the same physical experience of sitting in a moving train, they thought differently about their journey and consequently responded differently to the rescheduled meeting question. These results demonstrate how ongoing sensorimotor experience has an influence people's comprehension of metaphorical statements about time. As seen in the studies on imagining and understanding *grasp the concept*, moving the body in particular ways can facilitate people's creation of simulations of action relevant to the actions referred to by metaphoric language that alters the way these metaphors are interpreted.

Having people perform different types of movement can also affect their understanding of time metaphors. Participants in another experiment were asked to study a drawing that depicted a chair with a rope attached (Boroditsky & Ramscar, 2002). Half of the participants imagined that they were pulling the chair towards them with the rope. The other half imagined being seated in the chair, pulling themselves forward along the rope. Following the imagination activity, the participants were asked the same question about the meeting being moved forward two days. Participants who imagined pulling the chair toward their bodies were more likely to answer that the meeting had been moved to Monday, consistent with the metaphorical idea that time is an object moving toward them. Conversely, the participants who imagined pulling themselves along the rope more often answered that the meeting had been rescheduled for Friday, consistent with the idea that time is a stationary object with the person moving toward it. Once again, ongoing body movement shapes online metaphor understanding, suggesting that people simulate what time, in this case, is like to in relation to their bodies, which affects the way respond to the metaphorical time question. (See also Gentner, Imai, & Boroditsky, 2002; McGlone & Harding, 1998;, and Nunez, Motz, & Teuscher, 2006).

Fictive Motion and Embodied Simulation

Suppose a realtor is talking to you on the phone about a piece of property. He uses descriptions such as *There's an apple orchard that runs along the hillside* and *A dirt road goes across a creek*. How do you make sense of his descriptions given that he is using motion verbs (*runs, goes*) but there is no actual motion? Such sentences are common in English, and you readily generate an image of an elongated orchard that "goes" from one point on a hillside to another. In processing the sentence, you understand

that no *actual* motion transpires because you know that things like orchards and dirt roads can't move and you are used to hearing sentences that have inanimate subjects, yet in scanning from one part of the image to another, you experience a fleeting sense of motion. This subjective sense of motion is what Talmy (1996) and others have called *fictive motion*. (See also Langacker, 1987; Matsumoto, 1996).

Some language theorists have questioned whether any sort of motion imagery is involved in processing fictive motion sentences (Jackendoff, 2002). But several psycholinguistic experiments have provided evidence to support the idea that people do simulate motion in processing these sentences. Participants in one set of experiments were timed as they read fictive motion target sentences such as *The road goes through the desert* at the end of stories about protagonists traveling through physical space (Matlock, 2004b). Overall, people took less time to read and make a decision about these fictive motion sentences after they had read about travel that was fast (versus slow), over a short distance (versus long), or through an easy terrain (versus difficult). But critically, people did not differ in the time it took them to read non-fictive motion sentence (e.g., *The road is in the desert*) under the same conditions. The results of these studies indicate that thought about actual movement can influence the time it takes to process fictive motion sentences. For instance, when people think about slow motion, they simulate more slowly when thinking about fictive motion. The results suggest that embodied simulation is part of understanding a commonly form of figurative language.

Other research supports the idea that fictive motion includes simulated motion. Matlock, Ramscar, and Boroditsky (2005) tested whether *fictive motion* would influence people's understanding of time because relatively abstract ideas about time and the

understanding of fictive motion both involve a shared underlying representational format extracted from our concrete experience with actual moving objects. In one experiment, participants first read sentences with or without fictive motion, such as *The tattoo runs along his spine* or *The tattoo is next to his spine*, and then drew the meaning conveyed by the sentence. Next they answered the ambiguous question adapted from McGlone and Harding (1998) and used in Boroditsky and Ramscar (2002), *Next Wednesday's meeting has been moved forward two days. What day is the meeting now that it has been re-scheduled?* People were more likely to respond Friday (versus Monday) if they had read and drawn a fictive motion sentence, but evenly divided in their answers if they had read and drawn a non-fictive motion sentence. Fictive motion depictions included more motion elements (e.g., cars, bikes) than did non-fictive motion sentences (see Matlock, Ramscar, & Boroditsky, 2004).

