

Time After Time: The Psychological Reality of the Ego- and Time-Reference-Point Distinction in Metaphorical Construals of Time

Rafael E. Núñez, Benjamin A. Motz, and Ursina Teuscher
Department of Cognitive Science
University of California, San Diego

Research in cognitive linguistics and in processing of temporal metaphors has traditionally distinguished between Moving-Ego and Moving-Time mappings: Either the Ego is construed as moving regarding fixed temporal landmarks or Time is construed as moving regarding the Ego. Both of these metaphors involve time events in reference to an Ego, which specifies the present time “now.” We build on recent theoretical suggestions for a more fundamental classification of temporal metaphors: Ego- and Time-Reference-Point metaphors (Ego-RP and Time-RP). The distinction focuses on the role of reference points in ascribing orientation, rather than on the identity of a moving entity (Ego or Time). Using visual priming experiments we provide evidence of the psychological reality of the Time-RP metaphor, a temporal metaphor with no reference to an Ego.

Research on conceptual metaphor has built up linguistic evidence that there is an extensive system of metaphors underlying human thought. These metaphors, which map inferential structure from a source domain onto a target domain, allow us to conceive abstract concepts in terms of more concrete concepts (Gibbs, 1994; Johnson, 1987; Lakoff & Johnson, 1980, 1999; Lakoff & Núñez, 2000; Turner, 1987). Regarding time metaphors, scholars have traditionally made a division between Moving-Time and Moving-Ego metaphors (Clark, 1973; Gentner, 2001; Evans, 2003; Lakoff, 1993; Lakoff & Johnson, 1980; Traugott, 1978). In the former, time

Correspondence should be addressed to Rafael E. Núñez, Department of Cognitive Science, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093. E-mail: nunez@cogsci.ucsd.edu

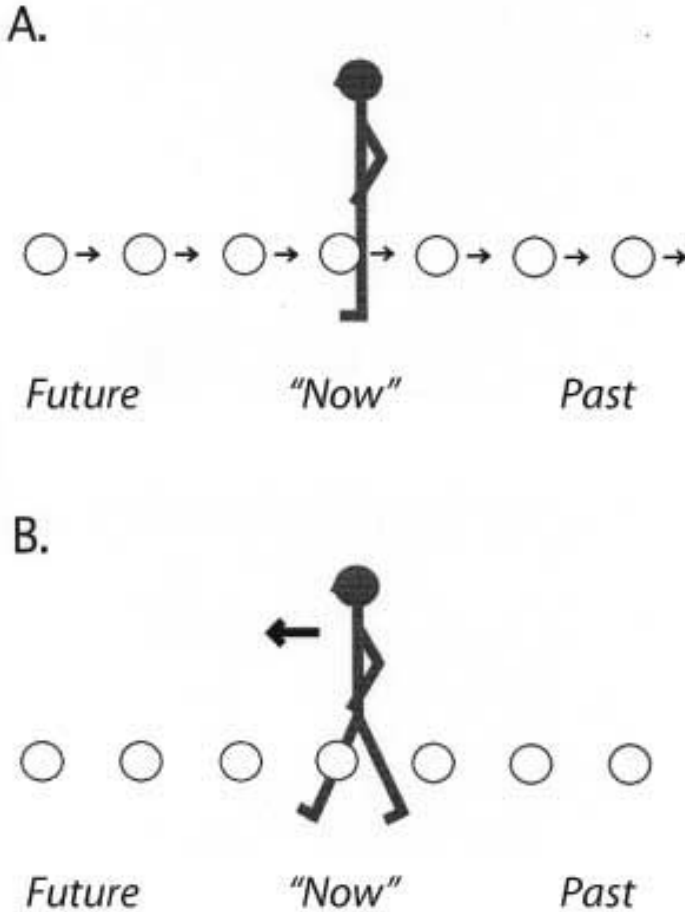


FIGURE 1 Moving-Time (A) and Moving-Ego (B) conceptual metaphors. In both cases, a canonical observer, the Ego, is collocated with the present time, now. Locations in front of the Ego are mapped with future events and those behind the Ego with past events.

events move regarding a fixed observer from front (future) to back (past) as in “*Christmas is approaching*” or “*The summer went by*” (Figure 1A), whereas in the latter the observer moves frontward toward fixed (future) time events as in “*We are approaching the end of the year*” or “*leave those sad days behind*” (Figure 1B). In both cases the observer’s location is mapped onto the present time, “now,” thus defining the inherently deictic semantic categories “future” and “past.”

