The Conceptual Motivation of Fictive Motion*

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Abstract

Beginning with Talmy's work in the late 1970's and early1980's, cognitive linguists have argued that fictive motion—roughly, mentally simulated motion along a path or linear configuration—motivates the use and structure of a class of figurative uses of motion verbs. On this view, a motion verb describes an inherently static scene, as in The road runs along the coast or A trail goes through the desert, but evokes the simulation of "movement" or "scanning" along a trajectory through imagined space. The imagery is believed to be subjective in that the conceptualizer enacts the movement or scanning, and its purpose is believed to be functional—allegedly, simulating motion allows the language user to infer or convey information about the physical layout of a scene, especially the configuration and position of the path or trajectory (e.g., road). The goal of this chapter is to examine the linguistic behavior of fictive motion constructions (e.g., The road runs along the coast), and to discuss whether simulated motion and scanning motivates the use and comprehension of fictive motion constructions. Central to the discussion is relevant work from psychology,

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including psycholinguistic experiments that test fictive motion in English motion verbs.

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1. Introduction

Motion verbs such as *go* and *run* are pervasive. Ontologically primary and reflective of one of the most fundamental human activities, motion verbs exist in all languages and show similar patterns of semantic extension crosslinguistically. When used literally[1], a motion verb describes how a physical entity changes from one place in space to another place in space. Implicit in the event is the passage of time and the continuation of movement from a starting point to an end point (Miller and Johnson-Laird 1976). For instance, in *She drives to Palo Alto from Los Gatos*, the driver starts her journey in Los Gatos and ends her journey in Palo Alto. En route, she passes through Campbell, Cupertino, Mountain View, and many other towns before reaching her destination.

When used non-literally, a motion verb may have little or nothing to do with physical motion. For instance, in *Christmas is coming* and *His mood goes from morose to ecstatic*, no movement transpires. Instead, time is understood as "moving" toward the speaker, and one emotional state is understood as "moving" to another (see Boroditsky 2000; Clark 1973; Radden 1996). In some cases, a motion verb may even go so far as to grammaticalize, adopting a new grammatical function. This is the case with English *go*, which has become a future marker, as in *I'm going to drive home* and *What are you going to do?* (Bybee, Pagliuca, and Perkins 1991; Heine, Claudi, and Hünnemeyer 1991).[2] As is well documented, motion verb extensions like these are motivated by conceptual metaphors (e.g., TIME IS SPACE,

1. The word "literally" is used somewhat loosely. I do not make a hard-and-fast distinction between literal and non-literal language, for such a distinction is problematic, as shown by Rumelhart (1979) and Gibbs (1994a, 1994b).

2. See Sweetser (1990) and Emanatian (1992) for similar developments in French and Chagga, respectively.

CHANGE IS MOTION), which enable to the understanding of a relatively abstract domain in terms of a relatively concrete one (e.g., Gibbs 1994b; Lakoff 1987; Lakoff and Johnson 1980; Radden 1997; Sweetser 1990).

Motivation is a popular theme in cognitive linguistics. Roughly speaking, it concerns the extent to which a linguistic form or set of linguistic forms makes sense or is explainable within a language or across multiple languages. Motivation encompasses a range of influences on the on way language is used and the way it is structured. It includes *external influences*, such as culture and social context, as well as internal influences, such as perception and higher level cognitive processes (e.g., categorization). Though motivation seeks to explain how language works and how it changes over time, it stands in sharp contrast to generative explanations for linguistic behavior. No rules are posited and no predictions are made (because there is no surface structure to be derived from a deep structure (Langacker, 1987). As cognitive linguists have shown time and time again, motivation is a perfectly reasonable way to describe and account for linguistic patterns, including semantic extensions of verbs. (For in-depth discussion of motivation, see Chapter 1 in this volume and Lakoff 1987)

This paper concerns the motivation of a particular type of motion verb extension, specifically, the type shown in the examples in (1).

(1) a. The road runs along the coast.
b. A trail goes through the desert.
c. The railroad tracks follow the river from Briceberg to El Portal.

Though extremely common in everyday English, this type of semantic extension deserves in-depth attention for a number of reasons. Especially remarkable is that despite the obvious presence of a motion verb and the potential for motion, no explicit motion is expressed. For instance, (1a) describes a stationary situation (neither the road nor the coast moves) even though it contains a motion verb (runs) and describes a scene that could easily serve as a good setting for movement—people, vehicles, or other mobile entities could and do frequently travel on roads near coastlines.

The lack of motion in this kind of motion verb extension is especially apparent when comparing sentences such as (1a), (b), and (c) to sentences such as (2a), (b), and (c). The latter set features the same motion verbs and the same spatial scenes, but explicitly expresses movement.

(2) a. *Sarah runs along the coast.*

b. *The coyote goes through the desert.*
c. *A taxi follows the bus from Briceberg to El Portal.*

In these cases, a mover changes position in physical space. For instance, in (2a), Sarah starts running at one location near a coastline, continues running along the coastline, and eventually stops running at some other location along the coastline. Her movement occurs in a particular direction and unfolds in real time. It forms a path with a starting point, an endpoint, and points connecting the two. Thus, the sentences in (1a), (b), and (c) appear to be quite similar to those in (2a), (b), and (c) because in both cases there is a path through a spatial scene. However, the difference lies in whether or not motion actually occurs.