In a second experiment, participants read one of four fictive motion sentences that varied according to magnitude of fictive motion, defined as the number of scan points along a path (i.e., *Four / eight / 20 / over 80 pine trees run along the driveway*). The question was whether more scan points would encourage more movement through time, and hence, more Fridays. Participants were more likely to say *Friday* than *Monday* overall. However, the difference was enhanced for people who had read sentences with eight and 20 scan points (pine trees), and non-existent for people who had read sentences with very few (four) or very many (over 80) scan points, suggesting that number of scan points (and hence, more fictive motion simulation) promoted more motion through time.

In a third experiment, people read and drew fictive motion sentences with motion "going away" from or "coming" toward the individual (e.g., *The road goes/comes all the*

way to/from New York). The goal was to investigate whether fictive motion simulation included a diffuse, undirected type of motion or a more directed type of motion. The results showed that participants were more likely to say *Friday* when the direction was going away from them, and more likely to say *Monday* when the direction was coming toward them, suggesting that fictive motion simulation includes direction.

This set of studies shows that people engage in thought about motion when thinking about fictive motion and when they are thinking about time. So, for instance, when people have done a fictive motion simulation, they imagine forward motion and this encourages them to take a forward moving perspective and move forward through time. And when the path they have thought about is long, they are even more likely to think about forward movement through time. Last, when people simulate motion along a path as they read *The road goes all the way to New York*, they are pre-disposed to then move forward through time, specifically, to Friday.

Follow-up studies with the same ambiguous time question provide further evidence that fictive motion can influence the understanding of time metaphors (see Ramscar, Matlock, & Boroditsky, in progress). Even when participants draw *no* picture to convey the meaning of a fictive or a non-fictive motion sentence, they are more likely to say *Friday* than *Monday* with fictive motion. They are also more likely to say Friday with a "just right" number of scan points and with fictive motion "going away" from them. The results of this control study are important because they demonstrate that the affect was not due to hand movements while drawing the meaning conveyed by the sentence. Other work shows that counting direction can influence the understanding of time (see Matlock, Ramscar, & Srinivasan, in progress). People are more likely to

respond *Friday* to the ambiguous time question after counting from *5* to *17,* and more likely to say *Monda*y after counting from *17* to *5*. The results indicate that "going" from number to number either away from zero or toward zero, the default position of the speaker or listener (see Lakoff & Njunez, 2001), encourages people to conceptually move forward through time or back through time. The results provide further evidence that people simulate motion even when there is no explicit mover to imagine, and novel evidence that they do so even when there is no physical space to imagine.

Other psycholinguistic research has explored whether fictive motion language affects people's visual processing of spatial scenes (Matlock & Richardson, 2004). Participants' eye movements were tracked as they were presented with simple drawings of trajectories, such as roads, rivers and pipelines, while they passively heard either fictive motion or non-fictive motion descriptions such as *The road goes through the valley*, *The road is in the valley*. When people heard fictive motion descriptions they spent more time inspecting the trajectory region of the scene than when they heard non-fictive motion descriptions. Follow-up work ruled out the possibility that fictive motion descriptions were simply more interesting, and that alone attracted more visual attention to trajectory region versus other parts of the picture (Richardson & Matlock, 2006). Together these eye-tracking studies provide additional evidence that people engage in embodied simulation when they are processing fictive motion sentences.

