



Cognitive Science 39 (2015) 1979–1986

Copyright © 2015 Cognitive Science Society, Inc. All rights reserved.

ISSN: 0364-0213 print / 1551-6709 online

DOI: 10.1111/cogs.12294

Meaning is Not a Reflex: Context Dependence of Spatial Congruity Effects

Daniel Casasanto,^a Geoffrey Brookshire,^a Richard Ivry^b

^a*Psychology Department, University of Chicago*

^b*Psychology Department, University of California at Berkeley*

Received 22 December 2014; received in revised form 29 May 2015; accepted 4 June 2015

Abstract

In two experiments, Brookshire, Ivry, and Casasanto (2010) showed that words with positive and negative emotional valence can activate spatial representations with a high degree of automaticity, but also that this activation is highly context dependent. Lebois, Wilson-Mendenhall, and Barsalou (2015) reported that they “aimed to replicate” our study but found only null results in the “Brookshire et al. replication” conditions. Here we express concerns about three aspects of this paper. First, the study was not an attempt to replicate ours; it was a different study that adapted our method. Second, Lebois et al. did not accurately represent our theoretical position. Third, Lebois et al.’s main conclusion, that spatial congruity effects depend on the task context, was not supported by their data. Despite these concerns, we agree with Lebois et al.’s overall message that spatial aspects of words’ meanings are activated differently in different contexts. This was a main conclusion of our study as well.

Keywords: Conceptual metaphor; Context; Replication; Space; Valence

1. Introduction

In a 2010 paper (Brookshire et al., 2010), we proposed that the notion of “automaticity” typically used in cognitive psychology may not be appropriate for characterizing word meanings. In two experiments, we showed that implicit associations between vertical space and emotional valence are activated with a high degree of automaticity when people read positively or negatively valenced words—but also that “automaticity has its limits” (p. 1944). Previous theories, even those that emphasize the importance of context, have maintained that “context-independent properties form the core meanings of words”

Correspondence should be sent to Daniel Casasanto, Department of Psychology, University of Chicago, 5848 S. University Ave., Chicago, IL 60637. E-mail: casasantod@uchicago.edu

(Barsalou, 1982, p. 82). By contrast, we proposed that “context can modulate the activation of even those aspects of a word’s meaning that might seem to be indispensable.” We concluded that “the idea that there are necessary parts (i.e., features) of concepts or word meanings . . . is difficult to maintain” (pp. 1940–1941).

In our experiments, participants saw positive or negative words (e.g., hero, villain) presented in the center of a screen in either purple or green font, and they pressed a button that matched the font color. Pressing one button required an upward movement, and the other a downward movement. In some experimental conditions, participants responded faster when the direction of movement was congruent with the valence of the word (up for positive, down for negative) than when direction and valence were incongruent. This was true even though neither the spatial positions of the buttons nor the meanings of the words were relevant to the task, indicating that space-valence associations were activated highly automatically.

In other conditions, however, we showed that space-valence congruity effects could be extinguished when the list of stimulus words was repeated for a second time (Brookshire et al., 2010, Expt. 1) or when participants were oriented (even more strongly) toward the words’ font colors rather than their meanings (Brookshire et al., 2010, Expt. 2). Whereas previous studies had concluded that words activate spatial representations “automatically” (Bergen, Lindsay, Matlock, & Narayanan, 2007; Meier & Robinson, 2004) and “reflexively” (Estes, Verges, & Barsalou, 2008), we concluded that automaticity is “a continuum” and that “meaning is not a reflex” (p. 1941; see also Casasanto, 2011; Casasanto & Lupyan, 2015; Lai, Hagoort, & Casasanto, 2012; Lupyan & Casasanto, 2014; Van Ackeren, Casasanto, Bekkering, Hagoort, & Rueschemeyer (2012); Willems & Casasanto, 2011).

In a *Cognitive Science* paper, Lebois et al. (2015) used similar methods and arrived at strikingly similar conclusions. Although we agree broadly with these conclusions, we are concerned about three aspects of the paper. First, Lebois et al. claimed that they conducted a “Brookshire et al. replication” (a phrase the authors used 24 times), but they did not replicate our results. In fact, Lebois et al. did not *attempt* to replicate them; our study and Lebois et al.’s tested different theories, using different kinds of stimuli. Second, Lebois et al. did not accurately represent our theoretical position on the context dependence of spatial congruity effects, which anticipated theirs. Third, Lebois et al.’s main conclusion was that spatial congruity effects depend on the task context, but their data do not support this conclusion (i.e., there was no significant effect of task context). We briefly explain each of these concerns below and discuss how following some of Daniel Kahneman’s (2014) suggestions for “replication etiquette” could have prevented misleading claims from being enshrined in the scientific record.