The semantic extensions of motion verbs in (1a), (b), and (c) are not limited to English. When examining motion verbs crosslinguistically, we see many languages with this same type of extension. To name a few, *The road runs along the coast* (or *The road goes along the coast*) is expressed in Swedish as *Vägen går längs kusten*, in Italian as *La strada corre lungo la costa*, in French as *La route parcourt le long de la côte*, and in Spanish as *El Camino va por la costa*.[3] In such languages, just as in English, a set of motion verbs is frequently and systematically used by speakers to express stationary spatial scenes that "contain" path-like configurations (e.g., roads).

Despite the obvious absence of actual physical motion in sentences such as (1a), (b), and (c) (as well as comparable motion verb uses in other languages), cognitive linguists argue that conceptualization and construal[4] of such sentences involves an implicit type of motion. This implicit type of motion has been called *fictive motion* by Talmy (1983, 1996, 2000), *abstract motion* by Langacker (1986), and *subjective motion* by Matsumoto (1996).[5] On the cognitive linguistic view, comprehending a sentence such

3. For comparable examples in Japanese, see Matsumoto (1996).

4. My use of *construal* and *conceptualization* is in line with Talmy (1975, 1978, 1983) and Langacker (1987). Simply stated, conceptualization is equated with meaning and construal is the ability humans have to view a scene in alternate ways (for instance, from different perspectives, or with focus on different elements).

5. This phenomenon was originally studied by Leonard Talmy in the late 1970's and early 1980's. Early on, Talmy (1983) also used the term *virtual motion* to refer to fictive motion. Recently, Langacker (2000) has begun using the term

as (1a) requires the *conceptualizer* (language user, one who is conceptualizing) to mentally scan or "move" along the path associated with the subject noun phrase, for instance, *road* in (1a). In doing so, the conceptualizer experiences something akin to actual motion, for it involves "going" from a starting point to an end point, and it takes time to complete. The "movement" is believed to be subjective because it is the conceptualizer who induces or experiences the motion in the absence of an explicit agent. The "movement" is also purportedly necessarily enacted for it allows the conceptualizer to zero in on and infer information about the position and orientation of the path (see Langacker 1986; Matsumoto 1996).[6]

The goal of this paper is to investigate whether fictive motion (more generally mentally simulated motion) motivates the use and behavior of motion verbs in sentences like (1a–c), what I will hereafter refer to as *FM-constructions* (fictive motion constructions).[7] I begin by discussing some of the grammatical and semantic behavior of FM-constructions (Section 2). Then I turn to the dynamics of physical motion, perceived motion, and simulated motion (Section 3). After that, I discuss results from experiments that investigated whether fictive motion is actually involved in the comprehension of FM-constructions (Section 4). Last, I discuss what type of research needs to be done to achieve a better understanding of mentally simulated motion in language use (Section 5).

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virtual motion for a wide rage of dynamic construal, including temporal scanning (for instance, "replaying" events in the historical present).

6. Fictive motion is not restricted to sentences such as (1a), (b), and (c). According to Talmy (2000), for instance, fictive motion figures into the construal of a broad range of spatial sentences, including *There is a bench every now and then in the park*. It is also evoked with sentences such as *His girlfriends seem to get taller every year*, as discussed by Brandt (2002), Langacker (2002), and Sweetser (1997).

7. The term *FM-construction* is used for convenience in this paper. It is not intended as a basic-level construction like the constructions discussed by Goldberg (1995) and other constructional grammarians, although it may be appropriate to treat it as a subset of a more basic construction.

2. When motion verbs describe stationary scenes[8]

An FM-construction has the following constituents: subject noun phrase (NP), motion verb, and either a prepositional phrase (PP) (e.g., *along the coast* in *The road runs along the coast*) or a direct object (e.g., *the creek* in *The road crosses the creek*).[9] The subject NP represents the trajector (TR), which in this case is a path or linear entity such as a road. The motion verb is a verb that specifies (in its literal uses) a change in location. The prepositional object or direct object corresponds to a landmark (LM) (e.g., *the coast* as in *The road runs along the coast*), or a set of landmarks (e.g. *Capitola* and *Aptos* in *The road runs from Capitola to Aptos*), which specifies the location of the TR (near to and parallel with a coast).[10] The TR is critical in FM-constructions because its construal shapes the overall meaning and structure of the construction, including what is generally considered semantically and grammatically acceptable to English speakers.

In formulating or making sense of an FM-construction, the conceptualizer expresses or infers information about where the TR is located. In particular, the TR is positioned relative to a LM or set of LM's in the scene being described (see Matsumoto 1996). In (1a), *The road runs along the coast*, for instance, the road is proximal to and parallel to the coastline. In (1b), *A trail goes through the desert*, the trail extends from one end of the desert to the other (from the perspective of both the speaker and the listener). In (1c), *The railroad tracks follow the river from Briceberg to El Portal*, the railroad tracks are parallel to the river. Each of these sentences makes sense because the TR has a conceptually viable or plausible relationship with a LM or set of LM's. For instance, railroad tracks in the real world are often located along rivers, as linguistically expressed in (1c). This is not the case without an explicitly coded LM, as shown in (3a) and (b).

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8. Some observations in this section draw from Langacker (2002) and Talmy (2000).

9. As Ben Bergen points out (personal communication, April 2002), FM-constructions may also have the option of NP V Particle and NP V Particle NP, as in *At 4,000 feet elevation, the trail drops off.*

10. In discussing the conceptual structure of FM-constructions, I used the terminology of Langacker (1986, 1987). The terminology of Talmy (1975, 2000) would also have been fine (for instance, figure instead of TR).

