The experiential basis of motion language

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Abstract

People’s mental experience with physical motion has been shown to influence their understanding of time, but what about fictive motion, a tacit kind of motion expressed in sentences such as The road runs along the coast? The results of our study show that fictive motion does influence temporal understanding, providing additional evidence that cognitive simulation figures into language understanding and that people draw on spatial knowledge to ground their understanding of relatively abstract domains.

Keywords: conceptual structure, fictive motion, motion verbs, metaphor, psycholinguistics.

1. Introduction

People use motion verbs to describe situations in which something changes position in physical space. In their descriptions, an entity moves by its own volition, as in Julia runs from Cardiff to Del Mar every morning, by another’s volition, as in Our tour bus went over a mountain range, or by no volition at all, as in The ball floated across the pool. People also use motion verbs to describe various manners of movement, as in The soldier crawled across the field, A squirrel dashed up the tree, or The lost hikers meandered through the desert. Though these literal uses of motion verbs differ on what moves or how it moves, each sentence incorporates these schematic elements: space, path, and state change (Miller & Johnson-Laird 1976, Slobin 1996, Talmey 1975). For instance, in The ball floats across the pool, the ball moves from one location to another, forming a path via its movement. Or in Our tour bus went over a mountain range, the bus moves from location to location, but we construe it as having traveled on a highway or some other unspecified path.

People also use motion verbs to describe situations that appear to have little or nothing to do with physical motion. This includes emotional
or cognitive states, as in *He went from utter ecstasy to deep despair in less than five minutes or Her thoughts were racing*, as well as domains that lack actual physical structure, such as the internet, as in *Let’s go to your web site, or I came back to Yahoo* (Maglio & Matlock 1999). It also includes motion verb uses that refer to time, as in *Christmas went by quickly this year or Have we passed Christmas yet?* In the first case, known as the *time-moving* perspective, we construe *Christmas* as “moving” while we remain stationary. In the second, known as the *ego-moving* perspective, we construe *Christmas* as a stationary landmark while we “move” forward in time. (For discussion of the conceptual metaphors underlying these motion verb uses, and motivations for their semantic extensions, see Clark 1973, Gentner 2001, Lakoff 1987, Lakoff & Johnson 1980, Radden 1996, 1997).

In the same vein, people also use motion verbs when they talk about static spatial scenes, especially when describing where an object is relative to other objects. For instance, in *The road follows the coast*, the road is aligned with a coastline, or in *The tattoo runs along his spine*, the tattoo is adjacent to the spine. These motion verb uses fall under Talmy’s (1996, 2000) broad conceptual semantic category of *fictive motion*. In this paper, we focus on sentences instantiated with *co-extension path* fictive motion. Other types of fictive motion are seen in sentences such as *There is a bench every now and then in the park* (said while somebody is walking through a park), *The countryside rushed past us* (said by passengers on a train), and *His girlfriend get taller every year* (see also Langacker 1999, Sweetser 1997).

Fictive motion sentences include physical space as part of their semantic profile, but not physical motion or not any observable state change. For instance, nothing moves or changes in *The DSL line runs across the field, or even in The railroad tracks follow the dry creek bed*. Despite the lack of any explicit motion, Talmy (2000), in addition to Langacker (1986) and Matsumoto (1996), argues that fictive motion sentences involve dynamic construal, whereby simulated movement or scanning proceeds from one part of a scene to another (e.g., along the road in *The road goes from San Diego to LA*). This type of construal is said to be subjective, depending on factors such as the conceptualizer’s vantage point (e.g., conceptualizer in San Francisco) in the scene being construed. This is not to say that fictive motion construal necessarily involves vivid imagery (Langacker 1987, 1999). The conceptualizer need not “see” itself or any other entity moving inch by inch along a DSL line or a road.
Finally, the subject noun phrase referent in fictive motion sentences is conceptually primary or profiled (see Langacker, 1987). That referent is often inherently linear, as is road in The road goes from San Diego to LA, and if not, it is linearly extended by virtue of appearing in the construction, as is table in The table runs along the wall, or mirror in The mirror goes from the door to the light switch (see Matlock in press a, in press b).

