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Review Article

How to Represent Abstract Concepts? From the Perspective of Conceptual Metaphor Theory

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Abstract

How humans understand and represent concepts is always a hot topic in cognitive psychology. According to the conceptual metaphor theory [1], [2], understanding and representing abstract concepts rely on concrete concepts via metaphoric mappings. In this review, we discussed three core issues with the aim to have a comprehensive understanding of conceptual metaphors. First, I describe the underlying process of metaphoric mappings. Lakoff and Johnson (1999) [2] put forward that the source domain (concrete concepts) can be used to represent the target domain (abstract concepts). The metaphoric mappings from source domains to target domains are characterized as image schemas, which structure and provide sensory-motor grounding for abstract concepts. Then, I concerned on the directionality (the second issue) and automaticity (the third issue) of metaphoric mappings. According to conceptual metaphor theory, metaphoric mappings have the directionality from the concrete domain to the abstract domain, which is an automatic and obligatory process with neither effort nor awareness. However, directionality and automaticity were debated by recent research. In this article, by focusing on the three important issues, I provided a comprehensive review which would help deepen our understanding about the nature of metaphoric mappings.

Keywords:
Embodied Cognition; Conceptual Metaphor Theory; Directionality; Automaticity

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Introduction

An ancient but significant topic in human cognition is how humans understand concepts and represent information mentally. That is, what are the mental representations in the human mind, and how are mental representations formed? Are mental representations perceptual or non-perceptual? The topic has been discussed through a long history, from viewing cognition as to be perceptual by philosophers (such as Aristotle, Epicurus, Locke, Berkeley, Hume, et al) before two thousand years ago, to that perceptual character in cognition was eliminated for being considered to be unscientific by behaviorists and philosophers [3], [4], [5] with the development of logic, statistics, and computer science in the early twentieth century (here we call traditional views), and then to the emergence of theories of embodied cognition which turns back, but progressively to perceptual symbol systems about the representation scheme. However, there are still amounts of debates on the processing of concepts among traditional and emerging embodied cognition theories.

The traditional theories assumed mental representations are amodal symbols which are non-perceptual, abstract, and arbitrary. Amodal symbols do not carry any element of sensory, motor, and introspective states which constituted experience originally. Based on the amodal symbol system, original experience, such as sensory, motor, and introspective states, are transformed to feature lists, semantic networks, schemata, propositions, productions, frames, statistic vectors, and so forth, to represent knowledge [6], [7], [8], [9], [10].

Conversely, embodied theories, such as conceptual metaphor theory [2], [11], perceptual symbol systems [6], simulations of situations or actions [12], the theory of emotion [13], claim that knowledge is embodied and grounded in bodily states and the brain's modality-specific systems (see a review [14]). These theories of embodied cognition hold the human mind is grounded in bodily states, the environment, and the sensorimotor system. People use sensory or perceptual information to support higher-level cognitive processing.

The Divorce Between Traditional View and Embodied View on Abstract Concepts

Concrete concepts, which have their physical referents, can be perceived directly through people's physical interaction with them. Unlike concrete concepts, abstract concepts, such as morality, power, and time, can not be seen, heard, touched directly through sense modality, thus do not have direct perceptual characteristics. How are abstract concepts acquired, represented, and processed?

Traditional theories held the view that humans think in a purely symbolic language [15], [16], [17] and concepts are represented as artificial symbols without perceptual characteristics. These amodal symbols are non-perceptual without sensory-motor information in any modality. That is, amodal symbol representations are stored separately from sensory experiences, even though for concrete concepts with sensory information. Concrete concepts are encoded into symbols, like feature lists, semantic networks, and propositions, which do not own original perceptual information anymore, of course for abstract concepts that do not contain the perceptual information. According to amodal theories, both concrete concepts that contain perceptual information and abstract concepts that superficially do not have any perceptual characteristics, are integrated at the symbolic level of representation and then are processed in high-level cognitive processes.