Psychologists have since searched for experimental evidence of the psychological reality of these (and many other) theoretical conceptual metaphors (Gentner & Imai, 1992; Gibbs, 1994, 1996; Gibbs & Colston, 1995; Glucksberg, Brown, &

McGlone, 1993). When people are asked the ambiguous question, “Next Wednesday’s meeting has been moved forward 2 days. What day is the meeting, now that it has been rescheduled?” they are reported to interpret the phrase according to either Moving-Ego or Moving-Time metaphors. If, on the one hand, the Ego is conceived as moving “forward” through time, then future events are farther ahead relative to the Ego’s motion, so moving the meeting forward is rescheduling it to a later time in the future (from Wednesday to Friday). If, on the other hand, Time moves toward a stationary Ego, then moving the meeting forward is moving it closer to the Ego, that is, closer to the present (from Wednesday to Monday; McGlone & Harding, 1998).

Psychological research has demonstrated how real or imagined physical motion scenarios can prime construals of time by activating the relevant source domain (Boroditsky, 2000; Boroditsky & Ramscar, 2002; Gentner, Imai, & Boroditsky 2002). For instance, people who have just been moving (e.g., traveling on a plane or a train) or imagining self-motion tend to think of themselves as moving past stationary time events (Moving-Ego), and they are likely to say that the meeting was moved to Friday. Conversely, immobile observers of real or imagined objects moving toward themselves tend to think of time as approaching (Moving-Time), and therefore are more likely to report that the meeting was moved forward to Monday.

But these interpretations deserve further analysis. Whereas the reasoning behind the first case (Moving-Ego) seems adequate, the second case (Moving-Time) raises some important questions. Is it necessarily motion *toward themselves* (Ego) that leads people to give the “Monday” answer? That is, do people pick “Monday” because the meeting has been moved closer to the present (i.e., approaching the Ego), or because the meeting has been moved toward the front of the sequence of days (i.e., earlier than Wednesday), which just happens to be closer to the present? Furthermore, is *what moves* (Time or Ego) really the essential criterion for categorizing spatial metaphors for time?

The literature cited earlier divides time metaphors into the inverse Moving-Ego and Moving-Time mappings: Either the Ego is construed as moving regarding fixed temporal landmarks, or Time is construed as moving regarding the Ego. But Núñez and Sweetser (in press) have argued that linguistic data show much more complex patterns. (a) Not all spatial language for time is dynamic: “*The appointments are too close together*” or “*they were born a year apart*” simply treat times as locations. (b) When time is construed as moving, it is not always regarding the Ego as a reference point. In “*Wednesday follows Tuesday*,” or in “*February comes before March*” times are construed as moving, where Tuesday and March are moving reference points for the locations of Wednesday and February, respectively. There is no Ego reference point involved. (c) As a consequence, expressions like the one just mentioned do not require the specification of the present time “now,” and therefore, they don’t specify “future” or “past” either. Irrespective of when we say “*Spring follows Winter*,” the sentence keeps its core meaning (i.e., spring takes place after winter). This is quite distinct from “*the wedding is coming*,” which characterizes Time as moving toward

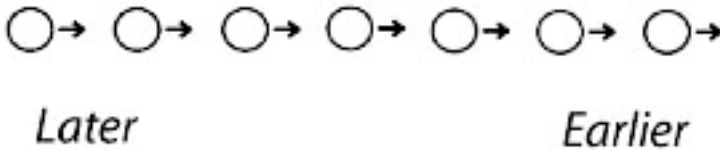


FIGURE 2 Time-RP conceptual metaphor, which maps locations in front of the sequence with earlier events in time, and those in the back with later events. No compulsory specification of the present “now” is required.

the Ego, and therefore preserves the meaning only as long as the wedding is in the future. Therefore, following Núñez (1999), Moore (2000), and Núñez and Sweetser (in press), rather than classifying the metaphors according to *what moves* (Ego or Time), we classify them according to the relevant (static or dynamic) *Reference Point* (RP). Thus we have *Ego-Reference-Point* (*Ego-RP*) metaphors, where the Ego’s location always specifies the present, “now,” (and of which the Moving-Time and Moving-Ego metaphors mentioned earlier are subcases), and *Time-Reference-Point* (*Time-RP*) metaphors, where earlier events in time are “in front of” later events, and where there is no compulsory specification of “now” (Figure 2). Table 1 shows the mapping underlying the inferential structure of the Time-RP metaphor (after Núñez & Sweetser, in press).

