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2

Relationships between Language and Cognition

Daniel Casasanto

2.1 Language, Cognition, and the Goals of Cognitive Linguistics

Understanding relationships between language and thought is fundamental to cognitive linguistics. Since the 1970s, cognitive linguists have sought to build *cognitively informed theories of language*. Such theories are exemplified by Ronald Langacker's (2008a) Cognitive Grammar or Charles Fillmore's (1988) Construction Grammar. With the rise of Conceptual Metaphor Theory (Lakoff and Johnson 1980a), however, a second, complementary goal began to drive research in cognitive linguistics: the goal of building *linguistically informed theories of cognition*. According to George Lakoff, "the locus of metaphor is not in language at all, but in the way we conceptualize one mental domain in terms of another" (1993: 203). Analyzing metaphorical language can be an end in itself, but it is a means to an end with respect to the central focus of metaphor theory and related research programs (e.g. Blending Theory; Fauconnier and Turner 2002) that seek to understand "the nature of the human conceptual system" (Lakoff and Johnson 1980b: 195).

These two goals are synergistic, and ultimately one cannot be achieved independently of the other. Yet, distinguishing them is crucial for defining research questions and strategies effectively. When we build cognitively informed theories of language, discoveries about the brain and mind serve as sources of hypotheses and potential constraints, but the data that are critical for evaluating these theories are, for the most part, *linguistic data* (e.g. descriptive analyses, corpus analyses, studies of language production or comprehension). By contrast, in order to avoid circular reasoning (Pullum 1991), when we build linguistically informed theories of cognition, discoveries about language serve as sources of hypotheses and potential constraints, but the data that are critical for evaluating these theories are, for the most part, *nonlinguistic data* (e.g. studies of how people think, perceive, act, feel, decide, remember, or imagine).

One thing that unites work toward both of these goals is the belief that "language offers a window into cognitive function, providing insights into the nature, structure and organisation of thoughts" (Evans and Green 2006: 5). This belief is supported by innumerable points of data: often, the way people talk reflects the way they think. Yet, importantly, this is only *one* of the possible relationships between language and thought. For cognitive linguistics to continue to grow, the idea that *language reflects thinking* must change from a dogma to a hypothesis: a hypothesis that has been validated in many cases, but starkly disconfirmed in others.

This chapter will demonstrate five different ways in which language and nonlinguistic mental representations can be related, using metaphorical language and thought as a testbed. These different relationships arise from patterns of interaction that people have with their linguistic, cultural, and physical environments:

1. Linguistic metaphors can reflect mental metaphors (i.e. nonlinguistic metaphorical mappings).
2. Linguistic metaphors can determine which mental metaphors people use.
3. Linguistic metaphors can create new mental metaphors.
4. People can think in mental metaphors that do not correspond to any linguistic metaphors.
5. People can think in mental metaphors that directly contradict their linguistic metaphors.

I will illustrate each of these relationships via spatial metaphors in language and/or the mind. First, however, I will give a brief introduction to Conceptual Metaphor Theory for the uninitiated reader, and then make an argument for a much-needed terminological shift, for the initiated reader.

2.2 From *conceptual metaphor* to *mental metaphor*

According to the main claim of Conceptual Metaphor Theory (Lakoff and Johnson 1980a), people often conceptualize one domain of knowledge or experience (the Target domain) using mental representations from another domain as a scaffold (the Source domain). The Target domain is typically abstract: something that we can *experience*, but can never see or touch (e.g. Time, Happiness, Value). The Source domain is typically (though not always) something relatively concrete that we can experience directly through the senses (e.g. Space, Force, Motion). Grafting a Target domain onto a Source domain may make the abstract domain effectively more concrete, and therefore easier to think about. Constructing abstract domains metaphorically may also allow people to 'recycle' neural resources: taking structures that evolved to support perception and action in the physical word and reusing them to support more abstract cognitive capacities that may be uniquely human (see Pinker 1997, Casasanto 2010, Merritt, Casasanto, and Brannon 2010).

Linguistic metaphors are hypothesized to signal nonlinguistic Source–Target mappings. Prices can be *high* or *low*; romances can be *hot* or *cool*; arguments can be *weak* or *forceful*. In each case, abstract entities (prices, romances, arguments) are described in terms of a concrete Source domain that can be apprehended directly through the senses (height, temperature, force). The Source–Target relationship is asymmetric: People do not typically use expressions like *that skyscraper is pricey* to describe a building's height, or say that *today's weather will be passionate* to indicate that the temperature will be warm. This asymmetry in the linguistic roles that words from Source and Target domains play is taken as an indication of an asymmetric dependence between nonlinguistic representations in these domains (for discussion see Gijssels and Casasanto this volume Ch. 40). In addition to being *asymmetric*, Source–Target mappings in language are *systematic*: In many cases a continuum of values in the Target domain is mapped onto a continuum of values in the Source domain; this systematic mapping gives metaphors inferential power. The inferences that can be made about the relative height of any two points in space get imported into the Target domain, and support inferences about the relative height of any two prices, etc. Finally, Source–Target mappings in language are *productive*. New instances of a given Source–Target mapping can be created on the fly, and easily understood. Even if you had never heard the expression *their romance was boiling*, you could understand this phrase as an instance of the PASSION IS HEAT mapping. Such asymmetric, systematic, productive mappings between nonlinguistic representations in Source and Target domains are what Lakoff and Johnson (1980a) named a *conceptual metaphor*.