2. Lebois et al. did not conduct a replication of Brookshire et al.’s experiments

Lebois et al. reported that they “aimed to replicate” Brookshire et al.’s study (p. 1775), but they found only null results in the “Brookshire et al. replication” conditions. These statements give the strong impression that they attempted and failed to

replicate our findings. Although Lebois et al. adapted our method, they performed a different experiment, using a different kind of stimulus. As such, Lebois et al.'s results and ours are hard to compare.

We used words that varied in their emotional valence, and we tested how automatically participants activated metaphorical spatial schemas (Good is Up; Bad is Down; Lakoff & Johnson, 1980), in different contexts. By contrast, Lebois et al. used words referring to objects that varied in their canonical up/down spatial locations (hat, sock). Our experiment was motivated by metaphor theory (Lakoff & Johnson, 1980), theirs by the theory of modality-specific simulation (Barsalou, 1999). A match between our results and theirs could not be considered a "replication," and a mismatch between the two sets of results cannot be considered a failure to replicate. Lebois et al. acknowledged some differences between our studies, but this does little to mitigate the impression that their paper reports a failed "Brookshire et al. replication"—which was not the case.

Despite the important differences between studies, the methods used in one of our conditions and one of Lebois et al.'s were similar. Why did Brookshire et al. (2010) find significant congruity effects under task conditions where Lebois et al. (2015) found none? Lebois et al. suggested that, if vertical spatial congruity effects are to be found, they should be found for words with literal spatial connotations (like they used) rather than words with metaphorical spatial connotations (like we used; see Bergen et al., 2007). Yet, whether one kind of stimulus or another produces stronger spatial congruity effects may depend critically on the details of the particular stimuli. Lebois et al. used unpublished stimuli that Casasanto constructed and normed. These object words were normed in the same way as the valenced words used by Brookshire et al. For both word lists, participants were asked to think about whether each word was associated with "upward or downward space" and then to rate "how far up or how far down the meaning of each word is" relative to the other words in its list, using nine-point scales. Overall, ratings were significantly more extreme for the metaphorical stimuli than for the literal stimuli ($t(190) = 2.79, p = .006$). This difference was driven by the "down" words. "Up" word ratings did not differ significantly between stimulus sets, but on average the negative valence words (e.g., hate, evil) were rated 1.33 points closer to "very low" in space than the literal object words (e.g., submarine, dungeon; $t(94) = 5.20, p = .000001$). This difference in the ratings alone predicts that spatial congruity effects may be stronger and easier to detect for the valenced words we used than for the literal spatial words Lebois et al. used.

Are the space-valence congruity effects that we found replicable? Three lines of evidence suggest they are. First, although we showed a space-valence congruity effect with shallower, more incidental processing of both space and valence than had been reported previously, related space-valence congruity effects have been shown many times (e.g., Brunyé, Gardony, Mahoney, & Taylor, 2012; Casasanto, 2009; Casasanto & Dijkstra, 2010; Crawford, Margolies, Drake, & Murphy, 2006; Meier & Robinson, 2004; Riskind, 1983; Tracy & Matsumoto, 2008; etc.) Second, we internally replicated our space-valence congruity effect using our font-color judgment task, across two experiments (Brookshire et al., 2010, Expt. 1, first repetition, and Expt. 2, meaning-orientation condition). Third,

Dudschig, de la Vega, De Filippis, and Kaup (2014) performed a conceptual replication of our font-color judgment task with valenced words and found a significant space-valence congruity effect—independently replicating our effect, again.

Furthermore, in addition to metaphor-congruity effects, vertical congruity effects have also been shown repeatedly for words with literal spatial connotations like Lebois et al. used (e.g., Estes et al., 2008; Lachmair, Dudschig, De Filippis, de la Vega, & Kaup, 2011; Šetić & Domijan, 2007; Zwaan & Yaxley, 2003a,b). Of particular relevance, Dudschig, Lachmair, de la Vega, De Filippis, and Kaup (2012) and Dudschig et al. (2014) reported six extensions of Brookshire et al.'s font-color judgment task: four experiments with up/down verbs (e.g., rise, fall) and two with up/down object words (e.g., cloud, shoe), like Lebois et al. used. Unlike Lebois et al., however, Dudschig et al. found significant spatial congruity effects across all six experiments, despite the fact that both the response direction and the words' meanings were irrelevant.

Dudschig and colleagues reported a total of seven experiments showing literal or metaphorical up/down spatial congruity effects using Brookshire et al.'s (2010) font-color judgment task. Such strong evidence that significant spatial congruity effects can be found with our task complicates Lebois et al.'s inherently problematic claim that they "predicted these null effects" (p. 1787).