Embodied theories [6], [18], [19], [20] proposed different views that representations of concepts are inherently perceptual building on concrete sensorimotor information. A growing number of empirical

evidences have investigated sensorimotor activation in cognitive processing. Several accounts of grounded cognition [1], [2], [6], [12], [18], [19], [21], [22] were put forward to explain how abstract concepts are grounded in experience and sensory-motor systems. For example, the perceptual symbol system claims the grounded underlying process of abstract concepts depends on perceptual simulations. Conceptual metaphor theory maintained the understanding of abstract concepts depends on the perceptual information of concrete concepts through conceptual metaphors. Both share the basic view that perceptual information is necessary to conceptual understanding and cognitive processing is embodied and grounded in physical experience consisting of (re)activation of multimodal representations through direct physical interactions with physical referents in the world.

From the perspective of conceptual metaphor theory, I discuss three questions in this review: the first is about the processing of underlying metaphoric mapping from concrete information to abstract concepts. The remaining is about the nature of the underlying processing. Is it automatic or not? Is the metaphoric mapping between concrete (source domain) and abstract concepts (target domain) symmetric or asymmetric (source to target vs. target to source)?

Conceptual Metaphor Theory

Lakoff and Johnson (1999) [2] put forward that concrete concepts (e.g., verticality: up/down) are used to represent and describe abstract concepts (e.g., emotion: positive/negative) through metaphoric mappings (can be called metaphor for abbreviation). A metaphor constitutes two domains: the source domain, often referring to concrete concepts, provides the conceptual source with direct physical experience to target domains which are the subject matter of one sentence and often refer to relatively more abstract concepts [2].

The metaphoric mappings from source domains to target domains are characterized as image schemas. In other words, image schemas are perceptual-motor gestalts that structure and provide sensory-motor grounding for abstract concepts. For instance, the image schema "SOURCE-PATH-GOAL" provides relational structures to the experience of moving our bodies from one starting location to the ending location (source domains). The abstract concept (our goal of life, success) is structured through this metaphoric mapping from the experience of source domains with moving experience. Such repeated situations of co-experience between concrete and abstract concepts form the metaphoric mappings over time. Gibbs (2006) [23] claimed that image schemas are not sensory-motor representations themselves but analog representations of mostly spatial relations and movements. Thus, image schemas are considered to be grounded for their sensory-motor experience originality.

To test the underlying process of metaphoric representation of abstract concepts empirically and directly, two views were put forward to provide the empirically testable hypothesis: the Metaphoric Structuring View [24], [25] and the Stroop-like Interference Effects [26]. Both are extensions of conceptual metaphor theory, which provided the possibility to test the directionality and automaticity of the underlying process of metaphoric association empirically.

The Metaphoric Structuring View: Does Metaphor have a Direction?

The Metaphoric Structuring View [24] is derived from the metaphoric representation view [2]. The view claims that metaphors play the role of providing relational structure from concrete domains to abstract domains because relational structures of abstract concepts may not be obvious from world experience and thus only can be "imported from concrete domains" just like analogies.

For example, time does not contain concrete information, which lacks the relational structure in the world. Time is experienced as a unidirectional continuum along which objects and events appeared and disappeared in our experiences. Across language, people use spatial terms, such as "ahead/behind" for English speakers and "up/down" for Chinese speakers, to talk about time, such as "we are looking forward to a brighter tomorrow", "The meeting is ahead of this Friday", "next Monday" and so on. According to the Metaphoric Structuring View, the relational structures in spatial schemas are used to understand and organize events in time.

Boroditsky's experiments tested whether time is structured through spatial metaphors [24]. Participants firstly judged several priming questions (either ego-moving or object-moving spatial schemas) about

spatial relations of objects in pictures. After that, participants were presented an ambiguous temporal sentence (e.g. Next Wednesday's meeting has been moved forward two days) and judged which day the meeting had been rescheduled. The meeting should be on Friday if participants were primed by the ego-moving spatial perspective which induced that "forward" is the direction of observers' movement; whereas the meeting should be on Monday when participants were in the time-moving condition where "forward" is considered the direction of time's motion. Results proved that space and time share similar relational structures, consistent with the Metaphoric Structural View.