So, people regularly use motion language to describe all sorts of things that have little or nothing to do with physical movement. The question is why do people do this? Why is such language so pervasive and so consistent? Our research seeks answers to these questions. In this paper, we first provide background of our earlier work, including work on metaphor and temporal understanding as well as fictive motion processing. We discuss a new experiment on fictive motion and metaphoric reasoning about time, and draw conclusions based on our results.

1.1. Earlier experimental work on figurative uses of motion verbs

In many experimental studies, Boroditsky (2000) and Boroditsky and Ramscar (2002) have explored the intimate connection between space and time, one component of which is the metaphorical construal of time as space. In one study, Boroditsky and Ramscar (2002) investigated whether thinking about motion would influence thinking about time. In one of their experiments, people were first asked to imagine themselves moving toward an object or to imagine an object moving toward them, and then to answer this ambiguous metaphorical question about time: Next Wednesday's meeting has been moved forward two days. What day is the meeting now that it has been rescheduled? When people had thought about themselves moving, they were more likely to say “Friday” because they were primed to move “forward” in time, but when they had thought about something moving toward them, they were more likely to say “Monday”. The results showed that the way people construed the meeting date was influenced by the way they had thought about physical movement. Namely, imagining doing the moving themselves encouraged forward temporal “movement” further away from themselves, while imagining something moving toward them while they remained stationary encouraged temporal movement toward themselves. The findings from this study and the others by Boroditsky (2000) and Boroditsky and Ram-
scar (2002) demonstrate that people draw on what they know about physical space and motion to understand relatively abstract domains such as time.

Matlock (2001) has also conducted experiments on the construal of non-literal motion, including the way people process fictive motion language in the context of real motion language. In one study, Matlock investigated how people understand sentences such as *The trail goes through the desert*, after reading different types of travel stories, for instance, about a person driving quickly versus a person driving slowly across a desert. The results indicated that the way people imagined motion while reading the story later influenced the way they understood relevant fictive motion sentences, such as *The trail goes through the desert*. Precisely, the time it took to read the fictive motion sentence depended on the way travel had been described in the story, including travel rate (fast versus slow), distance (far versus not far), and terrain (easy versus difficult). For example, overall reading times were faster after stories about travel through easy terrain (e.g., flat, smooth) than about travel through difficult terrain (e.g., bumpy, cluttered), or faster after stories about fast travel (e.g., 100 miles per hour) than about slow travel (e.g., 25 miles per hour). Matlock (2001) argued that differences in reading times resulted from differences in construal. People were not (necessarily) imagining any real motion while processing the critical fictive motion sentences that followed the stories, but they were simulating movement along a path in a way that was consistent with the way real movement had transpired along that same path in the mental model they had built from reading the story. So, for instance, people slowed down when they read sentences like *The trail goes through the desert* after reading about difficult terrain because they had to activate information about the original travel along the trail, including having to go over bumps, gullies, and so on. In follow-up work, Matlock (in press c) showed that the differences in reading times were not simply because of lexical priming or because people imagined more or less information in the scene. People were no slower or faster to read sentences such as *The trail is in the desert* in different contexts.

Matlock (in press b) provided additional evidence that people simulate motion when they attempt to understand fictive motion sentences. For instance, when people were asked to draw a picture to represent a sentence such as *The lake runs between the golf course and the railroad tracks*, the figure (e.g., lake) was consistently longer than when
they had been asked to draw a picture to represent the meaning of a semantically similar non-fictional motion sentence, such as The lake is between the golf course and the railroad tracks. People also drew longer arrows when representing a static figure described by a fictive motion sentence with a fast-manner motion verb, such as The road jets from one vista point to another than one with a slow-manner motion verb, such as The road crawls from one vista point to another. Critically, in none of these drawing tasks were people asked to think about motion, and on the surface, no motion is believed to have transpired with these sentences (see Matlock in press b).

