The Metaphors We Speak with Affect How We Think about Time and Space

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Abstract

A growing bulk of work indicates that we think about time in terms of space. Solving temporal ambiguities may involve adopting alternative spatial frames – namely time-moving vs. ego-moving perspectives. Previous work showed that people draw on either spatial perspective to disambiguate statements such as *Next Wednesday´s meeting has been moved forward 2 days* (Boroditsky, 2000). The ambiguity lies in the expression *move forward*, which can be translated into Spanish either as *adelantar* or as *mover hacia adelante.* A Spanish corpus analysis shows that, when these expressions are used to talk about time, the former is more frequently used to describe events moving towards the ego (time-moving perspective). We studied whether the use of these expressions influences the interpretation of ambiguous temporal statements in Spanish. Results from three experiments show that: 1.Both spatial schema primes and the choice of "move forward" translation constrain people´s interpretations of ambiguous temporal statements (Experiment 1); 2.The use of different metaphors to talk about *time* influences the solving of *spatial* ambiguities (Experiment 2); 3.Temporal primes containing no metaphorical forms fail to do so (Experiment 3). We conclude that the conventionalized use of expressions affects how people draw on spatial schemas when thinking about time and space.

Keywords: conceptual metaphor; ambiguous temporal statements; ego-moving/time-moving schemas; language use.

Introduction

The question of how people mentally represent time and space has been a recurring theme to which cognitive scientists have devoted much recent work. Conceptual Metaphor Theory suggests that abstract thought depends largely on metaphorical mappings from more concrete conceptual domains that emerge directly from perceptual representations such as spatial orientation or physical containment (Casasanto, 2010; Kövecses, 2010; Lakoff & Johnson, 1980, 1999). Time is an abstract concept that is not directly grounded on our physical experience, thus we may borrow spatial schemas to think about it.

Time and space representations seem to be asymmetrically dependent (Boroditsky, 2000; Lakoff & Johnson, 1980, 1999). Some evidence of the directionality of the space-time mapping comes from language use: we talk about time in terms of space as in periods of time being *long* or events being *ahead* of us. Linguistic forms used to describe spatial motion are also imported into time, as when we say that a certain date *is approaching* or a meeting has been *moved forward*.

Cross-linguistic studies show that linguistic expressions of the TIME IS SPACE conceptual metaphor can be found in languages as diverse as English, Mandarin Chinese, Hindi, and Sesotho among others (Altverson, 1994). Across cultures people use spatial metaphors to describe time more frequently than time metaphors to describe space (see Kövecses, 2010, for a review).

There are two distinct space-time metaphoric systems in English and other languages: the ego-moving and the time-moving schemas (Clark, 1973; Boroditsky, 2000). In the ego-moving perspective we represent the individual moving across the time line walking into the future (e.g., *we are approaching the weekend)*. In the time-moving schema, we think about a static individual who is being "hit" by the time line – that is, events are represented as approaching the ego (e.g., *the weekend is approaching*). Boroditsky (2000) showed that ego-moving and time-moving scenarios used as spatial primes affected the way people thought about time. By contrast, temporal primes had no influence over spatial thinking. In a different study, Boroditsky and Ramscar (2002) showed how our experience of spatial situations (e.g., mentally simulating spatial movement or moving along a cafeteria line) had an effect on the type of spatiotemporal metaphors that are activated. People experiencing motion compatible with the ego-moving schema were more likely to use an ego-moving representation of time, while those that underwent the experience of an object moving towards them were more likely to activate time-moving schemas.

The importance of distinguishing between mental metaphors and linguistic metaphors has been pointed out (e.g., Casasanto, 2010). Casasanto and Boroditsky (2008) performed a series of psychophysical tasks, which did not require the use of language, showing that spatial stimuli interfered significantly with temporal judgments, while temporal stimuli had no effect on spatial judgments. These findings showed that spatial and temporal mental representations are asymmetrically dependent, as predicted by the directionality of space-time linguistic metaphors, even when tasks contained no linguistic materials.

Casasanto, Fotakoupoulou and Boroditsky (2010) studied the question of whether space-time representations are symmetrical in the first stages of development. They studied space-time mapping behavior in kindergartners and

schoolchildren. Their results were consistent with former experiments performed with adults: kids are able to ignore irrelevant temporal information when they make spatial judgments, but they can´t ignore irrelevant spatial information when they make temporal judgments. This suggests that the origin of the asymmetric condition of metaphorical mapping might not be due (at least not exclusively) to language experience. One plausible explanation for the directionality observed in the space-time mapping is that mental metaphors are grounded in our interactions with the physical world. Because space is easier to perceive and reconstruct from our perceptual experiences, time representations might be parasitic on it (Casasanto, 2010; Casasanto, Fotakopoulou & Boroditsky, 2010).