An issue related to the metaphoric structures is whether the source concrete domains are necessary to structure the abstract domains. Murphy (1996) [25] commented on this issue and claimed that conceptual metaphor theory can make strong or weak versions of metaphoric structuring. The strong version assumes that the source concrete domain is automatically activated to structure the abstract domain which does not have its structure. The weak version claims that the source concrete domain is not necessarily activated when understanding the abstract domain. Under this view, the relational structure originated from source domain is stored at the abstract domain, and after repeated use, abstract domain can have its structure, but the structure can be influenced by concrete domain because it is formed and stored through repeated relations with concrete domain. In other words, concrete domain is not necessary for the processing of abstract domain, but processing of the concrete domain can influence the concurrent processing of abstract domain; however, the opposite influence (i.e. processing of abstract domain on the processing of concrete domain) would not appear.

Boroditsky (2000) [24] distinguished the two versions of Metaphoric Structuring by investigating whether spatial schemas are necessary to understand time. Participants did a two-page questionnaire with the first page of either spatial schema (i.e., ego-moving schema and object-moving schema) or temporal schema prime question (i.e., ego-moving schema and time-moving schema) and the second page of ambiguous spatial target question, or temporal target question (e.g. Next Wednesday's meeting has been moved forward two days. Which day is the meeting now that it's been moved?). Schema-consistency effect appeared in space-to-time condition, indicating people can use spatial schema (concrete domain) to represent time (abstract domain); however, participants were not influenced by temporal primes when interpreting ambiguous spatial target questions, which is consistent with the weak metaphoric structuring view (spatial schemas can be used to, but not necessary to think about time). Further, a similar pattern of results was found: spatial distance affected estimates of duration distance, but duration did not affect estimates of spatial distance [27].

Actually, such asymmetricity of weak version is consistent with the view of Lakoff and Johnson (1980, 1999) [1], [2] that there is direction in metaphoric associations between concrete domain and abstract domain. Specifically, understanding abstract concepts is based on concrete sensory-motor experience, but concrete concepts do not depend on abstract concepts. Piaget and Inhelder's (1972) [28] development view also supported this asymmetrical view that sensorimotor achievements occur before abstract thoughts do. Afterward, this asymmetrical view is accepted and called the Strict Directionality Hypothesis [29].

Murphy (1996) [25] also agreed the directionality nature of the conceptual metaphors and the tendency for concrete words taking on more abstract meanings over time [30]. He claimed that this asymmetry reflected the underlying conceptual structure of metaphors, as well as discourse and conceptual differences. For example, time must be understood in terms of space, but not vice versa. In daily language use, people often say "love is a rose", but not "a rose is love". Murphy explained the asymmetricity that abstract domains are more complex and thus harder to describe than concrete domain, so abstract concepts' meaning often reflects a progression from concrete to abstract domain, so words describing the concrete sensory experience can be understood as describing abstract concepts.

Although the Strict Directionality Hypothesis and the weaker version of conceptual structuring were proposed from different perspectives (linguistic analysis and conceptual structure), they share the same view that the direction of metaphoric mappings is asymmetrical.

Lee and Schwarz (2012) [31] presented the operational definition of the directionality nature of conceptual metaphors. If (a) manipulation of the concrete domain affects measurement in the abstract domain (concrete-to-abstract), and (b) manipulation of the abstract domain affects measurement in the

concrete domain (abstract-to-concrete) are both true, then the metaphoric effect would be considered bidirectional. If either (a) or (b) is true, then the metaphorical effect would be considered unidirectional. The unidirectionality implied by the Strict Directionality Hypothesis and the weaker version of conceptual structuring means concrete-to-abstract, but not abstract-to-concrete, i.e., (a) is true, but not (b). Lee and Schwarz explicitly raised the bidirectionality which is completely different from the common assumption about the directionality of conceptual metaphor theory. They argued primary metaphor's emergence originated from the conflations between concrete and abstract domains during early life experience. Such experiential correlation causes neural coactivation of concrete and abstract domains. And the cross-domain neural connections are supposed to provide the biological foundation for the cross-domain conceptual structure, i.e. conceptual metaphor. Concrete domain provides image-schemas to understand abstract domain. They also proposed that a conceptual metaphor has both linguistic and psychological consequences and claimed that even though it is unidirectional for linguistic expressions, its psychological consequences may be directional. They claimed that sensorimotor experiences and abstract domain are in dynamic interaction, and inferred that sensorimotor experiences can have an impact on abstract domain, but also can be shaped by abstract domain [14], [32], [33].

