Human Cognitive Processing (HCP)

Human Cognitive Processing is a bookseries presenting interdisciplinary research on the cognitive structure and processing of language and its anchoring in the human cognitive or mental systems.

Volume 24

New Directions in Cognitive Linguistics
Edited by Vyvyan Evans and Stéphanie Pourcel

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John Benjamins Publishing Company
Amsterdam / Philadelphia

Library of Congress Cataloging-in-Publication Data

New directions in cognitive linguistics / edited by Vyvyan Evans, Stéphanie Pourcel.
p. cm. (Human Cognitive Processing, ISSN 1387-6724 ; v. 24)
Includes bibliographical references and index.
1. Cognitive grammar. 2. Linguistics. I. Evans, Vyvyan. II. Pourcel, Stéphanie.
P165.N48 2009
415--dc22 2009010214
ISBN 978 90 272 2378 4 (HB; alk. paper)
ISBN 978 90 272 8944 5 (EB)

John Benjamins Publishing Co. · P.O. Box 36224 · 1020 ME Amsterdam · The Netherlands
John Benjamins North America · P.O. Box 27519 · Philadelphia PA 19118-0519 · USA

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Sperber, D. & Wilson, D. 1995. *Relevance: Communication and Cognition.* Oxford: Blackwell.
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van Peer, W. & Hakemulder, J. 2006. Foregrounding. In *The Pergamon Encyclopaedia of Language and Linguistics*, K. Brown (ed.), 546–551. Oxford: Elsevier.
Walker, M., Joshi, A. K. & Prince, E. F. 1998. *Centering Theory in Discourse*. Oxford: Oxford University Press.

When is a linguistic metaphor a conceptual metaphor?

Daniel Casasanto

1. Introduction

> In short, the locus of metaphor is not in language at all, but in the way we conceptualize one mental domain in terms of another. (Lakoff 1993: 203)

The central claim of Conceptual Metaphor Theory is that people *conceptualize* many abstract domains metaphorically, in terms of domains of knowledge that are relatively concrete or well-understood (Lakoff 1993; Lakoff and Johnson 1980, 1999).[1] George Lakoff (1993: 244) writes that "metaphor is fundamentally conceptual, not linguistic, in nature." Yet, the overwhelming majority of evidence for conceptual metaphor *is* linguistic in nature. The linguistic data that can be marshaled in support of metaphor theory are compelling and varied. They include analyses of the systematicity of source domain – target domain relations (e.g. H. Clark 1973; Lakoff and Johnson 1980, 1999), patterns of semantic change throughout history (Lafargue 1898/1906; Sweetser 1991), patterns of child language acquisition (Bowerman 1994; Johnson 1999), computational modeling of abstract word meanings (Narayanan 1997), and experimental data on language processing (e.g. Boroditsky 2000, 2001; Gibbs 1994; Glenberg and Kaschak, 2002). But are linguistic data enough?

There are both *in principle* and *in practice* reasons why we cannot infer the structure and content of non-linguistic mental representations based solely on linguistic and psycholinguistic data. In principle, if Conceptual Metaphor is a theory of mental representation (and not just of language), then it must be true that people structure their abstract concepts metaphorically even when they're not using language. Yet, this claim is impossible to test with methods that require people to process abstract concepts *in language*. It is plausible that the mental representations people form when they are using language are importantly different from the mental representations they form when they are

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[1] Throughout this chapter, Conceptual Metaphor Theory will be used to refer to Lakoff and Johnson's proposal, as well as related theories. This generalization obscures some theoretical differences among proposals by different researchers, and even differences between Lakoff and Johnson's CMT circa 1980 and circa 1999. However, the present discussion should be equally relevant for all theories that attempt to predict the structure of abstract concepts based on patterns in metaphorical language.

perceiving, remembering, and acting on the world without using language (E. Clark 2003; Slobin 1987). Linguistic tests alone cannot evaluate this possibility. In practice, while some non-linguistic experimental results have validated Conceptual Metaphor Theory, others have challenged it. This chapter will briefly review experiments testing our understanding of the abstract domain of *time*, and then present three experiments exploring the metaphorical basis of *similarity*. In keeping with the 'new directions' theme of this volume, this chapter will illustrate how tools developed by psychologists can be used to test cognitive linguistic theories, and how experimental results can suggest novel conceptualizations of long-studied domains.

2. Time is our fruit fly

Time has become for the metaphor theorist what the fruit fly is for the geneticist: the model system of choice for linguistic and psychological tests of relationships between metaphorical source and target domains. Linguistic analyses evince intricate systems of conceptual projections from the source domains of *space* and *motion* to the domain of time (e.g. Alverson 1994; H. Clark 1973; Evans 2004; Grady 1997; Lakoff and Johnson 1980, 1999), some of which have been validated in psycholinguistic experiments (e.g. Boroditsky 2000, 2001; Torralbo, Santiago, and Lupiáñez 2006), gesture experiments (Casasanto 2008a; Núñez and Sweetser 2006), and low-level psychophysical tests (Casasanto 2008b; Casasanto and Boroditsky 2008). The latter experiments were designed expressly to address the *in principle* limitation of language-based studies, described above.

2.1 Spatializing time in language and thought

Our approach was to test whether the same asymmetric relationship between space and time found in linguistic metaphors is also found in people's non-linguistic mental representations of time. People tend to talk about time in terms of space (e.g. a *long* vacation, a *short* engagement) more than they talk about space in terms of time (Lakoff and Johnson 1980). Do people also *think* about time in terms of space – more than the other way around – even when they're not using language? To find out, Lera Boroditsky and I conducted a series of experiments in which people watched simple, nonverbal stimuli (e.g. a line 'growing' across the computer screen), and clicked the mouse to reproduce either the duration of the stimulus (i.e. how much time the line remained on the screen) or its spatial displacement (i.e. the distance of the line from end to end). Results showed the predicted space–time asymmetry. Participants could ignore a line's duration when estimating its spatial distance, but they could not ignore distance when estimating duration. Lines that traveled a shorter distance were judged to take a shorter time, and lines that traveled a longer distance were judged to take a longer time – even though, in reality, all lines had the same average duration, regardless of the distance they traveled. Even when participants were warned which dimension of the stimulus they should pay attention to, they couldn't help incorporating irrelevant spatial information into their temporal judgments (but not vice versa). These experiments showed that the asymmetric relationship between space and time found in linguistic metaphors is also found in our more basic non-linguistic representations of distance and duration (Casasanto 2008b; Casasanto and Boroditsky 2008).