In the Time-RP source domain (one-dimensional space), “front” is usually (but not necessarily) already a metaphorical front recruited from another conceptual mapping. In it, people ascribe a precise orientation to objects relative to their prototypical direction of motion (as in the *frontal* part of an animal body, or the *front* of a car). When objects lack inherent orientation relative to motion (e.g., cubes), people ascribe orientation to them based on actual motion. For example, people can immediately and unerringly refer to the “front” side of a cube sliding along a flat surface (Clark, 1973; Fillmore, 1977/1997, 1982; Levinson, 2003;

TABLE 1
Time-Reference-Point Mapping

<i>Source Domain</i>		<i>Target Domain</i>
<i>One-Dimensional Space</i>		<i>Time</i>
Objects	→	Times
Sequence of objects	→	Chronological order of times
Objects in the sequence oriented in terms of “front–back” relationships (usually given by their direction of motion)	→	Times oriented in terms of “front–back” relationships (usually given by their direction of “motion”)
An object <i>A</i> located in front/behind an object <i>B</i>	→	A time <i>A</i> occurs earlier/later than time <i>B</i>
Movement of the entire sequence in one direction (usually horizontally)	→	Passing of time

Núñez, 1999; see also results reported in Experiment 1 of this study). This metaphorical orientation in the source domain (of objects moving together in a one-dimensional array) is preserved in the target domain of Time.

The mapping underlying the Time-RP metaphor provides three important entailments:

- a. If object *B* follows object *A* (in the source domain of space), then, via the mapping, time *B* occurs later than time *A*. Therefore, earlier times are in front, ahead of, later times.
- b. The mapping preserves transitive relations. In the source domain, if object *C* follows an object *B* in the sequence, and object *B* follows an object *A*, then object *C* follows object *A*. Therefore, via the mapping, if time *B* is later than time *A* and time *C* is later than time *B*, then time *C* is later than time *A*.
- c. Because the sequence of objects is one-dimensional (linear), time is one-dimensional.

The Time-RP metaphor accounts for the linguistic form and the semantic entailments of expressions like “*Christmas follows Thanksgiving*”; “*Greenwich Mean Time is lagging behind the scientific standard time*”; “*Boston time is 3 hr ahead of San Francisco time*”; “*It is 20 min ahead of 1 p.m.*”

The Ego- versus Time-RP classification of spatio-temporal metaphors explicitly distinguishes between the landmarks relative to which motion (or position) is construed, namely either the Ego or other Times. Figure 3 illustrates this new classification. The Moving-Time and Moving-Ego metaphors are Ego-RP subcases, in which not only the Ego (now) is present, but also acts as a reference point. Future and Past in these cases are necessarily relative to the Ego (now; for further details about these Ego-RP subcases, see Núñez & Sweetser, in press). In the Time-RP metaphor, only *earlier than* and *later than* relationships hold (there is no Future or Past).¹ The Ego (now) may be present, but if so, it does not act as the primary reference point.

¹The Time-RP metaphor is similar to what Evans (2003) has called the Complex Temporal Sequence model, in that both invoke a sequence and neither of them require a specification of present, past, and future. There are, however, some important differences: (a) Unlike the Time-RP metaphor, Evans’s model is not characterized by a clear mapping from *space* to *time* (as it is required by conceptual metaphor theory). Instead the model only provides a map from temporal entities onto temporal entities (e.g., a “sequence of temporal events” onto “chronology of events,” and “temporal events located before or preceding other events” onto “earlier events”; p. 231). (b) Evans’s model is not motivated by the role of reference points, as Time-RP is. As a result, it does not distinguish temporal relationships *intrinsic* to a sequence from those construed relative to an *observer*. For instance, the temporal expressions (translated from West African Hausa) “Tuesday is in front of/before Monday” and “Monday is in back of/after Tuesday” are treated as an instance of the Complex Temporal Sequence model (pp. 231–233). However, this is not an instance of the Time-RP mapping because in these examples *front* and *back* are construed relative to an observer.