Even though the unidirectional nature of conceptual metaphor is widely accepted by theoretical explanations, as well as supported by empirical evidence, there is also much research supporting the bidirectionality nature of conceptual metaphor. Table 1 summarized the studies on the directionality of metaphoric mapping between concrete domain and abstract domain.

As shown in Table 1, it is still debatable about the directionality of conceptual metaphors. To attempt to answer such a question, researchers proposed that metaphoric mappings could be modulated, such as primed types and languages. For example, Lakens (2010) [34] claims that metaphoric representations of abstract concepts are highly contextualized, and different representations can be primed (for example, in Boroditsky (2000), time can be thought differently when participants were differently primed, i.e., in the ego-moving or object-moving frame of reference). Boroditsky explains that language has a

Table 1. Studies on the directionality of metaphoric associations

	Related Metaphor	Symmetricity/Directionality
Ouellet, Santiago, Funes, and Lupiáñez (2010) [52]	Positive-Right Negative-Left	asymmetric/ unidirectional
Wapner, Werner, and Krus (1957) [53]	Higher grades-Up Lower grades-Down	asymmetric/ unidirectional
Adam and Galinsky (2012) [54]	Professional-Lab coat	asymmetric/ unidirectional
Casasanto (2009) [55]	Good-Handedness Good-Up/ Bad-Down	asymmetric/ unidirectional
IJzerman and Semin (2009) [56]	Social proximity-Warm	asymmetric/ unidirectional
Giessner and Schubert (2007); Schubert (2005) [49], [57]	Powerful-Up Powerless-Down	symmetric/ bidirectional
Zhong and Liljenquist (2006); Zhong, Strejcek, and Sivanathan (2010) [58], [59]	Moral-Cleanness Amoral-Dirty	symmetric/ bidirectional
Jostmann, Lakens, and Schubert (2009) and Schneider, Rutjens, Jostmann, and Lakens (2011) [60], [61]	Weight-Important	symmetric/ bidirectional
Ouellet et al. (2010) [62]	Past time-Left Future time-Right	symmetric/ bidirectional
Meier, Robinson, and Clore (2004) and Meier, Robinson, Crawford, and Ahlvers (2007) [26], [63]	Good-Brightness Bad-Darkness	symmetric/ bidirectional
Meier and Robinson (2004) [38]	Positive-Up Negative-Down	symmetric/ bidirectional

powerful role in shaping the metaphoric representations [35], [36]. Nevertheless, it is worth taking these questions into consideration in future research about whether, when, and how the metaphoric mappings are unidirectional or bidirectional.

Stroop-like Interference Effects: Is Metaphor Automatic?

Whether metaphor is a necessary part and is automatically activated while people process concepts is another important question, which was firstly investigated by Meier et al. (2004) [26]. They tested the association between affect and brightness by asking participants to evaluate emotional words which were presented randomly in either black or white color. Results showed that participants' responses were faster and more accurate when positive words in white color and negative words in black color (which we call the metaphor-congruent condition) than positive words in black color and positive words in white color (the metaphor-incongruent condition), suggesting that the brightness of stimuli is activated when doing valence-judgment. The judgment of the stimulus' valence is facilitated when its meaning and color are consistent with common metaphors. Conversely, judgments are interfered when they are inconsistent. This paradigm is assumed to investigate the automaticity of metaphoric representation, because the manipulation of concrete dimension is completely uninformative and irrelevant to the task on abstract concepts, such as power considered to be automatically connected to vertical position [37]; the association between affect and vertical position considered to be automatic [38]; affective evaluations considered to bias subsequent tone categorization automatically [39]; closeness considered to be mapped onto similarity automatically [40]. Meier and Robinson (2004) explained the metaphor congruency effects as the results of Stroop-like inference effect [34], [38].

The typical Stroop effect [41] refers to longer response times were needed when participants named the ink color of a color word depicting a color incongruent with the ink color than a color congruent with the ink color. This was extended to a general interference which occurs when irrelevant stimuli co-occur inconsistently with relevant stimuli (e.g., the word "red" was presented in green font) [42]. Automatic processes are fast and do not require attention for execution and thus automaticity account was applied to explain the Stroop effect [43].