Subsequent experiments showed that relationships between non-linguistic representations of time and space are highly specific, and can be predicted based on particulars of a speaker's first language. Whereas English tends to use metaphors that liken time to spatial distance (e.g. 'a *long* time', like 'a *long* road'), other languages like Greek favor metaphors that liken time to an *amount of a substance* accumulating in three-dimensional space (e.g. *POLI ORA*, tr. 'much time', like 'much water').

English and Greek speakers performed a pair of psychophysical tasks to test how deeply linguistic metaphors might influence non-linguistic thought. The first task required them to estimate the duration of a growing line while ignoring its spatial length, as above (i.e. the *distance interference* task). The second task required them to estimate the duration of a container gradually filling up with liquid while ignoring its fullness (i.e. the *amount interference* task). English and Greek speakers showed strikingly different patterns of results. English speakers' duration judgments were strongly affected by line length, but only weakly affected by container fullness. Greek speakers showed the opposite pattern, as we predicted based on the relative strengths of the TIME IS DISTANCE and TIME IS AMOUNT metaphors in English and Greek. Training experiments showed that teaching English speakers to use amount metaphors for time in the laboratory caused them to perform the filling container task indistinguishably from Greek speakers.

These experiments suggest that linguistic metaphors not only reflect the structure of speakers' non-linguistic duration representations, they can also shape those representations (Casasanto 2008b). More importantly for the current discussion, they validate both the psychological reality of Conceptual Metaphor Theory and the *specificity* of the predictions it can make. We don't just think about time in terms of space, we think about time using exactly the type of spatial representations (i.e. linear or three-dimensional) that our linguistic metaphors imply. (See Boroditsky 2001; H. Clark 1973; Núñez and Sweetser 2006; Torralbo, Santiago and Lupiáñez 2006; and Tversky, Kugelmass and Winter 1991 for further evidence of the specificity of spatial schemas for time.)

Yet, despite such evidence supporting Conceptual Metaphor Theory, other tests have yielded conflicting results, even in the domain of time. Evans (2004) presents a catalog of discrepancies between the facts of English metaphors and the predictions that emerge from a recent, well-reasoned incarnation of metaphor theory, Grady's (1997) theory of Primary Metaphor. Evans points out that based on common English expressions like *we're coming up on the deadline*, the most natural inference is that English speakers mentally represent time in terms of upward motion on a vertical spatial axis. Yet, several lines of evidence (including Evans's informal survey of native speakers' intuitions about such statements) indicate that English speakers mentally represent events as if they follow one another along a horizontal spatial axis (Boroditsky 2000, 2001; H. Clark 1973; Núñez and Sweetser 2006; Torralbo, Santiago and Lupiáñez 2006; Tversky, Kugelmass and Winter 1991). It may be possible to address this particular concern of Evans's, in part, by pointing to analogous spatial expressions like *we're coming up to the front of the* *queue* or *pull the car up to the curb* in which 'up' implies horizontal motion: this idiomatic horizontal use of 'up' occurs in the spatial domain as well as the temporal. As such, *coming up on the deadline* may arguably import a horizontal spatial schema into the domain of time. Still, the point remains that interpreting this spatio-temporal expression at face value would generate misleading predictions about the nature of non-linguistic time representations.

Trouble with time metaphors deepens when we consider other experimental results. Co-speech gestures corresponding to temporal expressions support Conceptual Metaphor Theory in some ways, but challenge it in others. Núñez and Sweetser (2006) interviewed Aymara speakers about how time expressions are used in their language, and then analyzed the gestures speakers produced during these interviews. They found that Aymara speakers often gestured frontward when talking about the past and backward when talking about the future, consistent with the unusual spatial metaphors in their language that suggest the past lies ahead of them and the future behind them. By contrast, I conducted a series of experiments in which English speakers produced spontaneous co-speech gestures when telling stories about past and future events, but these gestures were largely inconsistent with spatio-temporal metaphors in English – and every other known language (Casasanto 2008a). English space-time metaphors place the future in front of the speaker (e.g., *the best years are ahead of us*) and the past behind the speaker, (e.g., *our salad days are behind us*), implying that time flows along the sagittal (front/back) axis. However, when English speaking participants told stories about sequences of events they systematically gestured along the transverse (left/right) axis, placing the past to the left and the future to the right (see also Calbris 1990; Cienki 1998; Núñez and Sweetser 2006). This was true whether they used spatial language explicitly (e.g., 'a century before') or expressed the same ideas using non-spatial language (e.g., 'a century earlier'). These results are broadly consistent with the claim from Conceptual Metaphor Theory that English speakers mentally represent time in terms of horizontal space. Yet, they are inexplicable on a stricts version of this theory given that left-right spatio-temporal metaphors are entirely absent from English speech. Cultural conventions such as reading, writing, and calendars that represent time as flowing from left to right point toward a partial explanation of this behavior (Tversky, Kugelmass and Winter 1991), but there is no obvious way to predict – or even account for – the left-right spatialization of time based on patterns in metaphorical language.

These spontaneous gesture data (Casasanto 2008a) not only raise questions about the relationship between linguistic metaphors and conceptual metaphors, they also challenge many English speakers' intuitions about the way they gesture, and suggest a dissociation between people's conscious and unconscious spatializations of time. When I asked English speakers informally to show how they typically gesture to indicate pastward and futureward events, they often gestured on the sagittal axis – placing the future in front of them and the past behind them, consistent with front-back metaphors in English. This was true for naïve informants and metaphor theorists, alike. Yet, these deliberate, conscious gestures (or gesture demonstrations) differ strikingly from the spontaneous gestures that experimental participants produced when they were not talking explicitly about the concept of time. Speakers' conscious reflections on how they use space to represent time appear to be colored by the verbal metaphors at their disposal, but their unconscious representations of time reveal other non-linguistic sociocultural influences, as well. Understanding how space structures our mental representations of time will require integrating linguistic analyses and non-linguistic experimental results.

2.2 Time and speed

Speed also serves as a source domain for time in language, and provides another testbed for exploring the relationship between linguistic and conceptual metaphors. QUICKNESS acts as a metaphorical vehicle in utterances expressing either BREVITY (1a) or CONTRACTED DURATION (1b).