Does language play any role in the directionality of the space-time mapping? Most authors agree that language might have a modulating role on the inferential structure derived from primary metaphors. Initially we may all develop similar mental metaphors, but as we gain linguistic experience, mental mappings could be adjusted according to patterns of language use. For example, in a comparative study between Greek and English speakers, Casasanto (2010) showed that, although the asymmetric relationship showed up in both cases, the type of spatial stimuli that caused the most interference on temporal judgments was congruent with the linguistic metaphors most commonly used in participants´ native language. More recently, Duffy and Feist (2013) showed that the kind of verb used in ambiguous statements about time influenced the type of spatial schema (ego-moving or time-moving) that people chose during interpretation.

Along these lines, this work is intended to investigate whether the use of different metaphorical expressions in Spanish constrains the type of spatial schemas elicited during space-time mapping. Beyond aiming to provide evidence of metaphorical transfer effects, our primary goal is to show that the conventionalized use of certain expressions affects the ways in which people draw on competing spatial perspectives when thinking about time (and space). Consistent with the frequency patterns revealed by a corpus analysis of Colombian Spanish, the results from our three experiments suggest that the specific linguistic metaphors that we use to talk about time constrain the interpretation of temporal and spatial ambiguities. More generally, the results align with usage-based approaches (e.g., Langacker, 2000) according to which the patterns of language use and repetition shape our cognitive representations.

Interpreting Ambiguous Statements about Time

Solving temporal ambiguities may involve adopting different spatial representations – namely time-moving vs. ego-moving schemas (Boroditsky, 2000; Clark, 1973; Lakoff & Johnson, 1980). Boroditsky and Ramscar (2002) used ambiguous temporal questions to demonstrate that people use spatial information when disambiguating statements about time. In the first study of their paper, they used spatial primes to get participants to think about themselves moving through space (ego-moving perspective) or making an office chair come towards them through space (object-moving perspective). Afterwards, participants were asked to solve an ambiguous temporal statement—namely *Next Wednesday's meeting has been moved forward 2 days. What day is the meeting now that it has been rescheduled?* People primed to think about space adopted an ego-moving schema and answered Friday more often, while those primed to think in terms of an object moving towards them answered Monday more often.

It has been argued that the locus of the ambiguity might be the adverb *forward*, which can be interpreted either as indicating the direction of motion of the ego through time or as indicating the direction of motion of time towards the ego (Boroditsky 2000; Kranjec & McDonough, 2011). Recently, Duffy and Feist (2013) looked at responses to the ambiguous Next Wednesday's meeting question using different verbs (such as *pull* or *bring*) finding that both the verb and adverb constrain the interpretation.

Along these lines, Spanish provides an interesting case study to further explore this issue. The expression *move forward* can be translated into Spanish in two ways: (a) *mover hacia adelante*, and (b) a*delantar* – that is, the verbalization of the adverb *adelante* (ahead). Both expressions are synonymous in Spanish. Actually, according to the dictionary *Real Academia Española*, the first entrance for the definition of *adelantar* is "mover o llevar hacia adelante" (tr. to move or bring forward) (RAE, 2014).

Does the choice between *adelantar* and *mover hacia adelante* affect how people solve ambiguous statements about time in Spanish? Before dealing with this question, we conducted a corpus analysis to explore the patterns of usage of these two expressions. We used the *CREA* corpus of Spanish (Banco de datos CREA online, 2012), which contains over 160 million words of written texts (90%) and oral transcriptions (10%) from Spain and Latin American countries. Since our experiments were conducted in Colombia, we restricted our search to data from Colombian sources. We retrieved all sentences containing the expressions *adelantar* or the formula "VERB (V) + *hacia adelante"*. Phrases were then classified according to whether the target items were used in reference to space, time or had any other metaphorical meaning. Expressions used in reference to time or space, were classified into three categories: 1.ego-moving-perspective, 2. time/object-moving-perspective and 3.ambiguous (if the contextual information was not sufficient to decide between an ego-moving and a time-moving interpretation). For example, the sentence "the event on Wednesday has been moved forward to the Friday on the same week" would be classified as temporal/ego-moving-perspective. Decisions about sentence coding were reached by consensus of all four authors of this work.