The term *conceptual metaphor*, however, is often used ambiguously: It can refer to metaphorical expressions in language, or to nonlinguistic Source–Target mappings, or to both linguistic and nonlinguistic mappings (or to the link between them).[1] This widespread ambiguity has been tolerated, and perhaps unnoticed, because of the dogma that *language reflects thinking*. A standard assumption is that when people are using linguistic metaphors they are also using the corresponding nonlinguistic Source–Target mappings. Yet, in light of data like those I will review below, it should become clear that this assumption is not always supportable, and that it is an impediment to a more complete understanding of relationships between language and cognition.

[1] A standard phrasing of Conceptual Metaphor Theory's main claim contributes to confusion about whether metaphors under discussion are in language or thought. When we say that people 'conceptualize one domain *in terms of* another' we are using a THINKING IS TALKING metaphor to characterize the relationship between nonlinguistic domains.

To disambiguate between metaphors in language and in thought, I will use the term *linguistic metaphor* to refer to metaphoric expressions in language and *mental metaphor* to refer to mappings between nonlinguistic representations in Source and Target domains (see Casasanto 2009, 2013 for discussion). This distinction becomes crucial here as we explore multiple dissociations between linguistic metaphors and mental metaphors.

2.3 Linguistic Metaphors That Reflect Mental Metaphors

People use space to talk about abstract concepts (cf. Whorf 1956). Linear spatial schemas provide particularly productive Source domains. In linguistic metaphors, Time flows along a sagittal (front–back) axis; Political Views are organized along a lateral (left–right) axis; Number and Emotional Valence (i.e. positive versus negative emotions) are among the domains that are organized according to a vertical (up–down) axis. Beyond talking about these abstract Target domains in linear spatial metaphors, do people *think* about them metaphorically? That is, when people think about these Target domains, do they implicitly activate the particular Source domain representations that conventional metaphors in their language suggest they should? For these Source–Target pairs and several others, experimental evidence suggests the answer is often 'Yes.'

2.3.1 Sagittal Mappings of Time in Language and Thought

In many languages, the future is *ahead* and the past is behind: do people think about time this way? Some seminal experimental studies suggested that they do, but the inferences they supported were limited, either because the stimuli and responses were linguistic, or because the sagittal mappings were represented laterally on a two-dimensional page or computer screen. Subsequent studies have overcome these limitations. In one study participants were assigned to think about the past or the future, while wearing motion trackers. Participants assigned to think about the past tended to lean backwards, whereas participants assigned to think about the future tended to lean forwards (Miles, Nind, and Macrae 2010; see also Boroditsky 2000, Miles et al. 2010, Torralbo, Santiago, and Lupiáñez 2006). These results suggest that, even when people are not using sagittal space–time metaphors in language, they may spontaneously conceptualize the past as *ahead* and the future as *behind* them.

2.3.2 Vertical Mappings of Number in Language and Thought

Similarly, experiments suggest that people implicitly associate numbers with vertical space, consistent with linguistic metaphors designating some numbers as *high* and others as *low*. In one study, participants were asked to judge numbers as *odd* or *even*, responding by moving their eyes to a target location in vertical space. Making pairity (odd/even) judgments ensured that the numbers' cardinal magnitudes and ordinal positions were both irrelevant to the task. Still, the results showed that participants were faster to judge larger numbers' parity with upward eye movements, and smaller numbers' parity with downward eye movements (Schwarz and Keus 2004). Another study revealed how automatically these implicit number–space mappings are activated in people's minds. Participants were asked to generate random numbers between 1 and 30 each time a metronome ticked, while the experimenters tracked their eye movements. Participants tended to make upward eye movements spontaneously before producing a higher number, and downward eye movements before producing a lower number (Loetscher et al. 2010). The magnitude of the eye movements was correlated with the magnitude of the numbers produced (e.g. the largest upward movements preceded the highest numbers), suggesting that a continuum of numbers was mapped systematically to a vertical spatial continuum.

2.3.3 Vertical Mappings of Valence in Language and Thought

Finally, in many languages metaphorical expressions link positive and negative emotional valence with the top and bottom of a vertical spatial continuum (Lakoff and Johnson 1980a): A happy person is *high on life*, but a sad person is *down in the dumps*. A variety of experiments suggest that such linguistic expressions correspond to nonlinguistic mental metaphors. For example, people are faster to judge the valence of positive words like 'loyal' when they appear at the top of a screen, and negative words like 'cruel' when they appear at the bottom (Meier and Robinson 2004). When asked to recall the locations on a map where positive and negative incidents occurred (e.g. winning a prize versus having an accident), the locations of positive events tend to be shifted upward in people's memories, and the locations of negative events shifted downward (Brunyé et al. 2012). Upward- and downward-directed bodily actions can influence the retrieval of emotional memories. In one experiment, participants were assigned to move marbles either upward or downward, from one cardboard box to another, while retrieving and retelling stories from their past. They recounted more positive memories during upward movements, and more negative memories during downward movements (Casasanto and Dijkstra 2010).