(1) a. We'll take a quick vacation.
(QUICKNESS = BREVITY)
b. Our vacation went by quickly.
(QUICKNESS = CONTRACTED DURATION)

In the first example, the speaker comments on the duration of the vacation, per se, whereas in the second example the speaker comments that the duration felt contracted relative to expectation (whether or not the vacation was, in fact, brief). In both of these cases, speed is inversely related to duration, consistent with the relationship between velocity and time in Newtonian kinematics:

$$\text{Time} = \frac{\text{Distance}}{\text{Velocity}}$$

In this formula, time and distance are positively correlated, as suggested by metaphorical expressions like *a long party* and *a short concert*. The 'growing line' experiments reviewed above demonstrate that this positive correlation between distance and time exists in people's non-linguistic mental representations as well. Just as time and velocity are negatively correlated in this kinematic formula, time and speed (the scalar analog of velocity) appear negatively correlated in linguistic metaphors such as (1a) and (1b). Are time and speed also negatively correlated in people's non-linguistic mental representations?

Piaget's inquiries into children's understanding of time provide a surprising answer. Distance metaphors for time are similar in French and English (e.g. *depuis longtemps* means 'for a long time'). Consistent with these metaphors, Piaget found that French-speaking children often based their judgments of duration on their experience of distance. For example, when asked to judge the relative duration of two trains traveling along parallel tracks at different speeds, children often reported (erroneously) that the train traveling the longer distance took the longer time. Quickness metaphors for time also function similarly in French and English (e.g. *des vacances rapides* means 'a quick vacation' or 'a brief vacation'). Contrary to these metaphors, however, Piaget found that children often reported the train traveling at the *faster* speed took the longer time (Piaget 1927/1969; see also Mori, Kitagawa and Tadang 1974). Children believed that both distance and speed were positively correlated with time. Piaget concluded that time, space, and speed remain conflated in children's mental representations of motion events until about age nine, but that after this age they construct the logical relationships among these dimensions suggested by Newtonian kinematics (and by linguistic metaphors).

Experiments by Casasanto and Boroditsky suggest the conflation of time, space, and speed in children's minds may be more enduring than Piaget realized. Adult English speakers from the MIT community performed a version of the growing line task that allowed the influences of distance and speed on time estimates to be evaluated independently. Our results were remarkably consistent with Piaget's. As in our previous studies, we found a positive relationship between distance and time: participants judged lines that traveled a shorter distance to take a shorter time, and lines that traveled a longer distance to take a longer time (even though, on average, all lines took the same amount of time, regardless of their spatial length). Surprisingly, we also found a positive relationship between speed and time: participants judged lines that traveled *slower* to take *less time*, and lines that traveled *faster* to take *more time* (even though, on average, all lines took the same amount of time, regardless of their speed). The effect of speed on time estimation was just as strong as the effect of distance on time estimation. This positive relationship between speed and time remained significant even when the influence of distance was removed mathematically, by partial correlation. This outcome was unexpected in light of the highly specific patterns of cross-dimensional interference observed in the space–time experiments described earlier, which were predicted from metaphors in participants' first languages. Based on these, we can rule out the possibility that participants simply construe more of one dimension in a motion event as more of another, indiscriminately. If that were the case, we would not have found the asymmetric interference between time and space described in the first set of growing line experiments, or the cross-linguistic differences in space–time interference patterns in the growing line/filling container experiments comparing English and Greek speakers.

Why did Piaget's children and our MIT undergraduates reveal mental representations of motion events in which time, speed, and distance were all positively correlated? Piaget, who was an associate of Einstein's, suggested a link between psychological time and the relativity of physical time. Yet, it is hard to imagine our primitive intuitions of time, space, and speed being shaped by something so counterintuitive as Einsteinian relativity. An alternative explanation invokes the intuitive physics of *projectiles*. Newtonian kinematics makes a host of simplifying assumptions that are violated by our everyday interactions with the physical world. Although the equation above shows an inverse relationship between time and (average) velocity, consider the relationship between these dimensions when a projectile is thrown with either greater or lesser force. When we throw a ball hard, it travels a longer distance, at a greater velocity, and for a longer time than when we throw it softly: Distance α Time α Velocity. By throwing and observing projectiles, we may learn that there are, in fact, positive correlations of time, speed, and distance in our everyday experience. These correlations may have given rise (in either evolutionary or developmental time) to the primitive, non-Newtonian understanding of time and speed revealed by Casasanto and Boroditsky's low-level psychophysical experiments and by Piaget's studies. Eventually, perhaps through language use and explicit instruction as well as through physical experience, children learn that under special circumstances time and speed are inversely related (e.g. when distance is held constant, as in many of Piaget's experiments, or in the everyday experience of commuting from home to the office quickly or slowly along a given route).

This proposal, that the physics of projectiles shapes our intuitions of time, space, and speed, is speculative and in need of further investigation. What is important for the present discussion is that psychological tests reveal we have at least two contrasting ways of understanding the relationship between time and speed – only one of which can be predicted based on speed-time metaphors in language. Linguistic metaphors enshrine the more sophisticated inverse relationship between time and speed given by Newtonian kinematics. If our theory of how time is mentally represented were based solely on patterns in metaphorical language, we would never discover the more primitive relationship that governs children's understanding of time and speed, and influences ours as well.

3. Similarity and proximity: When does close in space mean 'close' in mind?

The domain of *similarity* provides another potential testbed for hypotheses about conceptual structure that are derived from linguistic metaphors. How do people judge the similarity of words, objects, or ideas? Despite concerns about its usefulness as a construct (Goodman 1972), similarity remains the focus of much psychological research, perhaps because our sense of similarity seems intimately linked with our capacity to generalize, to form categories, and to individuate concepts (Medin, Goldstone and Gentner 1993). In English (and many other languages), when speakers talk about similarity they often use words and expressions that describe spatial relations. Things that are similar along nearly any dimension can be described as *close*, and things that are dissimilar as *far*. For example:

(2) a. These two shades of blue aren't identical, but they're *close*.
b. The opposing candidates' stances on the issue couldn't be *farther apart*.

Is it possible that the way people talk about similarity reveals something fundamental about the way they conceptualize it? Our notion of similarity is abstract, like our ideas of *justice*, *love*, or *time* insomuch as it is (a) vaguely and variably defined, (b) highly context dependent, and (c) mentalistic: lacking a concrete referent in the physical world that can be perceived through the senses. The experiments reported here tested the hypothesis that our notion of similarity depends, in part, on mental representations of physical distance (Casasanto 2008c). In three experiments, participants rated the similarity of pairs of words or pictures, which were presented at varying distances on the computer screen (i.e. close, medium, or far apart). A simple prediction was made based on the distance metaphors for similarity that are used in metric psychological models of similarity and in everyday language: if people think about similarity the way they talk about it (i.e. similar things are *close*), then participants should judge stimuli to be more similar when they are presented close together on the screen than when they are presented far apart.