2. Experiment: Does fictive motion influence temporal reasoning?

In the current work, we investigate whether priming people with fictive motion would influence the way they reason about time when asked the ambiguous question from Boroditsky (2000) and Boroditsky and Ramscar (2002), namely, Next Wednesday’s meeting has been moved forward two days. What day is the meeting now that it has been rescheduled? Would having people engage in thought about fictive motion – by having them draw a picture of what a sentence such as The road goes along the coast conveys to them – encourage them to say Friday (versus Monday)? If so, it would suggest that fictive motion encourages an ego-moving perspective whereby people conceptualize forward temporal movement construal. And as a control, we could also give non-fictional motion sentences as primes, such as The road is next to the coast, to see if the same effect would arise. If there are more Fridays than Mondays after fictive motion primes but not after non-fictional motion primes, then we can conclude that people recruit elements of their understanding of fictive motion into their understanding of time. Such a result would provide additional evidence that fictive motion includes dynamic construal, specifically simulated motion, and additional evidence that people draw on their understanding of space and motion to make sense of relatively abstract domains such as time.

2.1. Method

In our experiment, 138 Stanford University undergraduates were asked to (a) read a single fictive-motion sentence (e.g., The road runs along the
coast) or non-fictional motion sentence (e.g., *The road is next to the coast*), (b) sketch what they imagined, and (c) then answer the ambiguous question, *Next Wednesday's meeting has been moved forward two days. What day is the meeting now that it has been rescheduled?* The instructions for the drawing task read as follows: "In the space below, please sketch the image conveyed to you by the following sentence." All volunteers completed the task and were given credit for their participation. All volunteers were native speakers of English or were highly proficient in the language. Hereafter, we will refer to all fictive motion sentences as *FM-sentences* and all non-fictional motion sentences as *NFM-sentences*. See Table 1 for a list of the 10 sentences used in the experiment. Five of these were FM-sentences and five were comparable NFM-sentences. Before the experiment, all were judged to be sensible English sentences (see Matlock, Ramscar & Boroditsky 2003).

2.2. Results

The task provided two sources of data. We analyzed participants' answers to the ambiguous question about when the meeting would be held, and we analyzed the way people depicted their understanding of the meaning of the sentences. Together, the two provided insights into how people processed fictive motion language, and what effect that had on the subsequent understanding of time.

2.2.1 Question data

As predicted, the primes we gave people influenced their responses to the ambiguous question about time. As shown in Figure 1, people were more likely to respond Friday than Monday after being primed with FM-sentences, but this was not the case when they were primed with NFM-sentences. Specifically, of all the participants primed with FM-sentences, 68% said the meeting was Friday while only 32% said it was Monday, but of all the participants primed with NFM-sentences, 51% said it was Friday, and 49% said it was Monday, $\chi^2(1) = 4.23, p < 0.04$. The results suggest that engaging in thought about fictive motion, like engaging in thought about real motion, affects temporal reasoning. People were more inclined to conceptually "move" forward in time after they had been
thinking about roads, tattoos and other static entities that "run" than they were after thinking about some non-fictional motion spatial arrangement.
(For additional statistics, see Matlock, Ramsar & Boroditsky 2003).

2.2.2 Drawing data

We also analyzed people's sketches. Here we were interested in how people would depict figures (i.e., subject noun phrase referents) such as roads and tattoos in both FM-sentences and NFM-sentences (see Tversky 1999, for excellent discussion of what drawings reveal about construal). We were especially interested in whether the figures in sketches of FM-sentences would be longer than those in sketches of NFM-sentences even though our FM- and NFM-sentences were judged to be highly semantically similar (see Matlock, Ramsar & Boroditsky 2003). The rationale is that if mentally simulated motion or visual scanning is part of fictive motion we should see more linear extension of the figure. That is, we should expect the road in a depiction of The road runs along the coast to be longer than the road in a depiction of The road is next to the coast (see also Matlock in press b).