(3) a. ? *The road runs.*
b. ? *The railroad tracks follow.*

The TR, the road, is not positioned relative to a LM in (3a), and neither is the TR, the railroad tracks, in (3b). Thus, the oddity of (3a) and (b) arises with the absence of an LM. Unless there is substantial background or implicit context (e.g., speaker provides iconic gestures for LM and TR or the speaker and listener are looking at a picture), the conceptualizer is unable to infer information about the configuration, position, or shape of the TR because there is nothing to relate it to.

The TR in an FM-construction is usually an inherently rectilinear or spatially extended entity, for instance, *road*, *underground cable*, or *garden hos*e, as shown in (4a) – (4c).

(4) a. *The road goes from Capitola to Aptos.*
b. *The underground cable follows the property line.*
c. *A garden hose runs along the back fence.*

However, when the TR is NOT inherently long, as in (4), it must be an entity with the potential to be conceptually spatially extended. This includes entities that may or may not be construed as being long, such as *tables*, *lakes*, and *fish ponds*, as shown in (5).

(5) a. *The table goes from the kitchen wall to the sliding glass doo*r.
b. *An alpine lake follows the property line.*
c. *The fish pond runs along the back fence.*

In reading (5a), for instance, we automatically visualize a table that is long and narrow, perhaps a long oval table or a rectangular table. We do not imagine a small round kitchen table or a perfectly square coffee table. This "restriction" emerges from the inherent conceptual properties of the construction, including motion information contributed by the motion verb. The "restriction" is not present with comparable constructions such as *The table is between the kitchen wall and the sliding glass door* or *The alpine lake is next to the property line*. Similar inferences and restrictions occur with *alpine lake* in (5b) and *fish pond* in (5c). The lake and the pond are visualized as being long and narrow. (For more examples, see Matlock, in press).

Examples (6a) and (6b) provide further evidence to show how critical spatial extension is in the conceptualization of the TR in FM-constructions. Infelicitous forms often arise when the TR is not construed as long, as shown in (6a) with hoola hoop, or (6b) with hot tub.

(6) a. ??*The hoola hoop runs from the door to the couch.*
b. ??*The small, perfectly round hot tub goes along the back fence.*

Of course there is no problem with (6a) if the hoola hoop is bent into a long oval shape, in which case it would actually be a long oval. Similarly, there is no problem with (6b) if the conceptualizer imagines viewing the hot tub from a low, side angle, for instance, while sitting on the ground 30 feet away (as opposed to viewing the hot tub from a bird's eye perspective).[11]

Even when the TR in an FM-construction has a long shape, it must be relatively large, as shown in (7a) – (d).

(7) a. ?? *The cell phone goes from the cup to the book.* (phone on desk)
b. *The cell phone goes from the cup to the book.* (phone in ad on billboard)

Imagine that the cell phone in (7a) is relatively long, say 2 inches by 4 inches (twice as long as wide). When construed with a phone of that size, most English speakers would agree the sentence sounds odd, but why would this happen when the shape is long? A plausible explanation (long shape, but sentence questionable) involves what Langacker (1986) has called *sequential scanning*. The basic idea is that to obtain a coherent understanding of a scene, the conceptualizer performs a continuous series of transformations such that one configuration in a construal is transformed into another, and another to another, and so on. This allows the conceptualizer to simulate or build up a representation of the TR in real time or something not unlike real time. Without sequential scanning, the conceptualizer could only activate various locations or points in a construal as discrete and not contiguous. No coherent whole would be achieved. (This sort of gestalt is of course not limited to fictive motion.) Thus, on this view, sequential

11. Obviously, (6b) is not problematic if the speaker intends to convey the belonging meaning of *go*, as in *The socks go in that drawer*, or *Your paper goes in Journal of Memory and Language*. But then such uses do not involve fictive motion.

scanning is minimal or completely absent when conceptualizing a small object like a cell phone even though it is actually rectilinear. Simply stated, there is simply no reason to scan a cell phone because a coherent whole can be obtained with just one glance (real or imagined). Of course the situation for the cell phone changes when the scale is sufficiently large, as shown in (7b). The sentence is fine when the cell phone is displayed on a large billboard advertisement because there is sufficient "space" in which to mentally scan the TR. A similar explanation applies to paths with actual motion, as shown in (8a) and (b).

(8) a. ?*The sidewalk runs from here to there.* (five feet long)
b. *The sidewalk runs from here to there.* (500 feet long)

A sidewalk must be sufficiently long to traverse or dynamically construe over time, that is, sequentially scan from one end of the TR to the other.

Sequential scanning also seems to explain the inconsistency we see in (9a) and (b) with temporal expressions, such as *for two hours*, or *for two seconds*.

(9) a. *The road runs along the coast for 2 hours.*
b. ? *The road runs along the coast for 2 seconds.*

The FM-construction in (9a) is fine because it reflects a reasonable amount of time in which to scan along a coastline. In contrast, (9b) does not reflect a reasonable amount of time. Nor does it reflect a reasonable amount of time to actually scan along a section of coastline if a person were running. Of course, one could say (9b) if the intention were to contrast the section of road along the coast with some other section of road (for instance, through a city), as in *The road runs through the city for over an hour, through the suburbs for 30 minutes, and then along the coast for only two seconds*!

The TR in an FM-construction is also (virtually) always stationary, as shown in (10a).