3.1 Experiment 1: Abstract nouns

Experiment 1 tested whether participants would rate pairs of abstract nouns to be more similar in meaning when they appeared closer together on the screen. Abstract nouns (e.g. *Grief, Justice, Hope*) were chosen as stimuli for this first test of the relationship between similarity and proximity because the predicted influence of space on similarity may be most evident for similarity judgments about abstract entities that cannot be perceived directly through the senses.

3.1.1 *Methods*

3.1.1.1 *Participants.* 27 native English speaking participants from the Stanford University community performed this experiment, in exchange for payment.

3.1.1.2 *Materials.* 72 abstract nouns (concreteness rating < 400) between 4 and 10 letters long were selected from the MRC Psycholinguistic Database. Nouns were randomly combined into 36 pairs (e.g. *Grief-Justice, Memory-Hope, Sympathy-Loyalty*). Words were presented on an iMac monitor (724 x 768 pixels resolution, 72 dpi) in 14 point courier font.

3.1.1.3 *Procedure.* Participants viewed word pairs in randomized order, one word at a time, and rated their similarity in meaning on a scale of 1 (not at all similar) to 9 (very similar). Before the first word appeared, a pair of empty 'picture frames' (150 pixels wide, 50 pixels high) appeared on the vertical midline of the screen for 500 ms. The centers of the frames were separated horizontally by 150 pixels in the Close condition, 300 pixels in the Medium condition, and 450 pixels in the Far condition. Pairs of Close, Medium, and Far picture frames appeared in one of four positions on the far left, middle left, middle right, or far right of the screen. This variation in position was orthogonal to the variation in distance between words, and was intended to reduce demand characteristics of the task. After 500 ms, the first word in each pair appeared for 2000 ms in the leftmost picture frame, then disappeared. After a 500 ms inter-stimulus interval, the second word of the pair appeared in the rightmost picture frame for 2000 ms. The words of each pair were presented serially rather than simultaneously to rule out low-level explanations for any observed differences in similarity ratings across conditions due to differences in saccadic activity or sharing of visual attention. Participants saw each word pair once, and the assignment of word pairs to conditions was counterbalanced across subjects.

3.1.2 *Results and discussion*

Results of Experiment 1 showed that stimuli were judged to be more similar when they were presented closer together than when they were farther apart (Fig. 1). Z-scored similarity ratings were compared using one-way ANOVA. Ratings differed significantly across conditions, both by subjects (F1(2,52) = 3.45, $p < .04$) and by items (F2(2,105) = 4.49, $p < .02$). A one-tailed paired-samples t-test showed a difference between Close and Far trials when analyzed by subjects (difference = 0.28, t(26) = 2.22, $p < .02$). A one-tailed independent-samples t-test confirmed this difference between Close and Far trials when analyzed by items (difference = 0.24, t(36) = 2.74, $p < .004$).

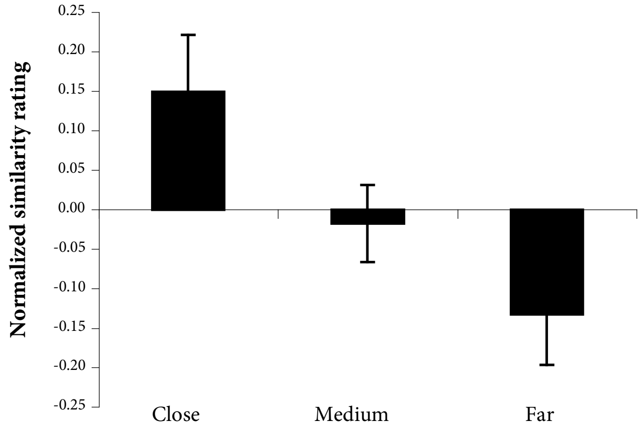

Figure 1. Similarity ratings for pairs of abstract nouns varied significantly as a function of their spatial separation on the screen. Pairs were judged to be more similar when they were presented closer together on the screen, consistent with predictions based on Conceptual Metaphor Theory. Error bars indicate s.e.m.

The finding that stimuli were rated more similar when presented closer together is consistent with predictions based on Conceptual Metaphor Theory. One concern in interpreting these results was that some of the word pairs were judged to have very low similarity in all conditions, and that the influence of proximity may have been restricted to these pairs for which word meanings were difficult to compare. However, when data were mean-split, the same qualitative relation between similarity and proximity was found for high-similarity and low-similarity pairs, analyzed separately.

3.2 Experiment 2: Unfamiliar faces

Experiment 2 tested whether the results of Experiment 1 would generalize to a different type of stimulus for which similarity had to be computed along different dimensions. To judge the similarity of the abstract nouns pairs, participants had to retrieve word meanings from memory, and to reason about unseen properties of abstract entities. Because the appearance of words is arbitrarily related to their meaning, the visual stimuli themselves provided little information (if any) that was relevant to the similarity judgment. Would distance still influence similarity judgments as in Experiment 1 even if more of the relevant information were given perceptually, in the visual stimuli themselves? According to Conceptual Metaphor Theory, it should.

Although 'concrete' entities that can be perceived directly are *not* posited to be structured metaphorically (Lakoff and Johnson 1999), people use the SIMILARITY IS PROXIMITY metaphor to describe similarity between both abstract and concrete things, alike: just as two abstract words can be said to be *close in meaning*, two lines can be *close in* *length*, two paint chips can be *close in color,* two shirts can be *close in size*, and two faces can be *close in appearance.* The relationship between similarity and proximity in linguistic metaphors generalizes broadly (so broadly, in fact, that it is difficult to imagine a case in which similarity cannot be described in terms of distance). The same metaphor can describe similarity along both conceptual and perceptual dimensions. Therefore, if people conceptualize similarity the way they talk about it, the same prediction about the relation between similarity and proximity should hold for both conceptual judgments about abstract entities and perceptual judgments about concrete entities.

For Experiment 2, participants judged the similarity of pairs of unfamiliar faces. Whereas participants in Experiment 1 were instructed to judge similarity of abstract words based on their *meanings*, participants in Experiment 2 were instructed to judge similarity of faces based on their *visual appearance*.

3.2.1 *Methods*

3.2.1.1 *Participants.* 33 native English speaking participants from the MIT community performed this experiment, in exchange for payment.

3.2.1.2 *Materials and procedure.* 60 pairs of unfamiliar faces were constructed from a database of University of Pennsylvania ID card photos. Half were male-male and half were female-female pairs. Faces pairs were presented exactly as word pairs were presented in Experiment 1, with the following exception: the height of the 'picture frames' was changed to accommodate the size of the photos (150 pixels wide by 200 pixels high).