2.3.4 When Language Reflects Thinking

Together, these studies (and others like them) indicate that when people think about the Target domains of Time, Number, and Emotional Valence, they tend to activate spatial Source domain representations with a high degree of automaticity, and activating them has measurable consequences in a variety of behavioral tasks. For the present discussion, it is notable that people activate the particular spatial schemas that conventional metaphors in their language suggest they should. Therefore, these results support the hypothesis that *language reflects thinking*. The next four sections challenge this hypothesis, first by showing how language can do more than simply reflect mental metaphors (sections 2.4–2.5), and then by showing how linguistic metaphors can dissociate from mental metaphors (sections 2.6–2.7).

2.4 Linguistic Metaphors Can Determine Which Pre-existing Mental Metaphors People Use

Could the linguistic metaphors people use influence how they think, causing people who use different linguistic metaphors to think in different mental metaphors? In order to support this claim, it would be necessary: (a) to show that different groups of people use different linguistic metaphors for the same Target domain; (b) to show that people who talk differently also think differently, in corresponding ways; (c) to avoid logical circularity by showing that between-group differences can be observed at the level of *nonlinguistic* mental representations; (d) to show that, beyond a language-thought correlation, language plays a causal role in determining how people think; and (e) to determine whether using different linguistic metaphors leads people to create different mental metaphors, or whether experience with language changes the way people use pre-existing mental metaphors. A set of experiments by Sarah Dolscheid and colleagues on mental metaphors for musical pitch meets all of these requirements.

2.4.1 Different Ways of Talking and Thinking about Pitch

In many languages, pitch is metaphorized in terms of vertical space: pitches are *high* or *low*. But this is not the only possible spatial metaphor for pitch. In languages like Farsi, Turkish, and Zapotec, high-frequency pitches are *thin* and low-frequency pitches are *thick* (Shayan, Ozturk, and Sicoli 2011). Beyond talking about pitch using spatial words, do people think about pitch using spatial representations? Several studies suggest that speakers of *height languages* like English activate vertical Space-Pitch mappings when judging pitches (e.g. Pratt 1930, Roffler and Butler 1968). In one set of experiments, Dolscheid et al. (2013) investigated whether speakers of *height languages* and *thickness languages* tend to use the same mental metaphors for pitch, or whether their mental metaphors are shaped by their experience of using linguistic metaphors.

Like English, Dutch describes pitches as *high* (*hoog*) or *low* (*laag*), but in Farsi high pitches are *thin* (*nāzok*) and low pitches are *thick* (*koloft*). Dolscheid et al. (2013) tested Dutch and Farsi speakers on a pair of nonlinguistic pitch reproduction tasks. Participants were asked to reproduce the pitches of tones that they heard in the presence of irrelevant spatial information: either lines that varied in their height (height interference task) or their thickness (thickness interference task). Dutch speakers' pitch estimates were strongly affected by irrelevant spatial height information. On average, a given tone was sung back higher when it had been accompanied by a line that was high on the computer screen, and lower when it had been accompanied by a line that appeared low on the screen. By contrast, lines of various thicknesses had no measurable effect on Dutch participants' pitch estimates. Farsi speakers showed the opposite pattern of results. Lines of varying heights had no measurable effect on Farsi speakers' pitch estimates, but tones accompanied by thin lines were sung back higher, and tones accompanied by thick lines were sung back lower.

2.4.2 Do Dutch and Farsi Speakers' *Nonlinguistic* Representations Differ?

This pattern of spatial interference on people's pitch reproduction performance reflected the Space–Pitch metaphors in their native languages. This pattern cannot be explained by differences in overall accuracy of pitch reproduction, or in differences in musical training between groups. Importantly, this pattern also cannot be explained by participants using language covertly, during the task: labeling the pitches they needed to reproduce as *high/low* or *thick/thin*. This explanation was ruled out by the experimental design, in which there was no correlation between space and pitch in the stimuli. As such, covertly labeling high pitches as *high* (or *thin*) and labeling low pitches as *low* (or *thick*) could not produce the observed effects of space on pitch reproduction; on the contrary, labeling pitches with the spatial metaphors in one's native language during the task could only work *against* the observed effects.

Rather than an effect of using language *online* during the task, these experiments show an effect of people's *previous* experience using either one linguistic metaphor or the other, and thereby strengthening either the nonlinguistic Height–Pitch or Thickness–Pitch mapping in memory. To confirm that the observed effects did not depend on participants covertly labeling pitches during the task, Dolscheid et al. (2013) repeated the height interference task in Dutch speakers with the addition of a verbal suppression task. On each trial of the task, participants had to rehearse a novel string of digits while perceiving and reproducing the pitches. As predicted, verbal suppression had no effect on the results of the pitch reproduction task. Dutch speakers still showed strong height–pitch interference, consistent with an *offline* effect of participants' previous linguistic experience on their subsequent nonlinguistic pitch representations (see also Casasanto 2008a).