(10) a. ?? *Carol runs from the door to the couch.*
b. *In the painting, Carol runs from the door to the couch.*

The sentence in (10a) sounds odd when our construal has Carol stretch out on the floor, even if she is asleep. However, there is no longer problematic

when Carol is construed as an abstract figure in a painting, as shown in (10b).

One explanation for why the TR must be stationary relates to limitations on processing in visual imagery. In construing (10a) (with an FM-reading, not an actual motion reading), the conceptualizer must attend to two types of motion – Carol's motion and the conceptualizer's "motion" (i.e., scanning). Another explanation, and not an incompatible one, is that by default the language user automatically assigns the actual motion meaning to the TR, giving it "mover" status. A more interesting example to show this point is provided in (11).

(11) *The river runs from the ocean to the mountain top.*

When people imagine a river, as in (11), it is likely that scanning proceeds in a downward direction, for instance, from the top of the mountain to the ocean. This sort of scanning is consistent with what is generally known about the direction of the flow of water, in particular, that it flows in a downward direction, not an upward direction. Yet, the sentence structure in (11) (with the river as the subject) has us scanning in the opposite direction. What results is a situation in which water motion proceeds in one direction (downhill), and fictive motion scanning proceeds in the other direction (uphill). Even though the sentence may be difficult to understand at first, it does not present a big problem because the reader or listener eventually settles on scanning in the "right" direction (from the coast to the mountain top). Notice that the construal of (11) is not problematic if prior to reading or hearing the sentence, we are informed that the river is totally dry, as in *The dry river bed runs from the ocean to the mountain top*.

Another pair of examples shows that the TR must be construed as stationary or at least nearly stationary, as shown in (12a) and (b).

(12) a. *The traffic runs all the way to Carmel Valley Road.* (cars traveling 2 MPH)
b. ?? *The traffic runs all the way to Carmel Valley Road.* (cars going 40 MPH)

(12a) is felicitous only if the vehicles are not moving or if they are just barely moving. As shown in (12b), the same sentence is no longer felicitous if the traffic is moving, for instance, if the cars are driving at 40 MPH. (An exception would be if the speaker were imagining viewing the line of traf-

fic from a plane or helicopter hundreds of feet above ground, in which case motion would be less noticeable.)

A final observation about the TR in FM-constructions relates to the way the conceptualizer anticipates motion along a path or what sorts of inferences the conceptualizer makes about paths and various types of motion. Each sentence in (1a) – (c), for instance, conveys information about a path that is traversable, that is, one that people or other movers travel on or could potentially travel on (e.g., *road*). Each sentence also features a spatial region that could potentially accommodate a traversable path (e.g., *coast*). For example, in (1a), *The road runs along the coast*, the road and the coastline create a good scenario that is conducive to travel. Compare (1a) to *The cable runs along the coast* or *The road runs across the glacier*. These would not be good travel scenarios, for a mover cannot travel on a cable, and a road is not ordinarily located on a glacier for obvious reasons. Let us use the term *Type 1* fictive motion to refer to FM-constructions such as *The road runs along the coast*.

Type 1 FM-constructions, i.e., those with paths ordinarily associated with motion, tolerate manner verbs[12], such as *crawl* and *race*, as shown in (13a) – (13c).

(13) a. *The highway crawls through the city.*
b. *The highway races through the city.*
c. *The footpath staggers from the bar to the outhouse.*

In such motion verb uses, the manner verb does not describe an actual motion event or a particular way of moving. Nothing in (13a) is actually crawling (unlike in *The injured soldier crawled through the city*). Rather, the manner verb conveys information about how motion could occur or is known to occur along a given path, for instance, slowly in (13a), and quickly in (13b). This involves a part-for-part metonymy whereby certain properties about movement give rise to certain properties about the path. For instance, in (13a), what is known about crawling (slow motion) yields the construal of a path ordinarily associated with slow motion (e.g., Highway 101 in Bay Area has bad traffic at rush hour), and in (13b), what is known about racing brings about the construal of a path that is ordinarily

12. Manner verbs express motion from one point to another but they also convey information about the way the mover moved, for instance, quickly, slowly, erratically, effortfully, whimsically, and so on (see Slobin 1996b; Talmy 2000).

associated with fast motion (e.g., Highway 280 in the Bay Area does not have much traffic). Specifically, this appears to involve a metonymy of the form MOTION ALONG A PATH FOR THE PATH.

Finally, the manner verb in an FM-construction goes far beyond conveying information associated with speed (slow or fast). A manner verb might also highlight information about the emotional or physical state of movers known to travel along a certain path, as shown in (13c). The verb *stagger* is often associated with inebriation and a particular way of walking. Namely, a drunk person will walk erratically, zigzagging back and forth, and maybe even stumbling or falling down. The result of this type of motion is a crooked path (for instance, if the mover walks across a muddy field and one looks at the footprints left behind). This points to a more specific metonymy: MANNER OF MOTION ALONG A PATH FOR CONFIGURATION OF THE PATH. That is, the way a person walks (e.g., when in a particular state) shapes the construal of the configuration of a path, even when no actual motion occurs.