The results were the following: from a total of 118 sentences containing the form *adelantar*, 62 (52.5%) described time, 5 (4.2%) space, and 52 (43.3%) had a

different (metaphorical) meaning; from a total of 32 sentences containing the form V+*hacia-adelante*, 14 (43.8%) described time and 18 (56.2%) space. Among expressions where *adelantar* was used in reference to time, 52 of them were tagged as time-moving-perspective and 10 as ambiguous (χ^2 (1,N= 62); p<.0001), and among those used in reference to space, 2 were tagged as ego-moving-perspective and 3 as ambiguous (*ns*.). Among the 14 sentences where V+*hacia adelante* was used in reference to time, 12 of them were tagged as ego-moving perspective, 1 was tagged as time-moving-perspective and 1 as ambiguous (χ^2(2, N=14); p<.001), and among spatial sentences, 8 were tagged as ego-moving-perspective, 10 as ambiguous (*ns*.).

The data suggest a difference between the conventionalized use of the target expressions in reference to spatial and temporal contexts. Specifically, in temporal contexts, *adelantar* seems to be used more often to refer to events moving in time towards people, while V+*hacia adelante* seems to be used more often to refer to people moving through the time line. However, that appears not to be the case when these expressions are used in reference to space.

Now we turn to the question of whether the use of *adelantar/mover hacia adelante* in ambiguous statements about time influences the way people solve them. Additionally, we are interested in exploring whether spatial schema primes affect disambiguation of temporal statements when different translations of "*move forward*" are used to construct temporal targets. Experiment 1 was designed to address these questions. Moreover, we ask whether thinking about time exerts any measurable priming effect on the solving of spatial ambiguities. Previous work suggests that is not the case (Boroditsky, 2000). In Spanish, however, the expression *adelantar* is used more frequently to describe time-moving temporal scenarios while *mover hacia adelante* is typically used to describe ego-moving temporal scenarios. Thus, the use of these forms when talking about time might contribute to the activation of different spatial perspectives influencing the transfer from temporal primes to spatial targets. Experiments 2 and 3 were designed to address this issue.

Experiment 1

Experiment 1 was intended as a replica of Study 1 in Boroditsky and Ramscar (2002). We aimed to investigate whether spatial primes affect the interpretations of ambiguous temporal statements in Spanish. To do so, we used similar spatial primes as those used in Boroditsky and Ramscar (2002) followed by the translation to Spanish of the ambiguous temporal question used in the original study: *Next Wednesday's meeting has been moved forward two days. What day is the meeting now that it has been rescheduled?* The expression *move forward* was translated either as *adelantar* or as *mover hacia adelante*.

The experiment was a two-factorial ("move forward" wording type and spatial prime schema type) fully crossed between participants design. The first factor was the "*move forward"* translation used in the probe question (*adelantar* vs *mover hacia adelante*). The ambiguous temporal statement used in our study was the following: *La reunión del próximo miércoles ha sido [***adelantada***/*movida hacia adelante*] dos días. ¿Qué día será la reunión ahora que ha sido reprogramada?*

The two levels of the second factor – spatial prime schema type – were ego-moving and object-moving schema primes. Similar to Boroditsky and Ramscar (2002), spatial primes were designed to get people to think about themselves moving through space in an office chair (ego-moving prime) or making an office chair come towards them though space (object-moving prime).

Method

Participants One hundred and eight undergraduate students from the Universidad de Los Andes and Universidad Nacional de Colombia, all native Spanish speakers, completed voluntarily a two-page questionnaire.

Materials and Procedure Four types of questionnaires were created (*adelantar*/ego-moving prime; *adelantar*/object-moving prime; *mover-hacia-adelante*/ego-moving prime; *mover-hacia-adelante*/object-moving prime). Conditions were counterbalanced across subjects. The first page of the questionnaire depicted the spatial prime, which was similar to the one used in Boroditsky and Ramscar (2002). In the ego-moving prime condition, participants were exposed to a drawing of a man sitting on a chair on one end of a track. An X was drawn on the opposite end of the track. Participants were instructed to imagine they were the man on the picture maneuvering the chair towards the X. They were instructed to draw an arrow indicating the path of motion. In the object-moving prime condition, participants were exposed to a drawing of a man next to an X, on one end of a track. The man holds a rope attached to a chair on the opposite end of the track. Participants were instructed to imagine that, with the rope, they had to maneuver the chair towards the X (that is, towards them). They were also instructed to draw an arrow indicating the path of the motion. The left-right orientation of the spatial primes was counterbalanced. In the second page of the questionnaire they were asked the ambiguous question in one of the two wording conditions ("move forward" translated either as *adelantar* or as *mover hacia adelante*).