In the Stroop effect, there are two dimensions of stimuli, one (naming the ink color) requires much more attention and is processed slower than the other (reading the irrelevant word), thus the relatively slower color naming requires much more attention resources which is considered to be controlled than the relatively fast word reading that is considered to be automatic. Based on this, the automatic process cannot be withdrawn and interfere with the controlled process, but not vice versa. The interference was explained as automatic activation of the irrelevant information (e.g., the meaning of the word) when doing the target task (naming the font color of the word). Macleod and Dunbar (1988) [44] proposed the view of automaticity as a continuum against the all-or-none view of automaticity, Kahneman and Chajczyk (1983) [45] indicated that a process is considered as strongly automatic if it is unaffected by attention-allocation strategy; or as partly automatic if it can occur largely without attention, but is affected by attention.

Similarly, the metaphoric congruent effect occurs in the situation that processing the valence of affective words was influenced by the irrelevant brightness of the words. Likewise, there are two dimensions of stimuli too: one refers to the valence of the stimuli (abstract domain) which requires more attention than the other dimension, i.e., the brightness of the stimuli (concrete domain). The brightness of words was automatically activated even when participants were asked to evaluate the valence of the words by ignoring the brightness of them. Two dimensions here refer to the two domains of conceptual metaphors. The source domain is processed automatically without explicit attention even though it is uninformative for the processing of target domain. This automaticity view is consistent with Lakoff's (1993) view [46] that metaphoric mapping is used automatic and obligatory and it is an implicit cognitive process with neither effort nor awareness [34], [47].

Meier and Robinson (2005) [48] also advocated testing the automaticity or obligatoriness of metaphoric associations. Many researchers theoretically explained the process of conceptual mapping is automatic [38], [40], [49], [50]. However, this automaticity view has rarely been directly tested in the literature with few exceptions [51]. Therefore, I reviewed the empirical studies related to the automaticity of conceptual metaphor in Table 2.

Table 2. Studies on the automaticity of metaphoric associations

References	Related Metaphor	Automatic/ non-automatic
Giessner, Ryan, Schubert, and van Quaquebeke (2011) [37]	Powerful-Up Powerless-Down	Non-automatic
Boot and Pecher (2009) [40]	Near-Similar Far-Dissimilar	Automatic
Meier et al. (2007) [63]	Positive-Brightness Negative-Darkness	Automatic
Meier and Robinson (2004) [38]	Positive-Up Negative-Down	Automatic
Meier et al. (2004) [26]	Positive-White Negative-Black	Automatic
Cacioppo, Priester, and Berntson (1993) [64]	Like-Toward oneself Dislike-Away from oneself	Automatic
Santiago, Ouellet, Roman, and Valenzuela (2012) [51]	Positive-Up Negative-Down	Non-automatic

As shown in Table 2, it is clear that some studies tried to test automaticity to some extent which referred to valance-space metaphor, power-space metaphor, similarity-distance metaphor, and so on. Some studies let participants finish two tasks sequentially or do conceptual tasks while concrete factor was controlled. However, it is inconsistent in these studies and no one tried to provide a standard about it. Usually, if participants do not have the instruction or desire to use metaphors in experiment and these metaphors indeed are activated, this shows that metaphors are automatically activated. However, these inconsistent findings prevent us from having a clear conclusion about the automaticity of the activation of conceptual metaphor, which could be further investigated in future studies.

Conclusion

In this review, I started with the introduction of opposite opinions between amodal and modal theories, and then reached the aim of this review: conceptual metaphor theory. Conceptual metaphor theory proposed that understanding and representing abstract concepts need to rely on concrete concepts via metaphoric mappings. I focus on three issues related to conceptual metaphor theory in this review. The first issue I am concerned about is the underlying process of metaphoric mappings from concrete information to abstract concepts. Lakoff and Johnson put forward that source domain (concrete concepts) can be used to represent target domain (abstract concepts) [2]. The metaphoric mappings from source domains to target domains are characterized as image schemas, which structure and provide sensory-motor grounding for abstract concepts. The second issue I discuss is the directionality of the metaphoric mappings. According to conceptual metaphor theories, metaphoric mappings have the directionality from concrete domain to abstract domain. Understanding abstract concepts is based on concrete sensory-motor experience, but concrete concepts do not depend on abstract concepts. Although this unidirectional view is widely accepted, many studies found the effects in both concrete-to-abstract and abstract-to-concrete directions. Future research should take more consideration into whether, when, and how the metaphoric mappings are unidirectional or bidirectional. Similar debates existed in the issue of automaticity of conceptual metaphor, which is the third issue I discussed. From this review, we have some extent understanding about conceptual metaphor, including the underlying processes, its directionality, and automaticity. Nevertheless, debates still exist, and follow up studies are worthwhile to be conducted further to make it clearer and deepen our understanding.