Incidentally, FM-constructions such as those in (13a) – (c) have a somewhat poetic flavor and are less conventional than many of the other FM-constructions discussed in this paper; however, they are perfectly acceptable in the right context. For instance, (13c) is fine because we know that bars are associated with drinking and an outhouse might be associated with something after drinking. Thus, *bar* and *outhouse* make for a favorable reading of the manner verb *stagger*. This would probably not be the case with *Law School* and *School of Medicine*, as in ??*The footpath staggers from the Law School to the School of Medicine*. In any event, that manner verbs can be used in constructions that describe no actual motion, and that they provide information about the resultant state of a path, including its shape or how things move along it suggests the presence of metonymy.[13]

At this point, it should be noted that unlike, unlike Type 1 FM-constructions, *Type 2* FM-constructions—i.e., those with a TR with *no* association with motion such as (5a–c) (e.g., *The table goes from the kitchen to the sliding glass door*)—do not allow manner verbs. In this way, they differ from Type 1 FM-constructions. Examples of inappropriate Type 2 uses are shown in (14a) and (b).

13. For similar metonymies along with insightful discussion of the theoretical implications of metonymy, see Radden and Kovecses (1999).

(14) a. **The flower bed races along the back fence.*
b. **The underground cable crawls from Capitola to Aptos.*

The oddity of (14a) and (b) arises for the following reason. Because no motion is expected to occur or even known to occur along these TR's, manner cannot be construed. And from this it follows that properties associated with motion cannot metonymically map to properties about the shape or configuration of the path, as was the case with Type 1 fictive motion, as in (13a), (b), and (c).

In this section, I discussed the behavior and use of a number of examples of FM-constructions. From these observations, it appears that the TR is critical to how an FM-construction is construed. In particular, the TR must be relatively long or capable of spatial extension. It is also usually inanimate and bears a spatial relationship to some landmark (for instance, is parallel with, is close to). The verb in a FM-construction also plays a key role by contributing information about the configuration of the TR. This is especially evident in manner verbs, which metonymically derive information about the properties about the configurations of the TR based on world knowledge about how motion normally occurs along a path or within a particular spatial region.

Based on these observations as well as many other observations made by Talmy and other cognitive linguists, it seems reasonable to at least entertain the idea that our ability to simulate fictive motion motivates the use and behavior of FM-constructions, including what is generally seen as being linguistically acceptable. For instance, it is clear that the interpretation of FM-constructions and the way they are used relates to the spatial layout of the scene (e.g., TR's position relative to a LM) and information about the configuration of the path (e.g., influence of manner). However, the problem is that most of the observations made here and many of the observations made by linguists elsewhere simply assume that fictive motion has an actual basis in cognitive processing, in particular, that it is grounded in mental imagery. Before we can begin to understand how fictive motion motivates the use of FM-constructions, we must look at psychological work on mental imagery and mental simulation. Research in those areas may shed some light on fictive motion as a process and help us understand how it motivates sentences like (1a–c).[14]

14. This is not to say that it is the job of the linguist to do experiments or even cite experimental work. An important job of the linguist is to observe trends in a

3. Motion: Actual, perceived, and simulated

People constantly experience motion and this happens in a number of ways. They either can move by their own volition through physical space, as in running across a field or walking to work, or they can be moved by some external force, as in riding a raft down a river or being pushed against a wall by a strong wind. People can also move other objects through physical space, as in throwing a ball to third base, pushing a shopping cart off the side of a hill, or pulling a jammed piece of paper out of a printer. Each of these motion events involves *actual motion,* i.e., real movement through physical space.

People also experience motion through perception, especially vision (Arnheim 1969; Zeki 1993). Humans are constantly visually bombarded with objects coming into and going out of the visual field—a humming bird darts past the window or a squirrel scampers across a parking lot. Humans are so "wired" to process motion that sometimes they see themselves moving when they are completely stationary, for instance, when sitting on a bus and seeing an adjacent bus start to back up (for discussion of apparent motion, see Ramachandran and Antis 1986). People also readily detect motion through other sensory modalities, through other sensory modalities, including from auditory input, for instance, when a police car or ambulance races by with its siren on. These motion events constitute *perceived motion.*

Both actual and perceived motion involve an agent that moves from one point in space and time to another point in space and time. They also involve direction of motion—moving in a direction or scanning motion that occurs in a direction—including front versus back, up versus down, north versus south, or left versus right. Actual and perceived motion also involves a path. When an entity moves through physical space, that entity moves along a pre-existing path (e.g., paved trail) or creates a path if there is no pre-existing path (e.g., visible or even invisible footprints in the sand), and in both cases, a viewer perceives movement along a path (See Casati and Varzi 1999; Miller and Johnson-Laird 1976).

People do not just experience motion while going from one place to another, or while watching some other entity go from one place to another. People often deliberately move objects around to help them plan actions, solve problems, and reason about the world. A good example is seen in

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language and across languages and draw conclusions based on those observations (see Gibbs 1991).

recent cognitive science work on forming words from Scrabble tiles. When people are given a set of tiles and told to form as many words as they can, they do a dramatically better job (more words in given allotment of time) when they are allowed to use their hands than when they are not allowed to use their hands. When they manipulate the tiles, players are able to "off-load" cognition and do some of the computation involved in word-formation in the physical world. In contrast, when they do not manipulate the tiles, players must do all computation in their heads, which makes word formation harder and less efficient (Maglio, Matlock, Raphaely, Chernicky, and Kirsh 1999). Similar results have been found in longitudinal studies on how people learn to play and improve at the video game Tetris. As Tetris players get better and better at the game, they curiously start doing more and more seemingly superflous movements of game pieces on the screen, for instance, rapidly spinning pieces much more than is strictly necessary to help players access information that could lead to an appropriate placement (e.g., angle or orientation of piece). Yet these movements have been shown to serve a useful function. They somehow help the player maintain state by freeing up working memory, which allows them to attend more closely to other aspects of the game (Kirsh and Maglio 1994). (See Kirsh 1995, for other examples of manipulation of spatial arrangements and simplification of perception and computation.)