3.2.2 *Results and discussion*

Results of Experiment 2 showed that stimuli were judged to be more similar when they were presented *farther apart* than when they were presented closer together (Fig. 2). Z-scored similarity ratings were compared using one-way ANOVA. Ratings differed significantly across conditions, both by subjects (F1(2,64) = 3.61, p < .04) and by items (F2(2,177) = 3.29, p < .04). A two-tailed paired-samples t-test showed a difference between Close and Far trials when analyzed by subjects (difference = 0.16, t(32) = 2.90, p < .007). A two-tailed independent-samples t-test confirmed this difference between Close and Far trials when analyzed by items (difference = 0.12, t(118) = 2.45, p < .02).

Whereas in Experiment 1 closer stimuli were judged to be more similar, in Experiment 2 closer stimuli were judged to be *less* similar. Thus, Experiment 2 results not only fail to show an influence of proximity on similarity in the direction that was predicted based on Conceptual Metaphor Theory (i.e. closer = more similar), they also show a highly significant effect of proximity on similarity judgments in the opposite direction.

3.3 Experiment 3: Object pictures

Why did proximity have opposite effects on similarity ratings for abstract nouns and unfamiliar faces? Experiments 1 and 2 differed both in the kind of stimulus participants judged (i.e. verbal vs. pictorial) and in the kind of judgments they made (i.e. 'conceptual' judgments based on meaning vs. 'perceptual' judgments based on visual appearance). Experiment 3 evaluated whether the results of Experiments 1 and 2 differed because of the type of stimulus or the type of judgment.

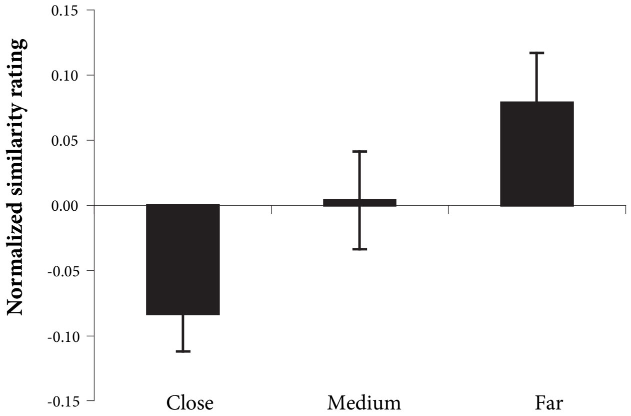

Figure 2. Similarity ratings for pairs of faces varied significantly as a function of their spatial separation on the screen. Pairs were judged to be less similar when they were presented closer together on the screen, contrary to predictions based on Conceptual Metaphor Theory. Error bars indicate s.e.m.

For Experiment 3, different judgments were made on the same set of stimulus pictures, which depicted common objects. Half of the participants were instructed to judge their similarity in visual appearance (a perceptual judgment), and the other half to judge their similarity in function or use (a conceptual judgment). If the difference between the results of Experiments 1 and 2 was due to a difference in the type of experimental materials used, then results of both Experiments 3a and 3b should resemble those of Experiment 2, in which pictorial stimuli were used: closer stimuli should be judged to be less similar, regardless of the type of judgment participants made. By contrast, if the difference between results of the first two experiments was due to participants judging abstract, unseen properties of the stimuli in Experiment 1 but judging concrete, perceptible properties of the stimuli in Experiment 2, then results of Experiment 3a (conceptual judgment) should be similar to those of Experiment 1 (i.e. closer stimuli should be judged more similar), whereas results of Experiment 3b (perceptual judgment) should be similar to those of Experiment 2 (i.e. closer stimuli should be judged less similar).

3.3.1 *Methods*

3.3.1.1 *Participants.* 40 participants performed Experiment 3a and an additional 40 performed Experiment 3b, in exchange for payment. All were native English speakers from the MIT community.

3.3.1.2 *Materials and procedure.* 30 pairs of objects were constructed from the Snodgrass and van der Wart line drawings. Objects were paired only within semantic categories (e.g. tools, clothing, furniture) to facilitate meaningful comparisons. Object pairs were presented as in previous experiments, with the following exception: stimuli appeared at one of two distances on the screen (instead of three), to maximize the difference between the Close condition, in which the centers of pictures were separated by 150 pixels, and the Far condition in which the centers of pictures were separated by 600 pixels.

3.3.2 *Results and discussion*

Results showed that during conceptual judgments (Experiment 3a), closer stimuli were judged to be more similar (Fig. 3, left). By contrast, during perceptual judgments (Experiment 3b), closer stimuli were judged to be less similar (Fig. 3, right). Similarity ratings were z-scored, and a mixed ANOVA with Distance (Close, Far) as a within-subjects factor and Judgment Type (Perceptual, Conceptual) as a between-subjects factor showed a significant 2-way interaction by subjects, ($F1(1,78) = 12.23$, $p < 0.001$) with no main effects. This significant interaction was confirmed in 2-way ANOVA by items, with Distance (Close, Far) and Judgment Type (Perceptual, Conceptual) as between-subjects factors ($F2(1,116) = 12.12$, $p < 0.001$), with no main effects.

Planned pair-wise comparisons tested the difference between Close and Far trials in Experiments 3a and 3b, by subjects and by items. Two-tailed paired samples t-tests showed that Close trials were rated significantly more similar than Far trials during conceptual judgments (Experiment 3a: difference = .10, $t(39) = 2.59$, $p < .02$ uncorrected, $p = .03$ after Bonferroni correction), whereas Close trials were rated significantly less similar than Far trials during perceptual judgments (Experiment 3b: difference = .09, $t(39) = 2.46$, $p < .02$ uncorrected, $p = .04$ after Bonferroni correction) when analyzed by subjects. Two-tailed independent-samples t-tests confirmed that this same pattern was found when data were analyzed by items: Close trials were rated significantly more similar than Far trials during conceptual judgments (Experiment 3a: difference = .10, $t(58) = 2.35$, $p < .03$ uncorrected, $p = .04$ after Bonferroni correction), whereas Close trials were rated significantly less similar than Far trials during perceptual judgments (Experiment 3b: difference = .10, $t(58) = 2.56$, $p < .02$ uncorrected, $p = .03$ after Bonferroni correction).