2.4.3 Does Language Play a *Causal* Role?

The results reviewed so far show a correlation between people's linguistic metaphors and their nonlinguistic mental metaphors, but they do not provide any evidence that language *causes* Dutch and Farsi speakers to mentally represent pitch differently. Dolscheid et al. (2013) reasoned that if using Thickness–Pitch metaphors in language is what causes Farsi speakers to activate Thickness–Pitch mappings implicitly when reproducing pitches, then giving Dutch speakers experience using similar Thickness–Pitch metaphors in language should cause them to reproduce pitches like Farsi speakers. A new sample of Dutch speakers were assigned to one of two training conditions: Participants in the *thickness training* group learned to describe pitches using Farsi-like metaphors (e.g. a tuba sounds *thicker* than a flute), but participants in the *height training* group (i.e. the control group) described pitches using standard Dutch metaphors (e.g. a tuba sounds *lower* than a flute). After about twenty minutes of this linguistic training, participants in both groups performed the nonlinguistic thickness interference task described above. Whereas *height trained* participants showed no effect of irrelevant thickness information on their pitch estimates, *thickness trained* participants showed a thickness interference effect that was statistically indistinguishable from the effect found in native Farsi speakers. Even a brief (but concentrated) dose of thickness metaphors in language was sufficient to influence Dutch speakers' mental metaphors, demonstrating that linguistic experience can give rise to the differences in nonlinguistic pitch representations that were found across natural language groups.

2.4.4 What Role Does Language Play in Shaping Space–Pitch Metaphors?

Do Space–Pitch metaphors in language cause people to *develop* the corresponding nonlinguistic Space–Pitch mappings, or does using linguistic metaphors change how likely people are to use a pre-existing mental metaphor? To evaluate these possibilities, Dolscheid et al. (2014) tested four-month-old infants on a pair of Space–Pitch congruity tasks. Infants heard pitches alternately rising and falling while they saw a ball rising and falling on a screen (height congruity task) or a cylinder growing thicker and thinner (thickness congruity task). For half of the trials, changes in pitch and space were congruent with the Height–Pitch and Thickness–Pitch mappings encoded in Dutch and Farsi, respectively, and for the other half of the trials they were incongruent with these

Space–Pitch mappings. The data showed that infants looked longer at congruent Space–Pitch displays than at incongruent displays. This was true both in the height congruity condition and in the thickness congruity condition. There was no difference in the magnitude of the congruity effect between conditions, suggesting that there was no difference in the strength of the Height–Pitch and Thickness–Pitch mappings in the infants' minds.

Four-month-olds are completely unable to produce Space–Pitch metaphors in language and are also, presumably, unable to understand them. Yet, they are already sensitive to two of the mental metaphors for pitch found in adults, suggesting that language is not responsible for creating these mappings – only for determining which mapping people tend to use.

2.4.5 Hierarchical Construction of Mental Metaphors

How could infants who are sensitive to both Height–Pitch and Thickness–Pitch mappings turn into adults who appear to activate only one of these mappings when they represent pitch? This process can be understood in terms of *hierarchical mental metaphors theory* (HMMT; Casasanto and Bottini 2014). According to this proposal, the implicit, nonlinguistic mental metaphors that people tend to use most often are specific members of a more general family of mental metaphors. The development of language-specific mental metaphors occurs over two stages. First, a superordinate family of mappings is established, which in the case of Space and Pitch includes both the Height–Pitch and Thickness–Pitch mappings. These mappings may be constructed, over either ontogenetic or phylogenetic time, on the basis of observable correlations between space and pitch in the natural world. The Height–Pitch mapping reflects the fact that people involuntarily raise their larynxes, chins, and sometimes other body parts (e.g. their eyebrows) when they produce higher pitches, and lower them when they produce lower pitches. It also reflects a statistical tendency for higher pitches to originate from higher locations, and lower pitches from lower locations (Parise, Knorre, and Ernst 2014). The Thickness–Pitch mapping reflects a pervasive correlation between pitches and the size of the objects or creatures that produce them. Consider the different pitches produced by: strumming thin versus thick strings on a guitar; banging on a large steel oil drum versus a small steel can; barking by a small dog versus a big dog; etc. Although Dolscheid et al.'s (2014) data confirm that both the Height–Pitch and Thickness–Pitch mappings are present in infants' minds, they leave open the question of exactly how and when these mappings become established initially.

Whatever the ultimate origin of Space–Pitch mappings in prelinguistic children may be, when children learn metaphors in language, a second process begins. Dolscheid et al.'s (2013) findings in adults suggest that each time people use a linguistic metaphor like *a high pitch* they activate the corresponding mental metaphor, strengthening this mapping at the expense of competing mappings in the same family of Space–Pitch associations. As a consequence, speakers of height languages like Dutch and English come to rely on vertical spatial schemas to scaffold their pitch representations more strongly than multidimensional spatial schemas, whereas speakers of thickness languages like Farsi come to rely on multidimensional spatial schemas more strongly than vertical spatial schemas.

According to HMMT, strengthening certain mental metaphors results in the *weakening* of other members of the family of mappings (consistent with the dynamics of many memory networks) – but this does not cause these dispreferred mappings to be extinguished. This aspect of the theory may explain the representational flexibility demonstrated by Dolscheid et al.'s (2013) training experiment. Dutch speakers could be induced to use a nonlinguistic Thickness–Pitch mapping after only a brief training intervention because no spatial mappings had to be created or destroyed; rather, the new pattern of language experience boosted the strength of the Thickness–Pitch mapping that had presumably been present in the Dutch speakers' minds since infancy, causing participants to think about pitch in a way that was not new, just rarely used. HMMT provides an account of how mental metaphors can be fundamental to our understanding of Target-domain concepts, and yet surprisingly context-dependent.