The benefits of physical movement are of course not limited to enacting physical actions in game-playing. They also show up in gesture. Although gestures were initially thought to be meaningless or to have no real communicative purpose, recent work in psychology has shown that simple movements, such as pointing at an object or making a downward sweeping movement (e.g., to describe falling down), play an important role in language. One set of experiments shows that people are better at solving and explaining math problems when they are free to use their hands than when they are not The same work also shows that gestures facilitate recall of lexical items (Goldin-Meadows, Nusbaum, Kelly, and Wagner 2001). Another set of experiments shows that speakers are better able to access low frequency words or words with elusive meanings when they are allowed to gesture (compared to when they are not) (Krauss 1998). And other research shows that a speaker and an addressee interact more effectively (e.g., use fewer words) while working on a joint project (constructing a Lego model) when they can see each other pointing and doing other gestures than when they cannot, providing further evidence for the idea that hand movements have a cognitive and communicative function (Clark and Krych in pro-

gress). (For many nice examples demonstrating the communicative import of pointing, see Clark, in press).

Human experience with motion goes beyond actual movement and perceived movement—it also includes mentally simulated or imagined motion. Numerous studies in psychology show that people "move" inside imagined spatial regions. For instance, in one classic study, participants were given a map of an island with various landmarks. They were instructed to memorize the layout of the island, including the locations of the landmarks. Later, when asked to imagine the island and imagine "moving" from one location to another, it took people longer to scan between locations that were far from each other on the (original) map than it did to scan between locations that were close to each other on the map. Hence, the results suggested that scanning time of locations on the imagined map is proportional to actual distances between locations on the map (Kosslyn, Ball, and Reiser 1978). Similar results have been obtained in studies that present participants purely verbal descriptions of spatial regions, suggesting that people can readily construct a spatial model from verbal input alone and mentally scan from location to location in their model (Denis and Cocude 1989). (See Barsalou 1999, 2002 and Glenberg 1999, in press, for other examples of imagined movement through spatial models).

Simulated motion is part of the general human ability to experience motion. Just as people manipulate objects in the world to help them plan, think about, and solve physical problems, they also mentally simulate manipulations of objects. The work of Shepard and Metzler (1971) demonstrates this. In their classic study, participants were told to look at three-dimensional geometric shapes in two different drawings. The shapes were either identical or similar and appeared at different angles of rotation. Participants were instructed to specify whether the objects were the same or different. The results showed that the greater the difference in angle of rotation, the longer it took participants to determine whether the two objects were the same, indicating that participants relied on mental rotation to line up the objects so they could make their judgments, and pointing to a more general tendency in people to use dynamic mental imagery to solve problems

Another good example of mental "movement" of objects in reasoning is seen in the recent work of Schwartz (1999). In his study, people were given two glasses. The glasses were the same height and had water filled to the same level, but one glass was narrow and the other was wide. The task required participants to judge how far the two glasses would have to be tilted

before water would start to pour out. The results showed that people were generally bad at making correct judgments about when water would start to pour. For instance, they often mistakenly said that the water would pour from the two glasses at the same angle. However, when people closed their eyes and imagined tilting the glasses until the imagined water just reached the rim, they were much more likely to make correct judgments, namely, that the wide glass would pour the water first (for related work, see Schwartz and Black 1996; Schwartz and Black 1999).

4. Simulated motion and fictive motion constructions: Psycholinguistic evidence

In the section above, I demonstrated that people naturally mentally simulate motion, and showed that in some ways, simulations are similar to actual motion and perceived motion. In this section, I discuss a series of empirical studies that directly bear on the issue of whether mentally simulated motion influences language understanding. Based on this work, I will argue that linguistic behavior of the FM-construction is motivated by the way that people naturally mentally simulate motion.

In recent work (Matlock 2001), I conducted a series of on-line experiments that examined how long it would take people to read and make a decision about target sentences such as (1a) in various types of contexts. Faster decision times were obtained for such sentences after people read a story about fast travel than after a story about slow travel. Faster decisions also arose with short-distance primes versus long-distance primes, and with easy-travel primes versus difficult-travel primes. The overall results suggest that in understanding an FM-sentence, people re-activate and simulate aspects of the protagonist's motion, including speed, distance, and the terrain across which the movement occurred. In doing so, they construct a dynamic representation that mirrors the actual motion of the protagonist. That the same FM-construction – which expresses no actual motion – is processed differently depending on the protagonist's movements provides evidence for fictive motion in the understanding of motion verbs.