An additional meta-analysis was performed, comparing the effect of distance on similarity ratings for Close vs. Far trials across Experiments 1, 2, 3a, and 3b. The effect of proximity on similarity judgments for each experiment was defined as the difference between participants' mean similarity ratings in the Close and Far conditions [Effect of Proximity on Similarity = (mean of normalized similarity ratings in Close condition) – (mean of normalized similarity ratings in Far condition)], and was compared across all experiments using one-way ANOVA ($F(3,136) = 8.81$, $p < 0.0001$; Fig. 4). Two-tailed pair-wise independent-samples t-tests showed significant differences between the effects of proximity on similarity ratings for Abstract Nouns vs. Perceptual Object Judgments (difference = .37, $t(56) = 3.28$, $p < .002$ uncorrected, $p=.01$ after Bonferroni correction), Abstract Nouns vs. Faces (difference = .44, $t(58) = 3.41$, $p < .001$ uncorrected, $p = .006$ after Bonferroni correction), Perceptual Object Judgments vs. Conceptual Object Judgments (difference = .19, $t(78) = 3.57$, $p < .001$ uncorrected, $p = .006$ after Bonferroni correction), and for Conceptual Object Judgments vs. Faces (difference = .26, $t(71) = 3.98$, $p < .0001$ uncorrected, $p = .0006$ after Bonferroni correction). Importantly, no differences were found between

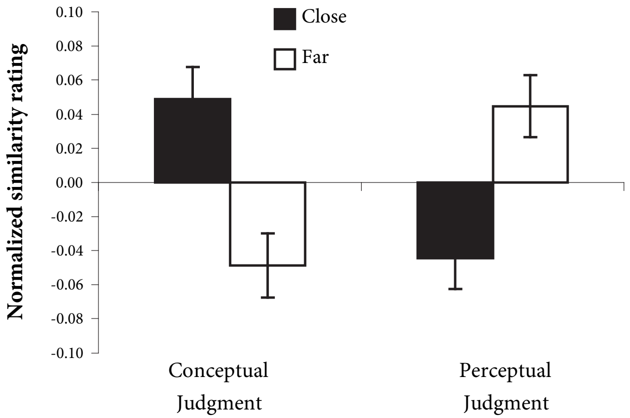

Figure 3. Results of Experiment 3a (left) and 3b (right). Similarity ratings for pairs of object pictures varied significantly as a function of their spatial separation on the screen. For the same set of stimuli, the relation between similarity and proximity was consistent with predictions based on Conceptual Metaphor Theory during Conceptual Judgments (Experiment 3a), but inconsistent during Perceptual Judgments (Experiment 3b). Error bars indicate s.e.m.

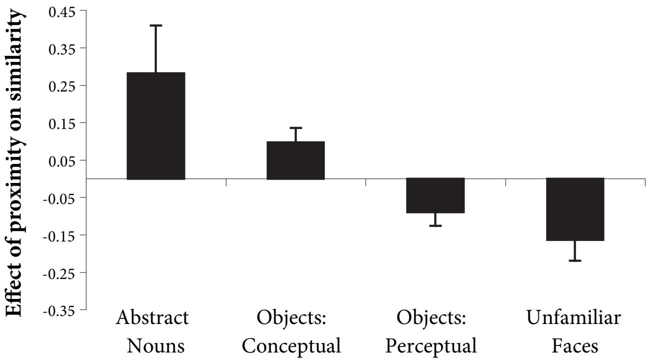

Figure 4. Comparison of the effect of proximity on similarity ratings across experiments. Error bars indicate s.e.m. Closer stimuli were rated more similar during conceptual judgments (Experiments 1 and 3a, left columns) but less similar during perceptual judgments (Experiments 3b and 2, right columns).

the effects of proximity on similarity ratings for Abstract Nouns vs. Conceptual Object Judgments (difference = .18, t(65) = 1.62, ns) or for Perceptual Object Judgments vs. Faces (difference = .07, t(71) = 1.14, ns).

In summary, this meta-analysis shows that all pair-wise comparisons *between* judgment types (conceptual vs. perceptual) yielded highly significant differences, whereas pair-wise comparisons *within* judgment types yielded no significant differences: results of the two experiments requiring conceptual judgments differed from the results of the two experiments requiring perceptual judgments. By contrast, the results of the two conceptual judgment experiments did not differ from one another, and the results of the two perceptual judgment experiments did not differ from one another.

Together, the results of Experiment 3 and of the meta-analysis suggest that the contrasting effects of proximity on similarity judgments found for Experiments 1 and 2 were not due to superficial differences between the verbal and pictorial stimuli. Rather, the effect of proximity on similarity depends on the kind of judgment participants make: conceptual judgments about abstract entities or unseen object properties vs. perceptual judgments about visible stimulus properties.

3.4 General discussion of Experiments 1–3

Experiments 1–3 tested whether similarity ratings for words and pictures vary as a function of how far apart stimuli appear on a computer screen. Results showed that physical proximity influenced similarity judgments significantly in all experiments, but the direction of influence varied according to the type of judgment participants made. Closer stimuli were rated more similar during ‘conceptual’ judgments of abstract entities or unseen object properties (Experiments 1 and 3a), whereas closer stimuli were rated less similar during ‘perceptual’ judgments of the visual appearance of faces and objects (Experiments 2 and 3b). Conceptual judgments followed the simplest prediction based on the SIMILARITY IS PROXIMITY metaphor (Lakoff and Johnson 1999): when stimuli appeared closer in physical space they were judged to be ‘closer’ in participants’ mental similarity space, as well. Perceptual judgments showed the opposite pattern, however, contrary to predictions based on linguistic metaphors for similarity.

Can these results be accommodated within a Conceptual Metaphor framework? The outcome of Experiments 1–3 is broadly consistent with the claim that abstract entities are mentally represented metaphorically, whereas concrete entities that can be perceived directly are represented non-metaphorically, on their own terms (Lakoff and Johnson 1980, 1999). Still, Conceptual Metaphor Theory is hard-pressed to account for the difference between the effects of space on perceptual vs. conceptual judgments, given that the same spatial metaphors for similarity can be used to describe both low-level perceptual properties and high-level conceptual properties: similarities in appearance, function, or meaning can all be described using words like *close* and *far*. Thus, linguistic metaphors suggest that the same conceptual metaphor underlies our notions of both perceptual and conceptual similarity (see examples (2a) and (2b), above). Although Experiments 1 and 3a supported the metaphor-based prediction that stimuli presented closer in space would be judged to be more similar, Experiments 2 and 3b showed the opposite pattern of results. Overall these studies pose a challenge to Conceptual Metaphor Theory, and suggest that we cannot necessarily infer relationships between similarity and proximity in people’s non-linguistic mental representations from patterns in metaphorical language.