FIGURE 3 A classification of spatial metaphors of time according to reference points rather than moving entities.

In this article we provide experimental evidence of the psychological reality of the Time-RP metaphor. Once people are primed with an image of a sequence of cubes moving horizontally across a screen, we then ask the ambiguous question about moving a meeting forward (McGlone & Harding, 1998). Because this visual display contains no reference to, or motion toward, an observer, we can safely say that the priming is Ego-free. If we observe an increase of interpretations of “forward” as “earlier” (e.g., moving the meeting from Wednesday to Monday) it would then be due to the head of relationship intrinsic to the sequence *and not* to the fact that people think of “time” as coming *toward them* as some researchers have suggested (Boroditsky, 2000; Boroditsky & Ramscar, 2002). It is important to point out that, strictly speaking, the Time-RP metaphor does not necessarily require motion: It only requires the objects of the sequence to be oriented in front of *other objects*. In this study, motion implies this orientation, thus allowing participants to ascribe a front-back orientation to objects in a sequence irrespective of the Ego location.

To further investigate the role of the Ego (or the lack thereof) we ask two types of questions relative to the deictic semantic categories “future” and “past” defined by the present time “now”:

- a. “Next Wednesday’s meeting has been moved forward” (an event in the future); and
- b. “Last Wednesday’s meeting got moved forward” (an event in the past).

The question about the event in the past is crucial, because it forces people to choose between an interpretation relative to the Ego’s front and one relative to the sequence front. If people consider spatial relations relative to an Ego, they should presumably construe all of last week as behind them. Thus *forward* relative to the

Ego orientation should mean “to a later time, closer to now” (i.e., moving last Wednesday’s meeting to last Friday, which is more recent). Conversely, if people choose “Monday” after observing horizontal motion with no reference to the Ego location, it would suggest that they interpret *forward* relative to the internal orientation of the sequence and not relative to the Ego, and therefore as “earlier than the original time (Wednesday).” Such a finding would provide evidence not only that the Ego is unnecessary for disambiguating such metaphoric phrases as *moving a meeting forward* (when the meaning “earlier” is intended), but that the primary reference point is provided by the front–back organization of the sequence itself. The psychological reality of the Time-RP metaphor would thus be established.

EXPERIMENT 1

The goal of Experiment 1 was to investigate whether “Monday” interpretations of “forward” could be primed by showing an Ego-free visual display.

Method

Participants. Sixty-six University of California, San Diego (UCSD) undergraduate students (30 male, 36 female) participated in the experiment.

Stimuli. The stimulus material for the priming consisted of a graphical array of colored boxes that was displayed on a standard lecture hall projection screen, using a liquid-crystal-display projector controlled by a personal-computer laptop with a display resolution of 1,024 × 768 pixels. The boxes slid horizontally across the screen with constant speed, either from left to right (Figure 4A), or from right to left (Figure 4B); 45 sec elapsed between the appearance of the first box on one side of the screen and the exit of the last box on the other side of the screen. To reduce the potential that an observer would interpret the motion as relative to themselves, the animation included a second phase. Once the boxes reached the center of the screen, each of the two balls contained in the boxes moved from their original box to another in a smooth arch. Thus, the balls moved relative to the boxes, either in the same direction of the boxes’ lateral entrance (forward) or in the opposite direction (backward).

The priming material further included five written questions intended to emphasize the orientation of the objects. Questions included, “What is the color of the frontmost box?” and “Did the black ball move forward or backward?” Importantly, these priming questions made no reference to objects moving toward an observer.

The target question was either “Next Wednesday’s meeting has been moved forward 2 days. On what day will the meeting now take place?” or “Last Wednesday’s meeting had been moved forward 2 days. On what day did the meeting take place?”