Finally, data from a map task provides further evidence that fictive motion includes mentally simulated motion. Pairs of participants where asked to put landmarks on a blank map where a director told a mapmaker what to do (Matlock & Clark, in progress). All pairs drew the same map with the same lines. Some participants drew

lines that represented roads while others drew lines that represented pipelines. Overall, participants who depicted roads used more motion verbs and produced more path gesture (sweeping gestures that go from one point in space to another) than those who produced identical lines for pipelines. These results suggest that in giving directions about how to draw a system of roads the director was drawing on knowledge about what roads are ordinarily used for, in particular, for travel through space. Drawing on that knowledge and putting it into verbal or visual form allows the director to simulate motion and invite the listener to simulate motion.

Together these psycholinguistic studies on fictive motion demonstrate that people naturally and tacitly simulate motion in understanding everyday spatial descriptions such as *The road goes through the park* or *A fence runs along the coastline*. The results show that figurative language understanding included embodied simulation that draws on what know about motion through perception and action.

Walking the Walk While Thinking About Metaphorical Talk

Many of the psycholinguistic studies described in this chapter illustrate how bodily action, and imagining specific bodily acts, constrains, and often facilitates people's interpretation of verbal metaphor. These real and imaginative bodily reenactments had specific consequences for how people interpreted the meanings of various metaphors. We now discuss a novel situation in which the embodied simulation created to understand metaphor affects how people move their whole bodies as they continue to think about what they have heard. Consider the following two brief narratives about the development of two different romantic relationships.

Story A

Imagine that you are a single person. A friend sets you up on a blind date. You really like this person and start dating a lot. Your relationship was moving along in a good direction. But then it got even better. The relationship felt like it was the best you ever had. This continues to this day. No matter what happens, the two of you are quite happy together.

Story B

Imagine that you are a single person. A friend sets you up on a blind date. You really like this person and start dating a lot. Your relationship was moving along in a good direction. But then you encountered some difficulties. The relationship did not feel the same as before. This lasted for some time. No matter how hard you two tried, the two of you were not getting along.

Story A describes a successful relationship, while B describes a relationship that appears to be in trouble. Both stories are similar, however, in conceiving of the relationships as entities that can move along some sort of path (RELATIONSHIPS ARE JOURNEYS), as indicated in the fourth line *Your relationship was moving along in the good direction*. Although no other part of the two stories explicitly refers to journeys, the two stories provide different impressions of the "relationship journey." Thus, Story A suggests a smooth, uninterrupted journey that is still progressing, while Story B implies a more difficult, perhaps interrupted, journey that may no longer be progressing.

Do people actually draw different inferences when reading these two stories? To what extent are the different meanings inferred based on the embodied metaphor RELATIONSHIPS ARE JOURNEYS? One study examined people's metaphorical interpretations of these two stories by asking them to make judgments about different aspects of the relationships depicted (Gibbs, 2006b). College students specifically judged the successful metaphorical relationships (Story A) to be progressing further, moving along in a straighter line and the story participants to be heading more in the same direction than was the case for the unsuccessful metaphorical story (Story B). Of course, there is nothing in these two stories that directly assert anything about the distance, speed, extent, and direction of the relationship "journeys" traveled. All of these inferences were drawn on the basis of people's metaphorical understandings of the stories as referring to RELATIONSHIPS ARE JOURNEYS, as suggested by the *Your relationship was moving along in a good direction* statement. Might these inferences be based on people's embodied simulation of the relationships, in which readers imagine moving along in a good direction that is then affected by the subsequent positive and negative character of the relationships?

One new set of studies used a new methodology to examine whether people's interpretations of simple narratives, like the above stories, partly rely on their embodied simulations of the metaphors involved (Gibbs, 2006b). People infer the detailed meanings of simple narratives involving conceptual metaphors by imagining their participation in the metaphorical actions explicitly mentioned in these stories. For example, when hearing *moving along in a good direction*, listeners imagine engaging in a body action, such as traveling along some path, which facilitates their metaphoric understanding of the

abstract, and physically impossible, idea that romantic relationships can move along a path toward some goal. If people imaginatively simulate themselves in the journey, then listening to these different renditions of the RELATIONSHIPS ARE JOURNEYS conceptual metaphor should have different real world embodied effects. To assess this idea, people listened to one of the two above stories, were blindfolded, and then walked along a path toward an object while they thought about the story. People should walk differently when hearing successful and unsuccessful metaphor stories, while these effects should be greatly attenuated after hearing nonmetaphorical narratives that did not suggest a conceptualization of the relationship as a kind of physical journey.