Competing Interests

The author declares no competing financial or nonfinancial interests.

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References

1. Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Vol. 111. Chicago, IL, University of Chicago Press.
2. Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to western thought*. New York, Basic Books.
3. Ryle, G. (1949). *The concept of mind*. University of Chicago Press.
4. Watson, J.B. (1913). Psychology as the Behaviorist Views it. *Psychological Review*, 20(2), 158. https://doi.org/10.1037/h0074428
5. Ludwig, W. and Anscombe, G. (1953). *Philosophical investigations*. London, Basic Blackw.
6. Barsalou, L.W. (1999). Perceptual symbol systems. *Behavioral and Brain Sciences*, 22(4), 577-660.
7. Barsalou, L. W., Niedenthal, P. M., Barbey, A. K., & Ruppert, J. A. (2003). Social embodiment. *Psychology of Learning and Motivation*, 43, 43-92.
8. Kunda, Z. (1999). *Social cognition: Making sense of people*. MIT press.
9. Smith, E.R. (1998). Mental representation and memory, in *The handbook of social psychology*. 391-445.
10. Wyer Jr, R.S. and Srull, T.K. (2014). *Handbook of social cognition: Applications*(Volume 2). Psychology Press.
11. Lakoff, G. and Johnson, M. (1980). The metaphorical structure of the human conceptual system. *Cognitive Science*, 4(2),195-208. https://doi.org/10.1207/s15516709cog0402_4
12. Barsalou, L.W. (2008). Grounded cognition. *Annual Review of Psychology*, 59, 617-645.
13. Damasio, A.R. and Damasio, H. (1994). Cortical systems for retrieval of concrete knowledge: The convergence zone framework. *Large-scale Neuronal Theories of the Brain*, 61-74.
14. Niedenthal, P. M., Barsalou, L. W., Winkielman, P., Krauth-Gruber, S., & Ric, F. (2005). Embodiment in attitudes, social perception, and emotion. *Personality and Social Psychology Review*, 9(3), 184-211. https://doi.org/10.1207/s15327957pspr0903_1
15. Anderson, J.R.(1990). *The adaptive character of thought*. Psychology Press.
16. Fodor, J.A.(1983). *The modularity of mind*. Cambridge, MA, MIT Press.
17. Jackendoff, R. and Jackendoff, R.S. (2002). *Foundations of language: Brain, meaning, grammar, evolution*. Oxford University Press, USA.
18. Gallese, V. and Lakoff, G. (2005). The brain's concepts: The role of the sensory-motor system in conceptual knowledge. *Cognitive Neuropsychology*, 22(3-4), 455-479. https://doi.org/10.1080/02643290442000310
19. Zwaan, R.A.(2004). The immersed experiencer: Toward an embodied theory of language comprehension. *Psychology of Learning and Motivation*, 44, 35-62.
20. Rohlfing, K.J. and Tani, J. (2011). Grounding language in action. *IEEE Transactions on Autonomous Mental Development*, 3(2), 109-112. https://doi.org/10.1109/tamd.2011.2140890
21. Glenberg, A.M. and Kaschak, M.P. (2002). Grounding language in action. *Psychonomic Bulletin & Review*, 9(3), 558-565. https://doi.org/10.3758/bf03196313
22. Pulvermüller, F.(1999). Words in the brain's language. *Behavioral and Brain Sciences*, 22(2), 253-279.
23. Gibbs Jr, R.W. (2005). *Embodiment and cognitive science*. Cambridge University Press.
24. Boroditsky, L.(2000). Metaphoric structuring: Understanding time through spatial metaphors. *Cognition*, 75(1), 1-28. https://doi.org/10.1016/s0010-0277(99)00073-6
25. Murphy, G.L.(1996). On metaphoric representation. *Cognition*, 60(2), 173-204.
26. Meier, B. P., Robinson, M. D., & Clore, G. L. (2004). Why good guys wear white: Automatic inferences about stimulus valence based on brightness. *Psychological Science*, 15(2), 82-87. https://doi.org/10.1111/j.0963-7214.2004.01502002.x
27. Casasanto, D. and Boroditsky, L. (2008). Time in the mind: Using space to think about time. *Cognition*, 106(2), 579-593. https://doi.org/10.1016/j.cognition.2007.03.004
28. Piaget, J. and Inhelder, B. (1972). *The psychology of the child*. Vol. 5001. New York, Basic Books.