Similar results were obtained in off-line experiments with drawings designed to test whether imagery played a role in understanding figurative motion verb constructions (Matlock, in press). In one experiment, participants drew pictures of sentences such as *The lake runs between the golf course and the railroad tracks* and *The lake is between the golf course and*

the railroad tracks (judged as describing the same scene in a norming study prior to the experiment). The purpose was to get at people's conceptions of the scene and to obtain a non-linguistic measure of their conceptions.[15] Of special interest was whether the trajector (for instance, *lake*) had a more elongated or extended shape in the former case (with motion verb) than in the latter case (with a copula verb). A difference would suggest that mental scanning (or at least more mental scanning) would occur with FM-constructions than with non-FM-constructions. The results showed uniformly longer shapes in the former case, which provides indirect support for the idea that people mentally simulate motion in understanding FM-constructions. Another experiment in the same study had participants draw similar pairs of sentences, but in this case, the subject-NP's were entities that are inherently long, for instance, roads, mountain ranges, and so on. The same results were obtained. And yet another experiment in the same set of studies had participants simply draw an arrow to represent the roads (or other paths, such as trails) they visualized while reading sentences such as *The road jets from one vista point to another* or *The road crawls from one vista point to another*. The results showed reliable differences in the way people drew arrows to represent their understanding of the path in the sentence. For instance, longer arrows were produced for sentences with fast verbs than for those with slow verbs. Importantly, no sentences conveyed any motion.

In a later study (Matlock in progress), people drew longer arrows for sentences about cluttered terrains than for ones about uncluttered terrains, for instance, *The road goes through the crowded city* (cluttered) versus *The road goes through the desert* (uncluttered). One explanation is that simply knowing that there was more clutter "slowed" down people's simulation, resulting in a slower hand and a longer line. An alternative explanation, however, is that the cluttered terrain involved a more complex type of simulation, whereby people anticipated each of the obstacles they visualized. If this is the case, longer lines may reflect time taken to anticipate obstacles. In any event, these results, along with those from the two other drawing experiments, suggest that people activate motion information while reading and conceptualizing static scenes verbally depicted by figurative uses of motion verbs. Further work, including on-line studies with

15. Drawings are external representations of people's conceptions of the world, and as such, they provide insights into how people conceptualize objects, states, and actions (Tversky 1999, 2001).

pictures, need to be done to gain a better understanding of how motion activation proceeds in real time, and how it compares to other imagery in other types of figurative language processing.

Taken together, the decision-time studies and drawing studies provide strong evidence to support the idea that mentally simulated motion is part of processing sentences such as *The road runs along the coast*. They also serve as evidence that language is structured the way it is because of the natural ability to simulate motion. As Langacker (2000) notes, it is intriguing that motion verbs such as *go* and spatial prepositions such as *to* and *from* – typically associated with motion along a path – are regularly used in FM-constructions. I think this is no accident. Nor is it an accident that there are several restrictions and contingencies relating to the use of such constructions, as outlined in an earlier section. For instance, sufficient length and scale are important because simulation, like real motion or perceived motion, takes time to complete. Therefore, one cannot simulate motion along an extremely short path such as a sidewalk that is only five feet long, but one can along a sidewalk that is, say, 500 yards long, as shown in (8b), *The sidewalk runs from here to there*. Finally, direction is important. In thinking about a long garden hose, as shown in (4c), *A garden hose runs along the back fence*, I scan in one direction, going from one end (probably where the faucet in located) to the other (where the water comes out). I do not start at the middle of the hose and move out in both directions at the same time. Thus, in mental scanning, as experienced in understanding (many) FM-constructions, scanning usually proceeds in one direction.

Further evidence to support the idea that people activate conceptual structure about motion when there is no explicit motion involved comes from other psychological work on figurative language about motion verbs and understanding abstract domains. Maglio and Matlock (1999) examined how people talk about the experience of using the World Wide Web. The studies were run in 1996, before the popularization of the web. Many had never used a Web browser and a few people had never even heard of the Web. When asked what their experience was like following a short session browsing the web, both novices and expert web users described the experience with language that was much like actual motion through physical space, for instance, *I went to a web site about tattoos, I stayed there for a while and then came back*. In related work, Matlock and Maglio (1996) found that language canonically used to express movement along a horizontal plane was preferable to language about vertical movement (exception is vertical movement on same screen, but in the early days of web use,

less information was presented on a single page, and consequently, there was less need to scroll), suggesting that people use language that mirrors or is at least consistent with how they ordinarily move through physical space (walking, running, or driving across a relatively flat surface, not shooting straight up into the air or tumbling downward).

5. Conceptual motivation of fictive motion constructions

In this paper, I have argued that simulated motion is grounded in and driven by cognition and perception. People run simulations because they can't help but do it. From this natural ability and people's on-going experiences with motion in the world, it follows that the use of FM-constructions, such as *The road runs along the coast*, is motivated. However, we still have a long way to go before we can show *exactly* how fictive motion motivates the grammatical constructions. A good starting point might be to look at how simulation works across a variety of grammatical constructions, taking into account the sorts of schemas discussed by Bergen and Chang (in press).

In addition, empirical work needs to be done on the more subtle underpinnings of fictive motion understanding, including the extent to which it is subjective. Langacker (1990) argues that subjectivity is an integral part of construal of sentences such as *The mountains run from Canada to Mexico*, in that the language user, in the absence of an explicit mover, does the moving. The first question that comes to mind is what does subjectivity mean for on-line processing? Subjectivity is plausible and certainly compatible with the fictive motion verb experiments I have discussed here and elsewhere (e.g., Matlock 2001), but none of those tasks targeted subjectivity per se. Nonetheless, we can still see that the language user mentally scans a trajectory, and that information about actual motion is activated in that simulation (e.g., rate, distance, terrain).