Previous studies have also reported positive associations between proximity and *conceptual* similarity for both abstract and relatively concrete entities. Sweetser (1998) observed that speakers sometimes bring their hands closer together in space to indicate the similarity of abstract ideas via spontaneous co-speech gestures. Goldstone (1994) asked participants to arrange various tokens of the letter “A” on the computer screen such that more similar tokens were positioned closer in space. Although in principle similarity between tokens of the letter “A” could depend on perceptual properties of the stimuli, Goldstone noted that when participants were asked to indicate similarity via spatial proximity they focused on “abstract commonalities” between tokens (1994: 385). Whereas participants’ non-spatial same/different judgments of the “A” stimuli were driven by perceptual similarity, instructing participants to arrange stimuli according to the rule that ‘closer = more similar’ led them to “tap into a level of similarity that is relatively cognitive rather than perceptual” (ibid.). This complex relationship between spatial proximity, conceptual similarity, and perceptual similarity appears to have been unexpected in the Goldstone study, as it was in the present study.

Conceptual Metaphor Theory does not predict the pattern of data reported here, and it is possible that no current theory of similarity predicts it *a priori*. However, considering the computation of similarity to be a rational statistical inference based on regularities in our environment may help to situate the observed pattern of results in an ecological framework (Anderson 1991; Shepard 1987; Tenenbaum and Griffiths 2001). As Gestalt psychologists observed, the world appears to be pervasively clumpy (Wertheimer 1923/1938). Things that belong to the same category tend to be found close together, and also tend to be similar to one another compared with things that belong to different categories. Given that we are continually exposed to such organization, and that recognizing clumpiness may be useful for reasoning about our environment, it seems plausible that people implicitly learn and use a set of relations that could be called The Clumpiness Principle (building on Wertheimer’s principles of proximity and similarity): Proximity α Similarity α Category Membership.

Tenenbaum and Griffiths (2001) proposed a Bayesian model according to which the similarity of two items is computed in terms of the probability that they are members of the same category (i.e. drawn from the same statistical distribution). In their model, the probability that items share category membership is proportional to the likelihood that they do given the information present in the stimuli, per se, and also proportional to the probability that they do given the observer’s prior experience and stored knowledge. If we assume this generalization-based view of similarity, then in the present experiments participants’ estimates of the probability that stimulus items belonged to the same category (and, therefore, of their similarity) depended in part on perceptible information given in the stimulus, and in part on their implicit knowledge of the Clumpiness Principle. In the case of *conceptual* similarity judgments, little relevant perceptual information was available in the stimulus items, so participants’ heuristic use of the Clumpiness Principle was evident: greater proximity was used as an index of more probable shared category membership and of greater similarity. In the case of the *perceptual* similarity judgments, however, participants' estimates of the probability that stimulus items belonged to the same category were likely to depend more strongly on the perceptible information given in the stimuli themselves, which overwhelmed any influence of the Clumpiness Principle.

On this proposal, when perceptible information was available in the stimuli (and was relevant to the task), participants used it. Participants may have judged closer stimuli to be *less* similar in Experiments 2 and 3b because proximity facilitates noticing small differences during perceptual judgments that might go unnoticed for stimuli presented farther apart.[2] By contrast, when perceptual information wasn't available in the stimuli (in Experiment 1) or wasn't relevant to the required judgment (in Experiment 3a), then participants' judgments reflected their heuristic use of the knowledge that proximity correlates with category membership and with similarity.

Thus, it may be possible to account for the contrasting effects of proximity on conceptual and perceptual similarity judgments if the computation of similarity is considered to be a process of rational inference that optimally combines perceptible information at hand with stored knowledge of experiential regularities (Anderson 1991; Shepard 1987; Tenenbaum and Griffiths 2001).

3.5 Summary of similarity and proximity experiments

Three experiments showed that changing the spatial separation between pairs of words or pictures on the computer screen changed the way people rated their similarity. Our notion of similarity appears to depend, in part, on our experience of spatial proximity, but not always as predicted by spatial metaphors in language. When participants made conceptual judgments about abstract entities or unseen object properties, stimuli presented closer together were judged to be more similar than stimuli presented farther apart, consistent with predictions based on linguistic metaphors. By contrast, when participants made perceptual judgments about visible stimulus properties, stimuli presented closer together were judged to be less similar than stimuli presented farther apart, contrary to predictions based on linguistic metaphors. These findings underscore the importance of testing Conceptual Metaphor Theory experimentally, and suggest that it is not possible to infer the relationship between similarity and proximity in people's non-linguistic mental representations based solely on patterns in metaphorical language.

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[2] Since all stimuli were presented serially this explanation requires that proximity still facilitates noticing small differences between stimuli even when members of a pair are never seen simultaneously. Although further research is needed to test this assumption, this seems plausible in light of research showing that the spatial location of visually presented information is automatically indexed in memory and accessed during retrieval, even when the spatial information is task-irrelevant (Richardson and Spivey 2000).

4. Conclusions

The studies reviewed here show both convergence and divergence between predictions based on linguistic metaphors and the results of behavioral experiments. Studies testing the conceptual metaphors TIME IS SPACE, TIME IS SPEED, and SIMILARITY IS PROXIMITY yielded some results that could not be predicted based on metaphors in English (or any known spoken language). Importantly, where these studies failed to support predictions based on linguistic metaphors they did not simply produce null effects. Rather, they provided clear evidence of relationships between source and target domains that were either orthogonal to the relationships encoded in language (in the case of the gesture experiments showing left–right spatialization of time), or directly contradictory to the relationships predicted by patterns in language (in the case of the time-speed experiments by Piaget and by Casasanto and Boroditsky, and also the experiments on perceptual similarity judgments reported here).

The first conclusion these studies support is that relationships between non-linguistic domains of knowledge cannot necessarily be inferred from metaphors in language. Linguistic metaphors reveal only a subset of the conceptual metaphors that appear to structure our mental representations of similarity and time. The second conclusion is that even when linguistic metaphors fail to predict the exact relationships revealed by behavioral tests, they nevertheless point to important links between the source and target domains. Space and time, speed and time, and proximity and similarity are not unrelated: rather, they appear to be related in more complex ways than linguistic analyses alone can discover. As such, linguistic metaphors should be treated as a source of *hypotheses* about the structure of abstract concepts. Evaluating these hypotheses – determining when a linguistic metaphor reflects an underlying conceptual metaphor – requires both linguistic and extra-linguistic methods, and calls for cooperation across disciplines of the cognitive sciences.