29. Santiago, J., Román, A., and Ouellet, M. (2011). Flexible foundations of abstract thought: A review and a theory, in *Spatial dimensions of social thought*, A.M.T. Schubert, Editor. de Gruyter. Berlin, Germany, 39-108. https://doi.org/10.1515/9783110254310.39
30. Sweetser, E. (1990). *From etymology to pragmatics: Metaphorical and cultural aspects of semantic structure*. Vol. 54. Cambridge University Press.
31. Lee, S.W.S. and Schwarz, N. (2012). Bidirectionality, mediation, and moderation of metaphorical effects: The embodiment of social suspicion and fishy smells. *Journal of Personality and Social Psychology*, 103(5), 737-749. https://doi.org/10.1037/a0029708
32. Witt, J.K. (2011). Action's effect on perception. *Current Directions in Psychological Science*, 20(3), 201-206. https://doi.org/10.1177/0963721411408770
33. Zadra, J.R. and Clore, G.L. (2011) Emotion and perception: The role of affective information. *Wiley Interdisciplinary Reviews: Cognitive Science*, 2(6), 676-685. https://doi.org/10.1002/wcs.147
34. Lakens, D. (2010). Abstract concepts in grounded cognition. *Dissertatie reeks Kurt Lewis Instituut*.
35. Boroditsky, L. (2001). Does language shape thought? Mandarin and English speakers' conceptions of time. *Cognitive Psychology*, 43(1), 1-22. https://doi.org/10.1006/cogp.2001.0748
36. Boroditsky, L. and Ramscar, M. (2002). The roles of body and mind in abstract thought. *Psychological Science*, 13(2), 185-189. https://doi.org/10.1111/1467-9280.00434
37. Giessner, S. R., Ryan, M. K., Schubert, T. W., & van Quaquebeke, N. (2011). The power of pictures: Vertical picture angles in power pictures. *Media Psychology*, 14(4), 442-464. https://doi.org/10.1080/15213269.2011.620541
38. Meier, B.P. and Robinson, M.D. (2004). Why the sunny side is up: Associations between affect and vertical position. *Psychological Science*, 15(4), 243-247. https://doi.org/10.1111/j.0956-7976.2004.00659.x
39. Weger, U. W., Meier, B. P., Robinson, M. D., & Inhoff, A. W. (2007). Things are sounding up: Affective influences on auditory tone perception. *Psychonomic Bulletin & Review*, 14(3), 517-521. https://doi.org/10.3758/bf03194100
40. Boot, I., & Pecher, D. (2010). Similarity is closeness: Metaphorical mapping in a conceptual task. *The Quarterly Journal of Experimental Psychology*, 63(5), 942-954. https://doi.org/10.1080/17470210903134351
41. Stroop, J.R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18(6), 643-662. https://doi.org/10.1037/h0054651
42. MacLeod, C.M. (1991). Half a century of research on the stroop effect: An integrative review. *Psychological Bulletin*, 109(2), 163-203. https://doi.org/10.1037/0033-2909.109.2.163
43. Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychological Review*, 84(2), 127-190. https://doi.org/10.1037/0033-295x.84.2.127
44. Macleod, C. M., & Dunbar, K. (1988). Training and Stroop-like interference: Evidence for a continuum of automaticity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 14(1), 126-135. https://doi.org/10.1037/0278-7393.14.1.126
45. Kahneman, D., & Chajczyk, D. (1983). Tests of the automaticity of reading: Dilution of Stroop effects by color-irrelevant stimuli. *Journal of Experimental Psychology: Human Perception and Performance*, 9(4), 497-509. https://doi.org/10.1037/0096-1523.9.4.497
46. Lakoff, G. (1993). The contemporary theory of metaphor, in *Metaphor and thought*, A. Ortony, Editor. Cambridge University Press.New York, 202-251. https://doi.org/10.1017/cbo9781139173865.013
47. Gibbs Jr, R.W. (1994) *The poetics of mind: Figurative thought, language, and understanding*. Cambridge University Press.
48. Meier, B. P., & Robinson, M. D. (2005). The metaphorical representation of affect. *Metaphor and Symbol*, 20(4), 239-257. https://doi.org/10.1207/s15327868ms2004_1
49. Schubert, T.W. (2005). Your highness: Vertical positions as perceptual symbols of power. *Journal of Personality and Social Psychology*, 89(1), 1-21. https://doi.org/10.1037/0022-3514.89.1.1
50. van Elk, M., & Blanke, O. (2011). The relation between body semantics and spatial body representations. *Acta Psychologica*, 138(3), 347-358.