Results and Discussion

Eight questionnaires were excluded from the analysis either because participants failed to complete the first page or provided nonsensical responses to the probe question (e.g., "Wednesday"), leaving a final sample of 100 participants: 48 in the *adelantar* condition (24 exposed to the ego-moving spatial prime and 24 to the object-moving spatial prime) and 52 in the *mover-hacia-adelante* condition (27 exposed to the ego-moving spatial prime and 25 to the time-moving spatial prime).

Results are summarized in Figure 1. Of the 24 participants in the *adelantar/*ego-moving prime condition, 10 (42%) responded *viernes* (Friday) and 14 (58%) responded *lunes* (Monday). From the 24 participants in the *adelantar/*object-moving prime condition, 2 of them (8%) responded Friday and 22 (92%) responded Monday. All participants in the *mover-hacia-adelante/*ego-moving prime condition responded Friday, and in the *mover-hacia-adelante/*object-moving prime condition, 19 (76%) responded Friday and 6 (24%) responded Monday.

As illustrated in Figure 1, participants showed a tendency toward responding Monday in the *adelantar* wording condition (75%), while in the *mover-hacia-adelante* wording condition most people responded Friday (88.5%). (χ^2 (1, N=100); p<.0001). A three-way contingency table analysis showed that there was also a significant effect of spatial schema primes on responses when controlling for the wording of the ambiguous statement. The effect of spatial primes was significant among the pool of participants filling the *adelantar* condition questionnaires (χ^2 (1, N=48) = 5.1; p=.017), as well as among participants filling questionnaires in the *mover-hacia-adelante* condition (χ^2 (1, N=52) = 5.44; p=.009). Similarly, a significant effect of wording type was found when controlling for spatial schema prime type, both among participants grouped by ego-moving prime questionnaires (χ^2 (1, N=51) = 18.9; p<.0001) and object-moving prime questionnaires (χ^2 (1, N=49)=20.2; p< .0001).

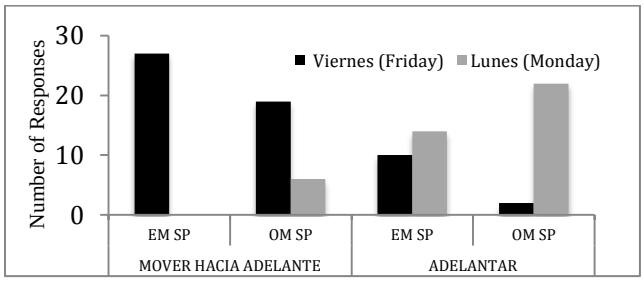

Figure 1: Number of Monday and Friday responses shown as a function of the experimental condition. EM=Ego Moving; OM=Object Moving; SP= Spatial Prime.

Taken together, the results are twofold: Consistently with the patterns of use revealed by the corpus analysis, using *adelantar* in the probe question biases participants toward responding *lunes* (Monday) while using *mover hacia adelante* biases responses toward *viernes* (Friday). Second, the finding in Boroditsky and Ramscar (2002) was replicated: the spatial schema prime type influences the way people solve ambiguous temporal questions in Spanish regardless of the "move forward" translation used in the probe question. The results then contribute to the cross-linguistic accumulating evidence that spatial information interferes with the temporal judgments.

We now turn to a different question: Does the type of expression used to talk about *time* affect the way people think about *space*? Previous work showed that thinking about time does not affect the solution of spatial ambiguities (Boroditsky, 2000). However, we hypothesize that Spanish expressions with conventionalized use might potentiate the activation of temporal schemas that may in turn contribute to constrain the interpretation of spatial ambiguities. Experiment 2 was designed to explore this hypothesis.

Experiment 2

In this second experiment we were concerned with whether temporal primes transfer to spatial targets. The prime stimuli were statements about time that were congruent with either an ego-moving or a time-moving scenario. Crucially, ego-moving temporal scenarios were described using the expression *mover hacia adelante* to convey "move forward in time", while time-moving temporal scenarios were described using the expression *adelantar* to also mean "move forward in time". Participants were primed with a series of sentences describing temporal scenarios and afterwards they were asked to solve a task that involved a spatial ambiguity.

Method

Participants One hundred and twenty undergraduate students from Universidad de Los Andes and Universidad Nacional de Colombia, all native Spanish speakers, completed voluntarily a two-page questionnaire.