Lebois et al. justified predicting null results by suggesting that "it is unclear whether, in [Brookshire et al.'s] studies, participants were aware of the verticality manipulation" (p. 1775). To be "aware," in Lebois et al.'s study, meant that participants were told: "The words you will see all have spatial qualities. For example, some will imply a low spatial location . . . while others will imply a higher location" (p. 1777). By this definition of "aware," it is certain that our participants were *not* aware of the verticality manipulation. A key feature of these experiments was that both valence and space were irrelevant to the task, concealing the verticality manipulation rather than calling participants' attention to it explicitly. A post-experiment debriefing probed participants' guesses about the purpose of the task. This debriefing was not discussed in our short report, due both to space limitations and to the fact that no participant revealed any knowledge of the metaphorical spatial content of the stimuli. Awareness of the verticality implied by the stimuli, therefore, cannot explain the difference between Lebois et al.'s results and ours.

Some null results are inevitable for almost any task that is run many times. Furthermore, shallow-processing tasks like ours often produce weaker effects than deeper, meaning-based tasks (Craik & Lockhart, 1972), and they may be harder to replicate, in general. But in light of the multiple conceptual replications and extensions of our font-color judgment task for words implying literal or metaphorical space, Lebois et al.'s null results in their "unaware" condition are hard to interpret.

3. Lebois et al. did not accurately represent our theoretical position

A main objective of Brookshire et al.'s (2010) study was to test, for the first time, whether vertical space-valence congruity effects are context dependent. We advocated a

“dynamic view of word meaning” according to which “our stimulus words cued the activation of spatio-motor representations in some contexts more than in others” (p. 1944). This objective was not evident in Lebois et al.’s (2015) description of our study, according to which “Brookshire et al. observed congruency effects that appeared to occur automatically (i.e., with no assistance from instructions or orienting tasks)” (p. 1783). This is only part of the story: Brookshire et al. wrote that “Stroop-like congruity effects suggest that spatial representations are activated with a considerable degree of automaticity when people read valenced words. The goal of [our] study was *to test the limits of this automaticity*” (p. 1941, italics added).

Partly by omission, Lebois et al. suggested that we were among the researchers who assume “congruency effects result from automatic and context-independent activation” (Lebois et al., 2015, p. 1770). Our paper did not suggest that spatial congruity effects are context-independent, but many other papers have made this assertion—ironically, these include papers by Barsalou and colleagues (e.g., Estes et al., 2008; Richardson, Spivey, Barsalou, & McRae, 2003). Of particular relevance to Lebois et al.’s paper, Estes et al. (2008) showed participants words for objects with canonical vertical spatial locations (e.g., head, foot), at the top or bottom of the screen. Participants responded *slower and less accurately* (cf., Lebois et al.) if the target appeared in a congruent spatial location. According to Estes et al. (2008), the activation of task-irrelevant spatial features of object words’ meanings is “automatic” and “reflexive” (p. 97).

Contrary to the conclusions of Estes et al. (2008), Lebois et al. wrote that “even the most salient features in a word’s meaning are not activated automatically” (p. 1764). We agree: We made this same point in Brookshire et al. (2010, pp. 1940–41; see Section 1 of this commentary) and in several other papers (e.g., Casasanto, 2011; Casasanto & Lupyan, 2015; Lai et al., 2012; Lupyan & Casasanto, 2014; Willems & Casasanto, 2011).

4. Lebois et al. did not provide any evidence that context modulates congruity effects

Although the title of Lebois et al.’s paper promises evidence for “the context-dependence of spatial meaning in grounded congruency effects,” their data did not show any significant effect of context. Showing a context effect would require showing that the context manipulation had a significant influence on the spatial congruity effects observed, indicated by an interaction of Congruity (Congruent, Incongruent) by Context (Aware, Unaware). Yet these necessary interactions did not approach significance, in either of the context-manipulation experiments (Expt. 1: $p = .22$; Expt. 2: $p = .30$). Lebois et al.’s main conclusion, that “congruency effects rely dynamically on context” (p. 1764), is not supported by the data, which showed only null effects of context.

Lebois et al.’s conclusions appear to be based on the fact that significant congruity effects were found in the “aware” condition but not in the “unaware” condition. Yet this pattern of results is neither necessary nor sufficient to support their claim. Claiming a

context effect on the basis of these data is like claiming that a drug is effective because a significant effect was found in the treatment condition but not in the placebo condition—even though there was *no difference* between treatment and placebo effects. This pattern of data would offer no evidence for the efficacy of the drug; likewise, the pattern Lebois et al. reported offers no evidence that the task context (i.e., different instructions) modulated spatial congruity effects.