This hypothesis was tested in a novel by having participants physically walk toward an object, 40' away, after hearing either a successful or unsuccessful story in either the metaphorical or nonmetaphorical condition. Another experimental condition asked participants to simply imagine walking to the object after hearing one of the stories. Analysis of the walking times generally showed that people walked significantly longer for the successful metaphorical stories (15.7 seconds) than for the unsuccessful metaphorical stories (12.8 seconds), but that this difference was not reliable in the nonmetaphorical condition (14.8 and 14.6 seconds). Analysis of the length of walking (in vertical relationship to the target) again showed that people walked further for the successful stories (2.4' beyond the object) than for the unsuccessful ones (2.3' below the object).

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Another experimental condition asked participants to simply imagine walking to the object after hearing one of the stories. For the imagined condition, participants were blindfolded, heard a story, but were then instructed to only imagine walking out to the yellow ball as they thought about the story, and to press a stopwatch as soon as they imagined arriving at the ball. The results of the imagine condition showed that people imagined walking longer for the successful metaphor stories (11.4 seconds) than for the unsuccessful metaphoric narratives (9.5 seconds). Unlike the data for the walking condition, where no difference was obtained, people imagined walking longer in the unsuccessful condition (12.5 seconds) than in the successful one (9.5 seconds). The reason for this latter finding is not clear.

These studies suggest that people's interpretation of the stories partly involved creating an embodied simulation, or a reenactment, of the relationship journey alluded to in the different metaphorical narratives. Even though relationships are not physical entities that literally travel along physical paths, people nonetheless conceive of relationships in metaphorical ways, especially when prompted to do so by statements like *Your relationship was moving along in a good direction*. This metaphorical conceptualization is not purely abstract, but embodied in the sense that participants imagine themselves moving in the different relationship journeys which subsequently affected their walking, and imagining of walking, as they thought about the stories.

We recognize that an experiment where people hear stories and then walk blindfolded toward an object is not a traditional method to assess immediate understanding of verbal metaphors. Unlike many of the other studies described in this chapter that examine the processes by which metaphors are understood, the walking experiment looks at the products of people's interpretations. People may have walked differently in the various conditions of the walking experiment because of imaginative processes that occurred after they had originally heard and understood the metaphorical and nonmetaphorical stories. More experimental work is necessary to test for this and other alternative explanations of these findings. But the results are still intriguing, and indeed consistent with the embodied simulation view advocated for in this chapter.

Conclusion

Metaphor is closely allied to human imagination. Our claim in this chapter has been that significant aspects of metaphor use involve people simulating what it must be like to engage in specific bodily actions referred to in metaphorical expressions. These mental reenactments first demonstrate how the imagination is tied to bodily action, and more specifically suggest the ongoing role that imaginative processes play in verbal metaphor understanding.

The vast body of work in cognitive science showing that simulations are critical to many aspects of cognition and nonmetaphorical language use is certainly consistent with our arguments about embodied simulations in understanding metaphor. Yet the surprising part of the psycholinguistic research described above is that people engage in embodied simulations for actions that in many cases are not physically possible to do in the real world precisely because they involve abstract entities. One may argue, once