2.5 Linguistic Metaphors Can Create New Mental Metaphors

Beyond selecting among pre-existing mental metaphors, can learning conventional metaphors in language cause people to create new mental metaphors? To date, one clear instance of a language-based spatial metaphor has been described: the left–right mapping of Political Views. In the late eighteenth century, the conservative members of the French Legislative Assembly sat on the right side of the room, and the liberal members on the left (Oppenheimer and Trail 2010). This arrangement had enduring consequences. More than two centuries later, liberal and conservative values are metaphorized on a left–right continuum, across many languages and cultures, as evidenced by English expressions like *the liberal left, centrist politics*, and *right-wing conservatives*.

In order to establish that a mental metaphor arises from experience using linguistic metaphors, it is necessary to show that: (a) beyond talking about the Target domain metaphorically, people use the corresponding Source domain representations to think about the Target domain; (b) other plausible origins of the mental metaphor have been ruled out; (c) beyond a language-thought correlation, metaphorical language plays a causal role in establishing the mental metaphor. A series of studies described by Casasanto (2013) satisfies the first two of these three requirements for the LIBERAL IS LEFT/CONSERVATIVE IS RIGHT mapping.

2.5.1 Do People *Think* about Politics Spatially?

Left–right linguistic metaphors for politics appear to correspond to active mental metaphors. In one experiment, US students were asked to sit in an ostensibly broken office chair while completing a political attitudes survey. Unbeknownst to participants, a wheel had been removed strategically from one side or the other, causing the chair to lean leftward or rightward. Responses showed that, on average, participants who had been assigned to sit in the left-leaning chair expressed more agreement with Democrats (traditionally the more liberal party), whereas participants assigned to sit in the right-leaning chair tended to agree more strongly with Republicans (Oppenheimer and Trail 2010).

The automaticity with which people activate an implicit left–right mapping of politics was confirmed in a series of reaction time studies in Dutch participants. Although The Netherlands has many political parties, which differ along multiple dimensions, the parties' liberality or conservativism is often described using left–right metaphors (Bienfait and van Beek 2001). Accordingly, when presented with parties' acronyms, Dutch participants were faster to make judgments about more liberal parties with their left hand (or when the acronym appeared on the left of the screen), and faster to make judgments about more conservative parties with their right hand (or when the acronym appeared on the right; van Elk, van Schie, and Bekkering 2010).

2.5.2 Ruling Out Nonlinguistic Origins of the Mental Metaphor

Where does this mental metaphor come from? Pointing to its historical roots does not answer the question of how this mental metaphor arises in individuals' minds: That is, the arrangement of eighteenth-century French politicians does not explain how individuals come to intuit a mapping between politics and space today. One potential origin of this mental metaphor is correlations in linguistic experience. Using the words *right* and *left* in both literal contexts (e.g. the can is *on the left* of the shelf) and metaphorical contexts (e.g. the candidate is *on the left* of the political spectrum) could cause people implicitly to associate politics with left–right space, building upon our general propensity to spatialize abstract concepts. Before accepting the conclusion that linguistic experience instills a nonlinguistic Space–Politics mapping in individuals' minds, it is important to consider other possibilities. Specifically it is important to rule out the possibilities that: (1) this mental metaphor could be innate; (2) it could arise from embodied experience; (3) it could arise from nonlinguistic cultural experiences.

First, in principle, the mapping could be innate (and this implicit mental metaphor could have biased the arrangement of the French Legislative Assembly). In practice, this proposal is dubious. Mental metaphors like the mapping of Temporal Duration onto Spatial Distance (see Casasanto and Boroditsky 2008, Gijssels and Casasanto this volume Ch. 40) are good candidates for an innate origin, since space and time are ubiquitous in our physical experience, and the need to compute Space–Time relationships has been important throughout our evolutionary history. It is unlikely, however, that liberal and conservative political ideologies, or even the concepts of *left* and *right* (which are absent from some modern languages and cultures; Levinson and Brown 1994), arose early enough in human history to have been encoded in our genes and neurally hardwired.

Second, there is no basis for the left–right mapping of politics in our physical interactions with the natural environment. This metaphor appears to function much like other *orientational metaphors*, which Lakoff and Johnson (1980a) have suggested arise from "correlations in our embodied experience." And yet, this mapping in language and in thought *cannot* be acquired through incidental learning of correlations between Politics and Space in the natural world. It is not credible, for example, that as we encounter other people in our everyday environment we tend see people with liberal views on our left and people with conservative views on our right – with such regularity that politics becomes implicitly mapped onto left–right space.

Third, the left–right mapping of politics in individuals' minds could arise from the spatialization of politics in nonlinguistic cultural conventions (e.g. graphic representations of politics and politicians in the media). This suggestion, which deserves consideration, assumes that liberal and conservative politicians or symbols are, in fact, commonly represented on the left and right, respectively. But this does not appear to be the case. For example, videos of televised debates between US presidential candidates for the most recent election years (2008, 2012) show no systematic link between the candidates' parties and their left–right positions on the stage. The US Senate and Congress are arranged similarly to the eighteenth-century French Legislative Assembly, but most people are not members of the Senate or Congress, and are therefore unlikely to be exposed to this spatialization of the political left and right with sufficient frequency to give rise to an implicit mental metaphor. When the Senate and Congress are viewed on TV, the camera's viewpoint varies between photographs and videos, sometimes showing the Democrats and Republicans in metaphor-congruent and sometimes in metaphor-incongruent sides of viewer-centered space.