Further empirical work should also examine *reconceptualization* (Langacker 2002). Simply stated, reconceptualization is the idea that people have to mentally trace a path or some portion of a scene more than once, for instance, to scan in two directions. For instance, upon hearing *The scar runs from her knee to her ankle*, my scanning starts at the knee and continues until I get to the ankle. But to understand *The scar runs to her knee from her ankle*, I must first scan from the knee to the ankle, and then scan from the ankle to the knee. If Langacker (2002) is right about reconceptu-

alization, we should see processing differences between the two sentences. Namely, the latter should take longer to process, even though on the surface the sentences appear to convey the same meaning. In any event, this may provide further evidence for or against the idea that people subjectively experience fictive motion

For comparative purposes, it would also be useful to look at how FM-constructions are processed in languages other than English. One question is whether languages that have traditionally been called "verb-framed", such as Spanish – in which path information is expressed primarily or virtually exclusively in the verb – will differ in terms of on-line processing from languages such as English and other "satellite-framed" languages – in which path is expressed primarily in adpositions and other verb "satellites" (see Slobin 1996a, 1996b; Talmy 2000).[16] Langacker (1999) argues that understanding FM-sentences requires the conceptualizer to use *sequential scanning* (roughly, build up a representation in steps by "moving" from point to point along the trajectory). In verb-framed languages, such as Spanish, motion verbs tend to fall toward the inceptive or instantaneous end of the continuum. In this way, they are more like English *exit* and *enter*, which background the sense of on-going activity, and instead highlight the point at which a mover changes position, for instance, the point between being in one location and being in another location, as in *He exited the room*. It is possible that the binary flavor of these verbs requires less scanning time than verbs such as *go*, *follow*, *meander*, *race*, and so on. On this same note, it would also be useful to see how construal relating to boundary constraints (Aske 1989) plays out in the on-line understanding of FM-sentences. For instance, if people were given a sentence such as *The road crosses the property line*, and primed with an explicit physical boundary, such as a concrete fence, it might make for slower processing times than if they had been primed with some sort of implicit non-physical boundary.

Finally, it is important to think about motivation and fictive motion in light of language as a joint activity and people's need to communicate with others (Clark 1996). Think about when you would actually say (1a), *The road runs along the coast*. You would probably not walk up to a total

16. This is not to say that the satellite- versus verb-framed language dichotomy uniformly applies across languages. A good example of a "problematic" language is Thai, which is traditionally believed to be a verb-framed language. Kessakul (1999) conclusively shows that it has many satellite-framed elements. Other examples are discussed by Croft (2002).

stranger in a library or say it out of the blue at the dinner table. But you might say it if somebody comes up to you on Pacific Avenue in Santa Cruz, and asked, *Excuse me, where does this road go?,* while pointing at a line representing Highway 1 on a map. The point is that FM-constructions are obviously contextually motivated. They occur in situations in which two or more people are talking about where something is or where they are going. For instance, in driving in an unfamiliar area, I look at a sign that says *Highway 49.* I ask my passenger, who is holding a map, *Where does that go*? At that point, the passenger might provide a response along the lines of the responses shown in (15a) – (15c).

(15) a. *On this map, it runs north from here.*
b. *Looks like it goes to several gold rush towns.*
c. *It crosses the Merced River and eventually gets to Highway 120.*

Or here is another situation that shows that context is critical to how these sentences are used and how they are understood in the real world. In walking on campus with a colleague in an area neither of us knows well, we step on to a sidewalk that appears to continue around a corner. As we turn the corner, he says, *Let's see where this goes*. After turning the corner we learn that the sidewalk dead-ends. I say, *It doesn't go anywhere*.

What is important here is that FM-sentences like these constantly come up in everyday conversation. Their use is motivated because such utterances arise as people attempt to establish and maintain common ground (Clark 1996). When we hear them, we usually instantly know what the speaker is talking about. For instance, in hearing (15b), I know that *it* refers to a road, specifically Road 49, and that *it* does not refer to a bus or information (*The bus goes to several gold rush towns, The information goes to several gold rush towns*). And when there is a problem, such as ambiguity or insufficient information, listeners ask speakers for more information (e.g., *Oh, do you mean that road over there*? (accompanied with a pointing gesture). Thus, though empirical research on fictive motion in natural discourse has yet to be done, it is probably safe to assume that common ground is another motivation for the way FM-constructions are used.

6. Conclusion

That motion verbs are systematically used to describe stationary scenes is not at all trivial or random. Based on the systematic behavior of FM-constructions in addition to psychological work on mental imagery, simulated action, common ground, and more directly, on experimental work on fictive motion, we can conclude with a reasonable degree of confidence that FM-constructions are motivated by our cognitive ability to mentally simulate motion along a path and by the natural urge to talk about where objects are located and where we are going in the world. In addition, FM-constructions are motivated by the need to move in the world, not merely for convenience or pleasure, but for survival. Not being able to move can be potentially dangerous (e.g., not being able to run out of a burning building, being unable to obtain food), and so is not being able to see motion (e.g., getting hit in the face by a hard ball because you did not see it coming your way, driving off the side of the road because you didn't notice the car pulling into your lane).

Therefore, the conclusion that fictive motion is motivated is really not all that remarkable, especially given that our natural ability to simulate motion ultimately lies in our direct experience with motion in the world. Our ability to simulate motion is merely a reflection of the need to be in motion and to perceive motion. Finally, our ability to use and make sense of language about motion in non-literal ways goes far beyond the types of sentences we looked at in this paper. Nonetheless, the same explanation applies: It simply reflects the primacy of motion in human experience and the embodiment of that experience in linguistic thought.

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