Materials and Procedure Two types of questionnaires were created corresponding to ego-moving and time-moving schema primes. Conditions were counterbalanced across subjects. The first page of the survey included temporal primes consisting of a set of four statements describing temporal scenarios, each followed by a comprehension question. The following are examples of the stimuli used:

a. *Ego-moving temporal schema prime condition:*
La reunión del próximo miércoles ha sido *movida hacia adelante* de modo que será el viernes de la misma semana.[tr. Next Wednesday´s meeting has been moved forward so it will take place on Friday of the same week.]

b. *Time-moving temporal schema prime condition:*
La reunión del próximo miércoles ha sido *adelantada* de modo que será el lunes de la misma semana.[Tr. Next Wednesday´s meeting has been moved forward so it will take place on Monday of the same week.]

Statements in both conditions were followed by the same comprehension question: *How many days are there between the initial and final schedules?* The purpose of this question was to ensure the participants read the statement carefully and engaged in thinking about the different temporal scenarios. The other three additional prime statements were similar to the examples above but differed in that months, years and hours were used as time units (instead of days), and a contest, a talk and a conference were used as events (instead of a meeting). Temporal statements depicting ego-moving scenarios consistently contained the expression

mover hacia adelante and those depicting time-moving scenarios consistently included the expression *adelantar* to convey "move forward in time".

Participants were instructed to turn the page after reading the four temporal statements and answering the comprehension questions. In the second page of the questionnaire they were asked to solve an ambiguous spatial task. Similar to Boroditsky (2000), participants were exposed to a hand-made drawing of three equal widgets that were arranged from closest to farthest. The widget on top of the drawing was significantly smaller than the widget at the bottom, while the middle widget was intermediate in size (see Figure 2, left panel). Participants answered the following ambiguous question written below the figure: *¿Cuál de los artefactos está adelante?(Márquelo con un círculo)* – that is, a translation from the probe question used in Study 2 in Boroditsky (2000): "*Which one of the widgets is ahead?(Please circle one)*". The intrinsic properties of the widgets impeded participants to infer the "aheadness" of the widgets, forcing them to adopt either an ego-moving perspective or object-moving perspective to solve the task.

Results and Discussion

Ten questionnaires were removed from the sample either because participants failed to complete the first page or because they provided atypical responses (e.g., circling the middle widget) leaving a final sample of 110 responses. From these, 54 corresponded to the time-moving prime condition and 56 to the ego-moving prime condition. Results are summarized in Figure 2 (right panel). Of the 54 participants who were exposed to the time-moving prime condition, 38 (70%) said that the bottom widget was ahead and 16 (30%) chose the one on top. On the other hand, of the 56 participants in the ego-moving prime condition, 26 (47%) said the bottom widget was ahead and 30 (53%) said the top widget was ahead. The difference across conditions was significant ($\chi^2(2,N=110)=5.5$; $p=.018$), suggesting that people´s responses were constrained by their thinking about the temporal scenarios. This appears to be at odds with previous work showing the absence of transfer effects from temporal primes to spatial targets (Boroditsky, 2000). In Spanish, however, patterns of language use are such that the metaphorical expression *adelantar* is more often used to describe events moving across the timeline towards the ego, while *mover hacia adelante* is more frequently used to describe the ego moving along the timeline. Thus, the use of these linguistic forms might contribute significantly to the activation of temporal ego-moving and time-moving schemas when participants are prompt to think about time.

But, what exactly is causing the effect? One possibility is that temporal representations *per se* activate schemas strong enough to constrain spatial interpretations. Another possibility is that the salience of the linguistic metaphor in the temporal primes contributes significantly to the effect. To shed light on this matter, we asked whether the results of Experiment 2 would replicate if temporal primes contained no metaphorical expressions as part of their wording. Experiment 3 was designed to address this question.

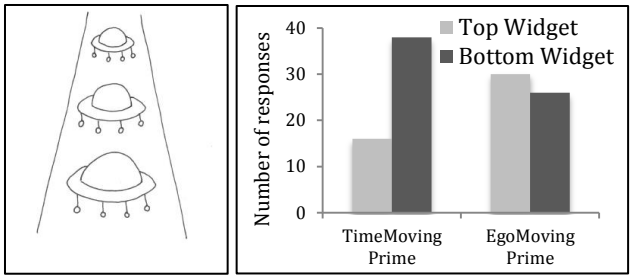

Figure 2: Ambiguous spatial target (left panel) and results from Experiment 2 (right panel).