The spatial positions of people may be subject to numerous functional constraints, but the spatialization of symbols in graphics is largely at the discretion of the artist. In the United States, donkeys and elephants symbolize the Democrat and Republican parties, respectively. Often these animals are depicted side by side, presumably to indicate opposition between the parties, or to represent the voters' two main alternatives. Is the donkey usually depicted on the left and the elephant on the right? To address this question, one study used Google Images (www.google.com) to a survey donkey–elephant images (Casasanto 2013). Of the images sampled, 51 percent were metaphor-congruent (donkey on the left, elephant on the right) and 49 percent were metaphor-incongruent (elephant on the left, donkey on the right); this difference did not approach statistical significance.

This survey provided no evidence that the symbols of the liberal and conservative parties are typically presented on the left and right sides, respectively. This may be because *right* and *left* depend on perspective. In many images, the donkey and elephant are facing out of the page, toward the viewer. Artists who wished to make the animals' locations congruent with the LIBERAL IS LEFT metaphor might sometimes place the donkey on the *viewer's left*, and other times on the *elephant's left* (i.e. the viewer's right), leading to the appearance of randomness.

2.5.3 Linguistic Metaphors Can Create Mental Metaphors

Whatever the reason for the apparent lack of any systematic use of left–right space in the placement of politicians before the TV camera, or in political graphics, the implications for the present question are clear. If politicians or their symbols are not systematically spatialized in non-linguistic cultural conventions, these conventions cannot be responsible for establishing the spatial mapping of politics in people's minds. It appears that talking about liberal and conservative political attitudes in terms of left–right space is what causes people to think about them that way.

This conclusion awaits further experimental validation: Only an experimental intervention, like Dolscheid et al's (2013) training study (section 2.4.3), can establish a causal relationship between language and thought. But since the origins of this mental metaphor do not appear to lie in innate hardwiring, correlations in the natural world, or correlations in cultural conventions, linguistic metaphors seem to be the only plausible source of the spatial metaphors for politics in people's minds. If so, then beyond just reflecting or modifying our mental metaphors, linguistic metaphors can also create new ways of thinking about abstract concepts.

2.6 Mental Metaphors That Do Not Correspond to Any Linguistic Metaphors

The preceding sections support and extend the thesis that the way people talk reflects (and sometimes shapes) the way they think. But this is not always the case. To find dissociations between metaphorical language and thought, we need look no farther than two conceptual domains already discussed above: Time and Number.

2.6.1 Lateral Mappings of Time

Linguistic metaphors for Time in English indicate that events unfold along the sagittal (front–back) axis, not the lateral (left–right) axis: The future is *ahead*, not *to the right*. Lateral Space–Time metaphors are not conventionalized in any known spoken language. And yet, there is abundant evidence that people conceptualize sequences of events according to a left–right spatial mapping. Evidence of a lateral *mental timeline* comes from dozens of experiments using diagram tasks (Tversky, Kugelmass, and Winter 1991), reaction time tasks (e.g. Torralbo, Santiago, and Lupiáñez 2006, Weger and Pratt 2008), and studies of spontaneous gesture (Cienki 1998, Cooperrider and Nuñez 2009, Casasanto and Jasmin 2012).

People exposed to languages that are written left to right tend to conceptualize *earlier* events on the *left* and *later* events on the *right*; people exposed to languages with right-to-left orthographies like Arabic and Hebrew show the opposite tendency, conceptualizing *earlier* events on the *right* and *later* events on the *left* (Tversky et al. 1991, Fuhrman and Boroditsky 2010, Ouellet et al. 2010). An experiment in which left-to-right readers were exposed to mirror-reversed text confirmed that experience reading in one direction or another is sufficient to determine the direction of the lateral mental timeline (even though participants read the same words and phrases in both orthography conditions, ruling out influences of language, per se; Casasanto and Bottini 2014).

In a study of spontaneous gestures, English speakers produced far more gestures that were congruent with the EARLIER IS LEFT/LATER IS RIGHT mapping than with the FUTURE IS AHEAD/PAST IS BEHIND mapping, suggesting that the lateral timeline may be activated more strongly or automatically than the sagittal timeline encoded in language (Casasanto and Jasmin 2012). Participants gestured laterally even when using sagittal language (e.g. gesturing left when saying "farther back [in the past]"; ibid.: 661); they were thinking *left* even when saying *back*, underscoring the dissociation between their linguistic metaphors and their mental metaphors for time (see Gijssels and Casasanto this volume Ch. 40 for further discussion).

2.6.2 Lateral Mappings of Number

A similar dissociation between language and thought is observed for spatial conceptions of number. In addition to spatializing numbers vertically, as linguistic metaphors suggest, people also implicitly spatialize them along a lateral *mental number line*. In Western cultures, smaller numbers are associated with the left side of space and larger numbers with the right, despite the complete absence of corresponding linguistic metaphors in any known language: nine is *higher* than eight, not *righter* than eight. The vertical space–number studies reviewed in section 2.3.2 also had horizontal conditions. When asked to judge the parity of numbers (odd versus even) and respond by moving their eyes to a target, participants were faster to indicate larger numbers' parity with rightward eye movements, and smaller numbers' parity with leftward eye movements (Schwarz and Keus 2004). When asked to generate random numbers, participants tended to make rightward eye movements spontaneously before producing a higher number, and leftward eye movements before producing a lower number (Loetscher et al. 2010).