51. Santiago, J., Ouellet, M., Roman, A., & Valenzuela, J. (2012). Attentional factors in conceptual congruency. *Cognitive Science*, 36(6), 1051-1077. https://doi.org/10.1111/j.1551-6709.2012.01240.x

52. Ouellet, M., Santiago, J., Funes, M. J., & Lupiáñez, J. (2010). Thinking about the Future Moves Attention to the Right. *Journal of Experimental Psychology: Human Perception and Performance*, 36(1), 17-24. https://doi.org/10.1037/a0017176

53. Wapner, S., Werner, H., & Krus, D. M. (1957). The effect of success and failure on space localization. *Journal of Personality*, 25(6), 752-756.

54. Adam, H., & Galinsky, A. D. (2012). Enclothed cognition. *Journal of Experimental Social Psychology*, 48(4), 918-925.

55. Casasanto, D. (2009). Embodiment of abstract concepts: Good and bad in right- and left-handers. *Journal of Experimental Psychology: General*, 138(3), 351-367. https://doi.org/10.1037/a0015854

56. IJzerman, H., & Semin, G. R. (2009). The thermometer of social relations: Mapping social proximity on temperature. *Psychological Science*, 20(10), 1214-1220. https://doi.org/10.1111/j.1467-9280.2009.02434.x

57. Giessner, S. R., & Schubert, T. W. (2007). High in the hierarchy: How vertical location and judgments of leaders' power are interrelated. *Organizational Behavior and Human Decision Processes*, 104(1), 30-44. https://doi.org/10.1016/j.obhdp.2006.10.001

58. Zhong, C. B., & Liljenquist, K. (2006). Washing away your sins: Threatened morality and physical cleansing. *Science*, 313(5792), 1451-1452. https://doi.org/10.1126/science.1130726

59. Zhong, C. B., Strejcek, B., & Sivanathan, N. (2010). A clean self can render harsh moral judgment. *Journal of Experimental Social Psychology*, 46(5), 859-862. https://doi.org/10.1016/j.jesp.2010.04.003

60. Schneider, I. K., Rutjens, B. T., Jostmann, N. B., & Lakens, D. (2011). Weighty matters importance literally feels heavy. *Social Psychological and Personality Science*, 2(5), 474-478.

61. Jostmann, N. B., Lakens, D., & Schubert, T. W. (2009). Weight as an embodiment of importance. *Psychological Science*, 20(9), 1169-1174. https://doi.org/10.1111/j.1467-9280.2009.02426.x

62. Ouellet, M., Santiago, J., Israeli, Z., & Gabay, S. (2010). Is the future the right time? *Experimental Psychology*, 57(4), 308-314. https://doi.org/10.1027/1618-3169/a000036

63. Meier, B. P., Robinson, M. D., Crawford, L. E., & Ahlvers, W. J. (2007). When "light" and "dark" thoughts become light and dark responses: Affect biases brightness judgments. *Emotion*, 7(2), 366-376. https://doi.org/10.1037/1528-3542.7.2.366

64. Cacioppo, J. T., Priester, J. R., & Berntson, G. G. (1993). Rudimentary determinants of attitudes: II. Arm flexion and extension have differential effects on attitudes. *Journal of Personality and Social Psychology*, 65(1), 5-17. https://doi.org/10.1037/0022-3514.65.1.5

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