Acknowledgements

Thanks to Laura Staum Casasanto, Herb Clark, and Vyvyan Evans for helpful comments. This research was supported in part by an NSF Graduate Research Fellowship, by NRSA post-doctoral fellowship #F32MH072502, and by a grant from the Spanish Ministry of Education and Science #SEJ2006-04732/PSIC, DGI.

References

Alverson, H. 1994. *Semantics and Experience: Universal Metaphors of Time in English, Mandarin, Hindi, and Sesotho*. Baltimore: Johns Hopkins University Press.
Anderson, J. 1991. The adaptive nature of human categorization. *Psychological Review* 98 (3): 409-429.
Boroditsky, L. 2000. Metaphoric structuring: Understanding time through spatial metaphors. *Cognition* 75 (1): 1–28.

Boroditsky, L. 2001. Does language shape thought? Mandarin and English speakers' conceptions of time. *Cognitive Psychology* 43 (1): 1–22.

Bowerman, M. 1994. From universal to language-specific in early grammatical development. *Philosophical Transactions: Biological Sciences* 346 (1315): 37–45.

Calbris, G. 1990. *The Semiotics of French Gestures*. Bloomington: Indiana University Press.

Casasanto, D. 2008a. Conceptual affiliates of metaphorical gestures. Paper presented at *International Conference on Language, Communication, & Cognition*. Brighton, UK.

Casasanto, D. 2008b. Who's afraid of the Big Bad Whorf? Cross-linguistic differences in temporal language and thought. *Language Learning* 58 (177): 63–79.

Casasanto, D. 2008c. Similarity and proximity: When does close in space mean close in mind? *Memory & Cognition* 36 (6): 1047–1056.

Casasanto, D. & Boroditsky, L. 2008. Time in the mind: Using space to think about time. *Cognition* 106: 579–593.

Cienki, A. 1998. Metaphoric gestures and some of their relations to verbal metaphoric expressions. In *Discourse and Cognition*, J.-P. Koenig (ed.), 189–204. Stanford: CSLI Publications.

Clark, E. 2003. Languages and representations. In *Language in Mind*, D. Gentner & S. Goldin-Meadow (eds), 17–23. Cambridge, MA: MIT Press.

Clark, H. H. 1973. Space, time, semantics and the child. In *Cognitive Development and the Acquisition of Language*, T. E. Moore (ed.), 27–63. New York: Academic Press.

Evans, V. 2004. *The Structure of Time: Language, Meaning and Temporal Cognition*. Amsterdam: John Benjamins.

Gibbs, R. W., Jr. 1994. *The Poetics of Mind: Figurative Thought, Language, and Understanding*. Cambridge: Cambridge University Press.

Glenberg, A. M. & Kaschak, M. P. 2002. Grounding language in action. *Psychonomic Bulletin and Review* 9: 558–565.

Grady, J. 1997. *Foundations of Meaning: Primary Metaphors and Primary Scenes*. PhD Dissertation, University of California at Berkeley.

Goldstone, R. 1994. An efficient method for obtaining similarity data. *Behavior Research Methods, Instruments, and Computers* 26 (4): 381–386.

Goodman, N. 1972. Seven strictures on similarity. In *Problems and Projects*, N. Goodman (ed.), 437–447. New York: Bobbs-Merrill.

Johnson, C. 1999. Metaphor vs. conflation in the acquisition of polysemy: The case of *see*. In *Cultural, Typological, and Psychological Perspectives in Cognitive Linguistics*, M. Hiraga, C. Sinha & S. Wilcox (eds), 155–169. Amsterdam: John Benjamins.

Lafargue, P. 1898/1906. *The Origin of Abstract Ideas: Inquiries into the Origin of the Idea of Justice and the Idea of Goodness*. Chicago: Charles Kerr and Co.

Lakoff, G. 1993. The contemporary theory of metaphor. In *Metaphor and Thought,* A. Ortony (ed.), 202–251. Cambridge: Cambridge University Press.

Lakoff, G. & Johnson, M. 1980. The metaphorical structure of the human conceptual system. *Cognitive Science* 4: 195–208 .

Lakoff, G. & Johnson, M. 1999. *Philosophy in the Flesh: The Embodied Mind and its Challenge to Western Thought*. Chicago: University of Chicago Press.

Medin, D., Goldstone, R. & Gentner, D. 1993. Respects for similarity. *Psychological Review* 100 (2): 254–278.

Mori, I., Kitagawa, O. & Tadang, N. 1974. The effect of language on a child's forming of spatio-temporal concept: On comparing Japanese and Thai children. *Science Education* 58 (4): 523–529.

Narayanan, S. 1997. *Embodiment in Language Understanding: Sensory-Motor Representations for Metaphoric Reasoning about Event Descriptions.* PhD Dissertation, University of California, Berkeley.

Núñez, R. & Sweetser, E. 2006. Looking ahead to the past: Convergent evidence from Aymara language and gesture in the crosslinguistic comparison of spatial construals of time. *Cognitive Science* 30 (3): 401–450.

Piaget, J. 1927/1969. *The Child's Conception of Time*. New York: Ballantine Books.

Richardson, D. & Spivey, M. 2000. Representation, space, and Hollywood Squares: Looking at things that aren't there anymore. *Cognition* 76: 269–295.

Shepard, R. 1987. Toward a universal law of generalization in psychological science. *Science* 237 (4820): 1317–1323.

Slobin, D. 1987. Thinking for speaking. Paper presented at the Annual Meeting of the Berkeley Linguistics Society, Berkeley, CA.

Sweetser, E. 1991. *From Etymology to Pragmatics: Metaphorical and Cultural Aspects of Semantic Structure.* Cambridge: Cambridge University Press.

Sweetser, E. 1998. Regular metaphoricity in gesture: Bodily-based models of speech interaction. Paper presented at the 16e Congrès International des Linguistes.

Tenenbaum, J. & Griffiths, T. 2001. Generalization, similarity, and Bayesian inference. *Behavioral and Brain Sciences* 24: 629–640.

Torralbo, A., Santiago, J. & Lupiáñez, J. 2006. Flexible conceptual projection of time onto spatial frames of reference. *Cognitive Science* 30 (4): 745–757.

Tversky, B., Kugelmass, S. & Winter, A. 1991. Cross-cultural and developmental trends in graphic productions. *Cognitive Psychology* 23: 515–557.

Wertheimer, M. 1923/1938. Laws of organization in perceptual forms. In *A Source Book of Gestalt psychology*, W. Ellis (ed.), 71–88. London: Routledge.