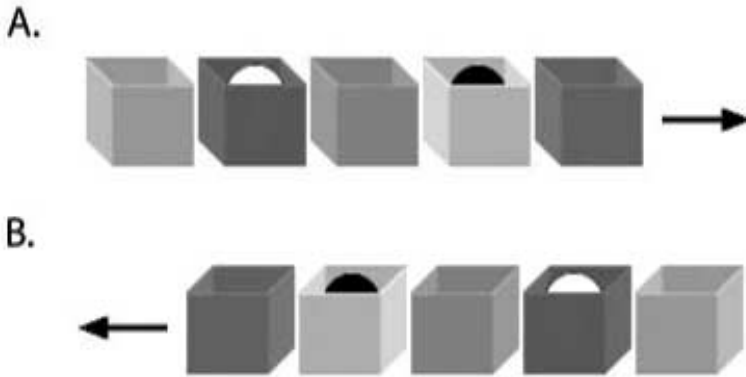


FIGURE 4 Visual stimuli used to prime the Time-RP conceptual mapping in Experiment 1. Images entered the display laterally, either from left to right (A), or from right to left (B). In practice, each box was a different color: green, yellow, blue, red, and magenta (arrows were not included in the display). The ordering of colors were opposite for the two directions of motion, so that the “frontmost” box was the same color for both directions.

Procedure

Seated participants saw the array of boxes slide across the screen, either from left to right ($n = 33$), or right to left ($n = 33$). They were instructed to answer the priming questions (see previous section, last paragraph) while viewing these animations. Priming questions were given in the same order to all participants. Immediately after priming, participants were asked one of the two target questions: either about “next Wednesday’s meeting” ($n = 34$) or about “last Wednesday’s meeting” ($n = 32$).

Results

When asked the priming question, “What is the color of the frontmost box?” 64 out of 66 participants identified the box that was farthest along the path of motion (97%), $\chi^2(1, N = 66) = 58.24, p = 2.32 \times 10^{-14}$. Lateral movement was thus very effective in allowing subjects to ascribe anteriority to the sequence of boxes.

In a neutral context people are about as likely to think of “next Wednesday’s meeting” being moved forward to Monday as to Friday (Boroditsky & Ramscar, 2001; McGlone & Harding, 1998). Boroditsky (2000) reported these proportions to be 45.7% and 54.3%, respectively. When compared against these proportions, our participants (after viewing Ego-free lateral motion) were significantly more inclined to report that the meeting was moved forward to Monday (63.6%) than Friday (36.4%), $\chi^2(1, N = 66) = 8.56, p = 0.0034$. Results thus indicate a strong proclivity to interpret “forward” as “earlier” when participants simply consider objects moving relative to one another.

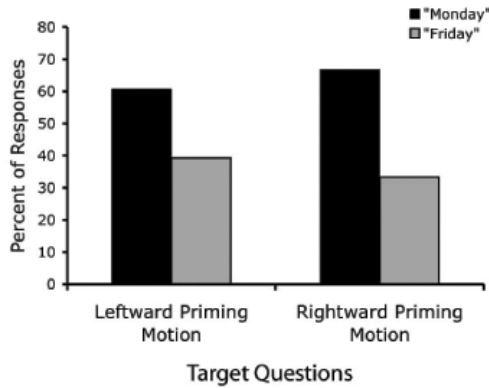


FIGURE 5 Responses to target question, split by direction of priming motion (leftward/rightward).

No evidence was found that these effects are changed by either the direction of motion of the cubes (leftward vs. rightward) or by the meeting location in time (future vs. past); 66.7% of participants replied “Monday” when the stimulus moved rightward, and 60.7% did so when it moved leftward (Figure 5), $\chi^2(1, N = 66) = 0.26, p = 0.61$. Similarly, 67.6% of participants replied “Monday” when asked about “next Wednesday’s meeting,” and 59.4% did so when asked about “last Wednesday’s meeting” $\chi^2(1, N = 66) = 0.49, p = 0.49$.

As predicted, no reference to an Ego was required to prime an interpretation of “forward” as “earlier,” suggesting that consideration of an Ego is not necessary for disambiguating spatio-temporal metaphoric terms, even when the target question involves past events.

These results, however, raise further questions. Would it be possible to replicate these effects when including a proper control group (rather than when comparing against proportions reported in the literature)? Further, would we observe the same results using simplified stimuli? Indeed, a possible concern in this experiment is that the presentation of three-dimensional boxes and moving balls might have activated an Ego (via three-dimensional perspective) in the conceptual mapping from spatial to temporal motion.