First, we calculated a length score for every figure by measuring in centimeters length and width, and then dividing length by width. Three drawings were discarded because the figure was an animate being "in motion". In all three cases, participants drew an "alive" bookshelf that was "literally" running. Then when we compared length scores for figures in the two types of sketches. We found that figures in FM-sketches were longer ($M = 9.45$) than those in NFM-sketches ($M = 4.50$), $t_{(139)} = 5.09$, $p < .0001$, as shown in Figure 2. Table 1 lists the sentences along with figure lengths averaged across participants.

We were also interested in whether people would include explicit motion elements in their drawings, for instance, a bicycle on a bike path, or a car on a road. The logic was that if people simulate motion or activate motion information while comprehending FM-sentences (even though there is no actual motion involved), then they would be likely to include explicit motion objects (e.g., bikes, cars, people) in their FM-sketches. Specifically, we would expect more motion elements in a FM-depiction than we would in a NFM-depiction. To see if this was the case, we counted all motion elements (e.g., bicycle) in sketches that depicted sentences with traversable paths as subject noun phrase referents, pre-
cisely, The bike path runs alongside the creek, The bike path is next to the creek, The highway runs along the coast, and The highway is next to the coast. Of all drawings, 25% contained motion elements. Overall, 76% appeared in FM-sentence depictions, and 24% in NFM-sentence depictions. Figure 3 shows the proportion of motion elements by sentence type and response. Figure 4 displays two sample drawings.

Taken together, the drawing results, longer figures and more motion elements for FM-sentences versus NFM-sentences, provide further support for the claim that fictive motion includes simulated motion. What makes the motion element results especially compelling is that both the fictive and non-fictional sets of data mentioned traversable paths.

3. Discussion

The results reported here show that fictive motion processing influences temporal reasoning. When people drew pictures to represent their understanding of a fictive motion sentence such as The road runs along the coast, they were much more likely to construe the meeting shift in our ambiguous question as forward movement in time (more Friday than Mondays). In contrast, they did not do this when they read and drew a sketch to depict a non-fictional motion sentence, such as The road is next to the coast (no more Fridays than Mondays). In addition, it is significant that figures (e.g., road) were longer in fictive motion depictions (than in non-fictional motion depictions) and that more motion elements were included in those depictions (see also Matlock, Ramscar & Boroditsky 2003).

Our results accord with our earlier work on fictive motion comprehension (Matlock, 2003). Again, we see that people simulate motion or build some kind of dynamic representation when they attempt to comprehend fictive motion sentences. Not only did fictive motion encourage more Fridays in responses, it encouraged greater linear extension of the figure, which suggests more motion or scanning related to the figure, for instance, a longer road because of more scanning or motion relative to that figure. In addition, fictive motion led to more motion elements in people's depictions. If there were no motion simulated in fictive motion comprehension, it is unlikely we would have seen the differences we did. There should have been no difference in Monday and Friday responses, or length of figures in drawings, and number of motion elements in drawings.
The results are congruent with Boroditsky and Ramscar's (2002) work on space and time. As mentioned, in one of their studies people imagined themselves or something else moving, and that influenced how they reasoned about time. This required consciously thinking about motion through physical space. However, in several other studies conducted by Boroditsky and Ramscar (2002), people were not necessarily consciously engaged in thought about motion, but the results were consistent. For instance, in a study conducted in an airport, the ambiguous question was posed to people who had been traveling or waiting to pick somebody up. The travelers were more likely to say Friday than Monday, but the non-travelers were at chance. In the current study, just as in the airport study (and others not discussed here), people were not asked to process motion information. Moreover, when asked to judge whether fictive motion sentences involve any motion, people uniformly say no (see Matlock in press b). Thus, our results provide evidence that fictive motion includes a tacit kind of motion simulation, one that is robust enough to influence the understanding of time.