The most common test of the lateral mental number line uses manual responses. Typically, when Western participants indicate the parity of numbers by pressing buttons with the left or right hands, they are faster to classify smaller numbers with the left hand and larger numbers with the right. This reaction time effect was given a memorable name, the SNARC effect (Spatial-Numerical Association of Response Codes; Dehaene, Bossini, and Giraux 1993), although experiments like Loetscher et al.'s show that this is a misnomer; the effect does not depend on an association between numbers and manual responses, but rather on a spatial conception of number that can be observed whether or not the hands are used. The SNARC effect, which has been replicated in hundreds of experiments (for review see Wood et al. 2008), is reversed or extinguished in some non-Western cultures, leading many researchers to conclude that, like the mental timeline, the direction of the mental number line is determined by experience with a left-to-right versus right-to-left orthography. However, this conclusion is not well supported by experimental data: the only direct tests of the effect of reading experience on the mental number line have produced null results (Dehaene, Bossini, and Giraux 1993, Pitt and Casasanto, in prep). The direction of the mental number line does appear to depend on other culture-specific practices, however, such as the typical arrangement of numbers in graphic displays (Fischer, Mills, and Shaki 2010) and finger-counting routines (Fischer 2008, Pitt and Casasanto 2014). For the present discussion, it is sufficient to note that, according to hundreds of studies, people implicitly organize numbers along a culture-specific mental number line: a mental metaphor that does not correspond to conventional metaphors in any known language.

2.7 Mental Metaphors That Contradict Linguistic Metaphors

To date two mental metaphors have been documented that directly contradict conventional metaphors and idioms in their users' languages, in the domains of Time and Emotional Valence.

2.7.1 Conceptualizing the Past as Ahead, Despite Linguistic Metaphors That Say the Future is Ahead

Speakers of Darija, a Moroccan dialect of Modern Standard Arabic, use sagittal metaphors for time that are similar to those found in English and many other languages: The *past* is *ahead* and the *future* is *behind*, in their language. Yet, when their implicit mental metaphors for Time were tested, Darija speakers showed the opposite Space–Time mapping. In two experiments, they showed a strong tendency to conceptualize the *past* as *ahead* and the *future* as *behind* (de la Fuente et al. 2014). Since no explanation for this reversed Space–Time mapping could be found in participants' language (cf., Nuñez and Sweetser 2006b) or in their bodily interactions with the environment (cf. Clark 1973), de la Fuente and colleagues turned to aspects of culture. They found that, compared to Europeans, Moroccans tend to place more value on ancient rituals and traditional values, focusing on the past, whereas Europeans tend to focus on the future. Further experiments showed that the culture-specific tendency to focus on the past or the future predicted where people tended to place the past and future in their mental models of Time – irrespective of their linguistic metaphors. When induced to think about the past, Spaniards (who normally conceptualize the future as ahead) were more likely to place the *past* ahead in their mental models, contra the conventional metaphors in their language. Together, de la Fuente et al.'s (2014) findings suggest that, at any moment, people may be spatializing the past and future in their mental metaphors exactly the opposite of the way it is spatialized in their linguistic metaphors (see Gijssels and Casasanto this volume Ch. 40 for further discussion).

2.7.2 Associating *Good* with *Left*, Despite Linguistic Expressions Associating *Good* with *Right*

Across many languages, good things are associated with the *right* and bad things with the *left* (e.g. *my right-hand man; the right answer* versus *sinister intent; two left feet*). These patterns in language are reinforced by nonlingusitic cultural conventions. In Western cultures, these customs include shaking hands with the right hand, and raising the right hand to swear an oath. In other cultures, they include prohibitions against pointing or eating with the left hand, which is reserved for dirty jobs (Kita and Essegby 2001).

Unconsciously, people also conceptualize *good* and *bad* in terms of left–right space, but not always in the way linguistic and cultural conventions suggest. Rather, people's implicit associations between space and valence are *body specific*: Right-handers associate *good* with *right*, but left-handers associate *good* with *left*, implicitly, in spite of conventions in language and culture. When asked to decide which of two products to buy, which of two job applicants to hire, or which of two alien creatures looks more honest, right- and left-handers respond differently. Right-handers tend to prefer the product, person, or creature presented on their right side but left-handers tend to prefer the one on their left (Casasanto 2009). This pattern persists even when people make judgments orally, without using their hands to respond. Children as young as five years old already make evaluations according to handedness and spatial location, judging animals shown on their dominant side to be nicer and smarter than animals on their non-dominant side (Casasanto and Henetz 2012). Reaction time tasks show that the body-specific association between valence and space is activated highly automatically. When judging the valence of words or faces, right- and left-handers are faster to classify stimuli as *positive* when responding with their dominant hand, and faster to classify them as *negative* when responding with their non-dominant hand (de la Vega et al. 2012, de la Vega et al. 2013, Kong 2013).