EXPERIMENT 2

Experiment 2 had the following goals: (a) to replicate the Time-RP priming effect observed in Experiment 1 with a proper control condition, thus establishing a valid baseline measure of peoples’ interpretation of “forward” within our paradigm; (b) to simplify the priming stimuli and with that reduce the possibility that some part of the priming would elicit an Ego-RP mapping; and (c) to investigate consistency

across different scales of spatio-temporal mappings by including in the target questions not only references to days in a week, but also to hours within a day.

Method

Participants. One hundred eleven UCSD undergraduate students (49 male, 62 female) participated in the experiment.

Stimuli. The presentation paradigm in Experiment 2 was similar to that in Experiment 1. A graphical array of colored moving squares was displayed on a standard lecture hall projection screen (Figure 6). The squares either moved horizontally across the screen from right to left (results from Experiment 1 showed no evidence that the direction of lateral motion affected participants' answers; see Figure 5) or remained fixed in the center of the screen for the control condition. In both cases, the presentation lasted about 45 sec.

The priming material additionally included a series of questions about the priming stimuli (e.g., "What is the color of the square with the white dot?"). These priming questions made no reference to objects moving toward an observer.

The target questions for Experiment 2 are displayed in Table 2.

Procedure

About half of the participants ($n = 57$) were shown the array of squares moving horizontally across the screen, whereas the rest of the participants, a control group ($n = 54$), saw the same array of squares fixed in the center of the screen.

While viewing the presentation on the screen, the participants were instructed to answer the priming questions, which were presented in the same order to all participants, and which served only to ensure that the participants were paying attention to the display. Immediately thereafter, all participants were asked two target questions (see Table 2): About half of the participants were asked two questions about a past meeting ($n = 53$), whereas the others were asked about a meeting taking place in the future ($n = 58$). The order of the two questions was counterbalanced across all participants.



FIGURE 6 Visual stimuli used to prime the Time-RP conceptual mapping in Experiment 2. This image either entered the display from the right (primed group), or appeared motionless in the center of the screen (control group). Boxes were colored as in Experiment 1.

TABLE 2
Target Questions

Future	
Days of the week	Next Wednesday's meeting has been moved forward 2 days. On what day will the meeting now take place?
Hours of the day	Tomorrow's 12:00 p.m. (noon) meeting has been moved forward 2 hours. At what time will the meeting now take place?
Past	
Days of the week	Last Wednesday's meeting got moved forward 2 days. On what day did the meeting take place?
Hours of the day	Yesterday's 12:00 p.m. (noon) meeting got moved forward 2 hours. At what time did the meeting take place?

Results

Participants were highly consistent in their answers. Those who replied "Monday" also replied "10 a.m." (92%), and those who replied "Friday" also replied "2 p.m." (92%), $\chi^2(1, N = 103) = 72.2, p = 1.19 \times 10^{-17}$; Squared Cramér's $\phi = 0.70$. For the following analyses only those participants whose responses were consistently "Earlier" ("Monday" and "10 a.m.") or "Later" ("Friday" and "2 p.m.") are considered ($n = 95$).

The proportion of "earlier" and "later" answers in primed participants ($n = 45$, 71% and 29%, respectively) was significantly different from the control group, in which participants did not view motion (52% and 48%, respectively), $\chi^2(1, N = 45) = 6.58, p = 0.01$ (Figure 7).

Among the primed participants, no differences were found in the proportions of "earlier" and "later" responses relative to the time of the question. When asked about the past, 70.8% of primed participants responded "earlier" and 71.4% did so when asked about the future, $\chi^2(1, N = 45) = 0.002, p = 0.96$ (Figure 8). More precisely, regarding past questions only, primed participants were significantly more likely to interpret "forward" as "earlier" (70.8%) over "later" (29.2%) than were participants in the control group (40% and 60%, respectively), $\chi^2(1, N = 44) = 4.23, p = 0.04$. These results suggest that primed people give "earlier" answers irrespective of whether the target question refers to future or past. More important, when people are given a question regarding the past, and thus are forced to choose between a "later" interpretation of "forward" (relative to the Ego front) and an "earlier" one (relative to the sequence front), they do choose the latter.