What are the implications of our work? What do our results suggest about mental representation and meaning understanding? Many linguists and psycholinguists continue to promote the view that language is a separate module and that it includes several sub-modules. This view, which maintains that processing meaning requires accessing a word in a lexicon and activating a static mental representation underlying that word, is not amenable to the idea of dynamic construal or mentally simulated motion along a path. Jackendoff (2000), for instance, argues that no mentally simulated motion transpires with sentences such as The road runs along the coast. He claims such sentences involve a static and atemporal representation whereby all points along a path schema (e.g., road) are simultaneously activated.

Our results challenge Jackendoff's claims or any other linguistic theories that do not allow for some kind of dynamic construal. If people really do always activate all points along a path with a sentence such as The road runs along the coast, then we should not have seen the differences we did in our experiment. That is, participants primed with fictive motion should have been no more likely to say Friday than Monday than those not primed with fictive motion. Nor should they have been any more likely to have drawn longer figures or to have included more motion elements in their sketches. A linguistic theory that maintains that mental representations are static and that meaning is divorced from non-linguistic
processes such as imagination and dynamic construal cannot explain the differences that we observed in our controlled experiment (or many others not reported here).

Based on the results presented here and against the backdrop of our other work, we come to the following conclusions. People readily simulate motion with fictive motion just as they do in all sorts of other cognitive domains. Here we see that it influences people's reasoning about "movement" in time, and the way they depict static spatial scenes. Our findings are not bizarre or unusual in the context of cognitive semantic theories or recent psychological research on language and embodied experience. The bottom line is that people cannot help but mentally simulate motion and incorporate mental simulation into their reasoning about time and other relatively abstract domains.

Author's note

We thank Augusto Soares da Silva, the editor and conference organizer. We also thank Herbert Clark, Leonard Talmy, Danny Oppenheimer, Dan Yarlett, Lauren Schmidt, and Paul Maglio for offering useful insights, and Laura Nowell for helping with coding. A portion of this work was presented at the 25th Annual Conference of the Cognitive Science Society in Boston in July, 2003.
Appendix

Table 1. Sentences used in the experiment along with their mean figure lengths in the drawings.

<table>
<thead>
<tr>
<th>FM Sentences</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12.56 The bike path runs alongside the creek</td>
<td></td>
</tr>
<tr>
<td>7.73 The highway runs along the coast</td>
<td></td>
</tr>
<tr>
<td>11.68 The county line runs along the river</td>
<td></td>
</tr>
<tr>
<td>8.4 The tattoo runs along his spine</td>
<td></td>
</tr>
<tr>
<td>2.77 The bookcase runs from the fireplace to the door</td>
<td></td>
</tr>
<tr>
<td>7.73 The bike path is next to the creek</td>
<td></td>
</tr>
<tr>
<td>6.21 The highway is next to the coast</td>
<td></td>
</tr>
<tr>
<td>4.81 The county line is the river</td>
<td></td>
</tr>
<tr>
<td>1.3 The tattoo is next to his spine</td>
<td></td>
</tr>
<tr>
<td>1.19 The bookcase is between the fireplace and the door</td>
<td></td>
</tr>
</tbody>
</table>

![Bar chart](image)

**Figure 1.** How did people answer the ambiguous question about time? Responses are grouped by sentence type (fictive motion versus non-fictive motion) and by response (Friday versus Monday).
Figure 2. How did people construe the figure and depict it in sketches after being primed with fictive or non-fictive motion? Reported here are average lengths of figures.

Figure 3. Did people include motion elements (e.g., bicycles) in their sketches of paths? When they did, did those elements occur more often in fictive motion depictions than in non-fictive motion depictions?
(1) Non-fiction motion

(2) Fictive motion

![Diagrams showing non-fiction and fictive motion examples]

**Figure 4.** Examples of sketches for (1) The bike path is next to the creek and (2) The bike path runs alongside the creek.

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