Beyond the laboratory, the association of *good* with the dominant side can be seen in left- and right-handers' spontaneous speech and gestures. In the final debates of the 2004 and 2008 US presidential elections, positive speech was more strongly associated with right-hand gestures and negative speech with left-hand gestures in the two right-handed candidates (George W. Bush, John Kerry), but the opposite association was found in the two left-handed candidates (John McCain, Barack Obama; Casasanto and Jasmin 2010). In a simulated election, left-handers were fifteen percentage points more likely to vote for a candidate whose name appeared on the left of the ballot, compared to right-handers, suggesting that this implicit mental metaphor may have measurable real-world consequences (Kim, Krosnick, and Casasanto 2015).

Three lines of evidence show that this mental metaphor is not shaped by experience with language or culture, but rather by bodily experience – the experience of acting more fluently with the dominant hand, and therefore associating *good* with the side of space where we act more fluently and *bad* with the side where we act more clumsily. First, across experiments, the GOOD IS LEFT mapping in left-handers appears to be stronger than the GOOD IS RIGHT mapping in right-handers; the opposite would be expected if there were additive effects of linguistic/cultural and bodily experiences (Casasanto 2009). Second, similar implicit mental metaphors are seen across cultures with different explicit Space–Valence associations. Whereas *left* is associated with being clumsy or rude in many European cultures, it is associated with being filthy or evil in Morocco,

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a predominantly Islamic nation. Yet, experiments showed no significant difference in the strength of the Space–Valence mapping across Spaniards and Moroccans (de la Fuente et al. 2015). Finally, changes in bodily experience can change people's Space–Valence mappings, independent of any change in language or culture. In one experiment, right-handers performed a fine motor task, arranging dominoes on a table, while wearing a cumbersome glove on either their left hand (which preserved their natural right-handedness), or on their right hand (which turned them temporarily into left-handers, in the relevant regard). After about twelve minutes of lopsided motor experience, participants removed the glove and performed a test of Space–Valence associations, which they believed to be unrelated. Participants who had worn the left glove still thought *right* was good, but participants who had worn the right glove showed the opposite GOOD IS LEFT bias, like natural left-handers (Casasanto and Chrysikou 2011). The rapidity of this change can be understood in terms of hierarchical mental metaphors theory (see Casasanto 2016a, 2016b).

Together, these studies reveal a second mental metaphor that stands in direct opposition the most relevant linguistic and cultural conventions. Left-handers (and impaired right-handers) manifest an implicit GOOD IS LEFT mapping, despite conventions in language and culture indicating that GOOD IS RIGHT.

2.8 Different Relationships between Talking and Thinking: Roles of Language, Culture, and Body

According to a foundational assumption in cognitive linguistics, the language we use reflects the way we think. Often this is true, but not always. There are multiple relationships between talking and thinking, which are conditioned by the particulars of our linguistic, cultural, and bodily experiences. The range of these language-thought relationships can be illustrated by the different relationships that have been discovered between linguistic metaphors and mental metaphors.

Often our spatial metaphors in language reflect nonlinguistic mental metaphors. For example, people may unconsciously activate sagittal spatial schemas to think about the past and future, and vertical spatial schemas to think about emotional positivity and negativity, or *high* and *low* numbers (section 2.3). Beyond reflecting our thoughts, spatial metaphors in language can also shape them: causing people, for example, to activate schematic representations of either *height* or *thickness* when conceptualizing musical pitch (section 2.4). Linguistic metaphors can even cause us to create new mental metaphors, as appears to be the case for lateral mappings of politics (section 2.5). Yet, in other cases people think in mental metaphors that do not correspond to any conventional linguistic metaphors, as when we conceptualize earlier and later events according to a left–right mental timeline, or lower and higher numbers according to a left–right mental number line. These lateral mappings of time and of number arise from experience with culture-specific activities like reading (a recent cultural overlay on natural language), using calendars and graphs, and counting on our fingers: activities that reinforce particular space–time or space–number associations in our minds (section 2.6). Finally, people can think in mental metaphors that directly contradict their linguistic metaphors; for example, when Moroccans conceptualize the past as in front of them, or when left-handers implicitly map *good* and *bad* to the *left* and *right* sides of space. The Moroccans' PAST IS AHEAD mapping appears to arise from a culture-specific tendency to focus on the past (and therefore to place the past in front of the eyes, where one could *focus* on it literally, if events in time were objects in space). The body-specific GOOD IS LEFT mapping arises from patterns of fluent and disfluent manual interactions with the physical environment (section 2.7).

The discovery of multiple relationships between language and cognition presents both challenges and opportunities for cognitive linguistics. The challenge lies in recognizing that, in many circumstances, analysing patterns in language constitutes *one step* in the process of elucidating relationships between language and cognition. Specifically, patterns in language provide a rich source of *hypotheses* about nonlinguistic mental representations. And therein lies the opportunity. Testing these hypotheses requires diverse methods, and encourages collaboration between linguists and researchers in allied fields. Even when predictions from language-based hypotheses are not upheld, testing them may be illuminating. In the studies reviewed here, for example, the hypothesis that people would conceptualize domains like Time, Number, and Valence in the same ways they that talk about them was repeatedly disconfirmed. Yet, more broadly, the hypothesis that people use spatial schemas to conceptualize these non-spatial domains received consistent and convergent support: people *think* metaphorically, in more ways than linguistic analyses, alone, can uncover. The project of exploring language-based hypotheses about the mind, using a combination of linguistic and nonlinguistic methods, opens the door for cognitive linguistics to have a broad influence on allied fields, and to become increasingly integrated with the other neural and cognitive sciences.