Discussion

The results of these experiments show that people do think of specific time events via a conceptual metaphor that draws temporal inferences from an Ego-free spatial sequence: the Time-RP metaphor. This metaphor maps locations that are in front

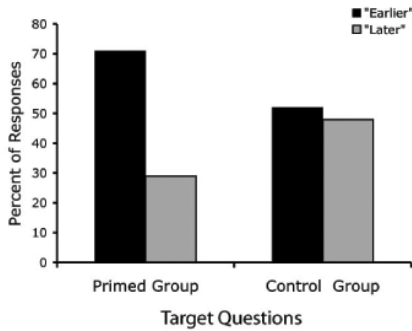


FIGURE 7 Responses to target questions in primed group versus control group from Experiment 2.

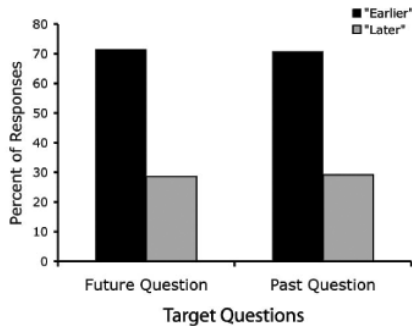


FIGURE 8 Responses to target questions in primed group (control group not included), split by the location of the event in time (future–past) from Experiment 2.

or ahead of others in the sequence with “earlier” events, and those that are behind with “later” events. Unlike the usual classification between Moving-Time and Moving-Ego metaphors, which by virtue of having an Ego always specify the present “now” and the inherently deictic semantic categories “future” and “past,” this Time-RP metaphor does not (necessarily) involve an Ego and has no compulsory specification of the present time “now.” This metaphor distinguishes *posteriority* (reference to one time as being later in a sequence than another) from *future* (reference to times later than “now”), and *anteriority* (reference to one time as earlier in a sequence than another) from *past* (reference to times earlier than “now”).

The results of our experiments suggest that when people give a “Monday” answer to the “next Wednesday’s meeting ...” question, they are not drawing the essential inferential organization from “an entity moving toward *me*,” as it is usually suggested, but from the intrinsic front–back relationship of the spatial sequence itself (i.e., anteriority–posteriority). The Time-RP metaphor, in which “moving for-

ward” is “moving earlier,” thus provides a more precise and parsimonious account of “Monday” answers than the one found in the literature.

This was empirically demonstrated through the investigation of cases involving past events (e.g., “last Wednesday’ meeting”), which dissociate the reference points relative to the Ego and the sequence. Previous research on temporal metaphorical reasoning using priming techniques has focused on events that are implicitly in the future (e.g., scheduling meetings) and therefore has not studied this crucial dissociation. Regarding past events, “earlier” responses rule out the possibility of an elicited Ego actively setting a primary reference point, because forward means “later” relative to the Ego orientation (closer to now in the past). Our results suggest that people primed with Ego-free stimuli construe the meaning of “forward” based on the front–back relations intrinsic to the sequence, thus providing evidence of the psychological reality of the Time-RP spatial metaphor for time.

The psychological reality of an Ego-free conceptual metaphor ought not to be interpreted as evidence of a “disembodied” human mechanism for thought. Conceiving embodied experience exclusively in terms of situations centered only on an Ego body and its associated sensations is, at best, unnecessarily restrictive, and, at worst, untenable. A substantial amount of everyday bodily-grounded experiences, such as visual and acoustic perception of distant objects in the environment, are not captured by that limited conception of embodied experience. For instance, almost all humans share the experience of observing ants prototypically moving in the direction of the frontal part of their bodies. Furthermore, the ants that are ahead in the line of motion arrive earlier to a specified location than those who are behind. Crucially, in these cases, our point of observation of such events is irrelevant. Irrespective of the Ego point of view, the ants still move in the direction of their fronts, and those who are ahead still arrive earlier than those who are behind. Ascribing the same “orientation” to other nonliving moving objects that do not have heads, faces, or noses (such as a group of rocks sliding down the hill) is then a coherent natural extension of the inferential structure of such visual experiences. We claim that the Time-RP metaphor is a type of conceptual mapping that extends the inferential organization of this observational experience (which is ultimately bodily-grounded) to the realm of time. In this article we give experimental evidence of the psychological reality of such a conceptual metaphor.