Experiment 3

Experiment 3 was identical to Experiment 2 except for the wording of the temporal statements used as primes. The aim of this study was to explore whether the results of Experiment 2 do replicate when priming materials contain no conventionalized metaphorical expressions.

Method

Participants A hundred and seventy six undergraduate students from the Universidad de Los Andes and Universidad Nacional de Colombia, all native Spanish speakers, completed voluntarily a two-page questionnaire.

Materials and Procedure Two types of questionnaires were created and counterbalanced across subjects. Similar to Experiment 2, questionnaires corresponded either to the ego-moving prime condition or the time-moving prime condition. The first page of the questionnaire included the temporal prime consisting of a set of four temporal statements describing temporal scenarios, each followed by a comprehension question. Unlike Experiment 2, the temporal statements included no conventionalized metaphorical expressions. The following is an example:

Ego-moving/time-moving *schema prime conditions:*

> La reunión del próximo miércoles ha sido *reprogramada* de modo que será el [**viernes**/lunes] de la misma semana. [Tr. Next Wednesday´s meeting has been *rescheduled* so it will take place on **Friday**/Monday on the same week.]

The additional three statements were the same as in Experiment 2, but differed in that the expressions *adelantar* and *mover hacia adelante* were replaced by the verb *reprogramar* (reschedule) in both the ego-moving and time-moving prime conditions, as in the example above. All statements were followed by the same comprehension questions as in Experiment 2. The procedure as well as the spatial target shown in the second page of the survey was the same as in Experiment 2.

Results and Discussion

Five atypical responses were excluded from the analysis, leaving a final sample of 171 responses, 85 in the time-moving prime condition and 86 in the ego-moving prime condition. Among participants exposed to the time-moving prime condition, 46 (54%) said that the bottom widget was ahead, while 39 (46%) chose the one on top. Similarly, among participants in the ego-moving prime condition, 44 (51%) said the bottom widget was ahead and 42 (49%) said the top widget was ahead. A chi-square analysis showed no significant difference across conditions (χ^2 (2, N=171); p >.8; *ns*.), suggesting that, thinking about temporal schemas alone might not be enough to constrain the interpretation of spatial ambiguities.

These findings suggest that transfer from temporal primes – containing no metaphorical expressions – to spatial targets fails to occur. This is consistent with previous work showing similar priming asymmetries (Boroditsky, 2000) and supports the notion that the concept of time might be parasitic on spatial representations (e.g., Casasanto, 2010).

Rather, the results of Experiment 3 suggest that the time-to-space transfer effect observed in Experiment 2 depends, at least in part, on the salience of the metaphorical expressions included in the temporal primes. In other words, specific linguistic instantiations of the TIME IS SPACE conceptual metaphor may constrain the interpretation of the spatial ambiguities. Is this just a red herring? A closer look to Experiment 2 suggests that there is more to it. Granted, the salience of the expressions *adelantar* and *mover hacia adelante* in temporal primes may be a key constraint to how people solve the spatial task. However, notice that these expressions provide no explicit linguistic information about the competing spatial perspectives (ego-moving vs. time-moving schemas). In fact, these two expressions are synonymous according to standard dictionaries. What seems to be occurring is that alternative spatial motion schemas become differentially activated as a consequence of the conventionalized use of the surface constituents of the linguistic metaphor.

Along these lines, beyond providing additional evidence of the psychological reality of conceptual metaphorical transfer effects, the main contribution of this work is to show that the patterns of use of linguistic expressions constrain the ways in which we draw on competing spatial perspectives when thinking about time and space. More generally, the results align with usage-based approaches (e.g., Langacker, 2000) according to which the patterns of language use and repetition shape the way we construct and represent our cognitive representations.

Conclusion

Although the same metaphor –the same mapping between source (space) and target (time) domains– may exist in many languages, the corresponding linguistic expressions of the metaphor may not be identical. The mental (nonlinguistic) metaphors underlying the space-time mapping is asymmetrically construed: representation of time might be parasitic on spatial schemas grounded on perceptual experience. However, the conventionalized use of linguistic forms constrains the kind of schemas that we naturally draw upon when thinking about time and space, suggesting that language use plays a key role on shaping the ways in which our conceptual metaphors operate. Finally, the results discussed in this paper shed light into the Whorfian question, expanding our understanding of how language is related to thought.

Acknowledgments

This work was funded by Vicedecanatura de Investigaciones, Univ. de Los Andes, Bogotá, Colombia.

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