more, that physical aspects of grasping or moving forward must be ignored or inhibited to properly understand metaphorical expressions such as *grasp the concept* or *the relationship was moving forward in a good direction*. But imagining one engaging in these actions is quite sensible given that many abstract concepts are at least partly understood in metaphoric terms. These embodied metaphorical conceptions mesh perfectly with bodily actions, such as when one thinks of concepts or racism as a concrete entity, sometimes animate, that can be touched, held on to, controlled, stomped on, etc. The psycholinguistic evidence presented here provides different glimpses into how embodied simulations shape people's immediate interpretation and conscious reflection of different kinds of metaphorical language that is rooted in correlations in bodily experience (e.g. GRASPING IS UNDERSTANDING). We also contend that the empirical findings reviewed here are inconsistent with claims that (a) people do not understand conventional statements such as *The road runs along the coastline* and *He finally grasped the concept* in metaphorical terms, or that (b) people access these figurative meanings by simply accessing a pre-established sense from a mental lexicon without engaging in any imaginative bodily activities.

One of the peculiar aspect of metaphor scholarship is the degree to which the field is split between people studying classic A is B metaphors (e.g., My lawyer is a shark), and those studying metaphors arising from correlations in experience (e.g., I can see the point you are making). Not surprisingly perhaps, people studying these different aspects of metaphor tend to adopt very different theoretical perspectives to explain metaphor in language and thought. Classic or resemblance metaphors are typically viewed as having little to do with embodied action, and are understood through comparison or

categorization processes (Gentner & Bowdle, this volume; Gluckberg, this volume). But it may be the case that people construct embodied simulations when they infer the metaphorical meanings of resemblance metaphors. Consider for example, some metaphors for teachers: *teachers are tour guides, teachers are fisherman*, or *teachers are astronauts*. Each of these seems to contrast dissimilar domains where the goal is to understand which aspects of the source domain (e.g., tour guides) gets mapped onto the target domain (e.g., teachers).

Yet people are not simply mapping static or relational features of source domains, and not just creating some superordinate category of which the target domain is a prototypical member. Instead, people understanding a statement like *teachers are tour guides* are constructing a embodied simulation of what it must be like to be a tour guide, and using that information to further constrain what the metaphor implies. One web site (AnnenbergMediaLearner.org) has an interactive workshop for teachers titled "What's your metaphor," where teachers write in answers to "What metaphor describes you as a teacher?," and asks participants to them "explain how this metaphor characterizes you as a teacher." The remarkable thing about people's metaphors is that they are the entire "A is B" form, but then describe the metaphor in terms of bodily action. For instance, one person claimed that their metaphor was *A teacher is a fisherman*, and wrote, "Standing by the river, putting the hook into the water (no barbs on the hook). Constantly guiding the rod down the river, toward the sea of self-fulfillment. There are rapids that can cause the fish to experience a sense of confusion, but the tension from the rod, is a constant, guiding them towards calmer waters. This journey can not be completed by one fisher, the rod is passed to the next fisher (teacher)."

This example is representative of how all these teachers interpreted their metaphors. People simulated what it must be like to be a fisherman, tour guide, astronaut, and described in details the actions they would take that may be similar to those done when teaching and what impact they had on their students. Thus, the new category of A teacher is a fisherman, for example, is created and appreciated by running the simulation, or engaging in an "as if" scenario where bodily action and its effects are critical to the metaphor's meaning. In fact, simulating embodied experiences may be critical to many aspects of categorization, not just those having to do with metaphor. One study supporting this idea asked people to generate exemplars from both common taxonomic categories, such as furniture and fruits, and ad hoc categories, such as things dogs chase or reasons for going on a holiday (Vallee-Tourangeau, Anthony, & Austin, 1998). When people were then asked to describe their strategies for generating the exemplars, participants in both the taxonomic and ad hoc groups often reported using "experiential mediation." Thus, when generating exemplars of "fruit," people did not read off some list in their heads, but imagined themselves in a familiar grocery store walking in the produce section noting individual types of fruit as they were encountered. These findings show that embodied simulation may not be something restricted to creating and understanding ad hoc categories, which include novel metaphors, but are applied when common taxonomic categories are accessed as well (see Barsalou, 2003).

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