ACKNOWLEDGMENT

The authors thank Seana Coulson for her helpful advice.

REFERENCES

- Boroditsky, L. (2000). Metaphoric structuring: understanding time through spatial metaphors. *Cognition*, 75, 1–28.

- Boroditsky, L., & Ramscar, M. (2002). The roles of body and mind in abstract thought. *Psychological Science*, 13, 185–189.
- Clark, H. (1973). Space, time, semantics and the child. In T. Moore (Ed.), *Cognitive development and the acquisition of language* (pp. 27–63). New York: Academic Press.
- Evans, V. (2003). *The structure of time: Language, meaning and temporal cognition*. Amsterdam, The Netherlands: John Benjamins.
- Fillmore, C. (1997). *Lectures on deixis*. Stanford, CA: CSLI. (Originally published in 1977 by the Indiana University Linguistics Club, as *The Santa Cruz Lectures on Deixis*.)
- Fillmore, C. J. (1982). Towards a descriptive framework for spatial deixis. In R. J. Jarvella & W. Klein (Eds.), *Speech, place and action: Studies in deixis and related topics* (pp. 31–59). New York: Wiley.
- Gentner, D. (2001). Spatial metaphors in temporal reasoning. In M. Gattis (Ed.), *Spatial schemas and abstract thought* (pp. 203–222). Cambridge, MA: MIT Press.
- Gentner, D., & Imai, M. (1992). Is the future always ahead? Evidence for system-mappings in understanding space-time metaphors. *Proceedings of the Fourteenth Annual Meeting of the Cognitive Science Society* (pp. 510–515).
- Gentner, D., Imai, M., & Boroditsky, L. (2002). As time goes by: Evidence for two systems in processing space > time metaphors. *Language and Cognitive Processes*, 17, 537–565.
- Gibbs, R. (1994). *The poetics of mind*. Cambridge, UK: Cambridge University Press.
- Gibbs, R. (1996). Why many concepts are metaphorical. *Cognition*, 61, 309–319.
- Gibbs, R., & Colston, H. (1995). The cognitive psychological reality of image-schemas and their transformations. *Cognitive Linguistics*, 6, 347–378.
- Glucksberg, S., Brown, M., & McGlone, M. (1993). Conceptual metaphors are not automatically accessed during idiom comprehension. *Memory and Cognition*, 21, 711–719.
- Johnson, M. (1987). *The body in the mind: The bodily basis of meaning, imagination and reason*. Chicago: University of Chicago Press.
- Lakoff, G. (1993). The contemporary theory of metaphor. In A. Ortony (Ed.), *Metaphor and thought* (2nd ed.; pp. 202–251). Cambridge, UK: Cambridge University Press.
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.
- Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh*. New York: Basic Books.
- Lakoff, G., & Núñez, R. (2000). *Where mathematics comes from: How the embodied mind brings mathematics into being*. New York: Basic Books.
- Levinson, S. (2003). *Space in language and cognition: Explorations in cognitive diversity*. Cambridge, UK: Cambridge University Press.
- McGlone, M., & Harding, J. (1998). Back (or forward?) to the future: The role of perspective in temporal language comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 24, 1211–1223.
- Moore, K. E. (2000). *Spatial experience and temporal metaphors in Wolof: Point of view, conceptual mapping, and linguistic practice*. Unpublished doctoral dissertation, University of California, Berkeley.
- Núñez, R. (1999). Could the future taste purple? In R. Núñez & W. Freeman (Eds.), *Reclaiming cognition: The primacy of action, intention, and emotion* (pp. 41–60). Thorverton, UK: Imprint Academic.
- Núñez, R., & Sweetser, E. (in press). Looking ahead to the past: Convergent evidence from Aymara language and gesture in the crosslinguistic comparison of spatial construals of time. *Cognitive Science*.
- Turner, M. (1987). *Death is the mother of beauty: Mind, metaphor, criticism*. Chicago: University of Chicago Press.
- Traugott, E. C. (1978). On the expression of spatio-temporal relations in language. In J. H. Greenberg (Ed.), *Universals of human language: Word structure* (Vol. 3, pp. 369–400). Stanford, CT: Stanford University Press.