5. Conclusions

Our main concern is not about whether Lebois et al.'s context effects were significant or whether the claims from recent papers on spatial congruity effects are mutually consistent. Our concern is with the potential reputational cost of having a paper published that we believe to be misleading: both about the replicability of our study and the theoretical position we argued regarding the context dependence of space-valence congruity effects. Lebois et al. did not conduct a replication of Brookshire et al. (2010). Loose use of the term “replication,” especially when the supposed replication produces a null result, is problematic. As Daniel Kahneman (2014) pointed out in a commentary on replication etiquette:

Even rumors of a failed replication cause immediate reputational damage by raising a suspicion of negligence (if not worse). The hypothesis that the failure is due to a flawed replication comes less readily to mind[.]

Kahneman suggests that “a good-faith effort to consult with the original author should be viewed as essential to a valid replication”. If we had been consulted at any point during the writing or review of Lebois et al.'s paper, we could have potentially avoided having misleading claims added to the scientific record.

We disagree with Lebois et al.'s treatment of “automaticity” as binary rather than continuous, but we are very much in agreement with their conclusions about the context dependence of all aspects of meaning—a major theme of our own research (see Casasanto & Lupyan, 2015). In the future, we would hope for closer agreement with the authors about what constitutes a replication attempt and how we can proceed most collegially in performing and publishing them.

Acknowledgments

This research was supported by an NSF grant (BCS #125710) and a James S. McDonnell Foundation Scholar Award (#220020236) to D.C.

References

- Barsalou, L. W. (1982). Context-independent and context-dependent information in concepts. *Memory and Cognition*, 10(1), 82–93.
- Barsalou, L. W. (1999). Perceptual symbol systems. *Behavioral and Brain Sciences*, 22, 577–660.
- Bergen, B. K., Lindsay, S., Matlock, T., & Narayanan, S. (2007). Spatial and linguistic aspects of visual imagery in sentence comprehension. *Cognitive Science*, 31(5), 733–764.
- Brookshire, G., Ivry, R., & Casasanto, D. (2010). Modulation of motor-meaning congruity effects for valenced words. In S. Ohlsson & R. Catrambone (Eds.), *Proceedings of the 32nd Annual Conference of the Cognitive Science Society* (pp. 1940–1945). Austin, TX: Cognitive Science Society.
- Brunyé, T. T., Gardony, A., Mahoney, C. R., & Taylor, H. A. (2012). Body-specific representations of spatial location. *Cognition*, 123(2), 229–239.
- Casasanto, D. (2009). Embodiment of abstract concepts: Good and bad in right- and left-handers. *Journal of Experimental Psychology: General*, 138(3), 351.
- Casasanto, D. (2011). Different bodies, different minds: The body-specificity of language and thought. *Current Directions in Psychological Science*, 20(6), 378–383.
- Casasanto, D., & Dijkstra, K. (2010). Motor action and emotional memory. *Cognition*, 115(1), 179–185.
- Casasanto, D., & Lupyan, G. (2015). All concepts are ad hoc concepts. In E. Margolis & S. Laurence (Eds.), *The conceptual mind: New directions in the study of concepts* (pp. 543–566). Cambridge, MA: MIT Press.
- Craik, F. I., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, 11(6), 671–684.
- Crawford, L. E., Margolies, S. M., Drake, J. T., & Murphy, M. E. (2006). Affect biases memory of location: Evidence for the spatial representation of affect. *Cognition and Emotion*, 20(8), 1153–1169.
- Dudschig, C., de la Vega, I., De Filippis, M., & Kaup, B. (2014). Language and vertical space: On the automaticity of language action interconnections. *Cortex*, 58, 151–160.
- Dudschig, C., Lachmair, M., de la Vega, I., De Filippis, M., & Kaup, B. (2012). Do task-irrelevant direction-associated motion verbs affect action planning? Evidence from a Stroop paradigm. *Memory and Cognition*, 40(7), 1081–1094.
- Estes, Z., Verges, M., & Barsalou, L. W. (2008). Head up, foot down: Object words orient attention to the objects' typical location. *Psychological Science*, 19(2), 93–97.
- Kahneman, D. (2014). A new etiquette for replication. *Social Psychology*, 45(4), 299–311.
- Lachmair, M., Dudschig, C., De Filippis, M., de la Vega, I., & Kaup, B. (2011). Root versus roof: Automatic activation of location information during word processing. *Psychonomic Bulletin and Review*, 18(6), 1180–1188.
- Lai, V. T., Hagoort, P., & Casasanto, D. (2012). Affective primacy vs. Cognitive primacy: Dissolving the debate. *Frontiers in Cognitive Science*, 3(243), 1–8.
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.
- Lebois, L. A., Wilson-Mendenhall, C. D., & Barsalou, L. W. (2015). Are automatic conceptual cores the gold standard of semantic processing? The context-dependence of spatial meaning in grounded congruency effects. *Cognitive Science*, 39(8), 1764–1801. doi:10.1111/cogs.12174.
- Lupyan, G., & Casasanto, D. (2015). Meaningless words promote meaningful categorization. *Language and Cognition*, 7(02), 167–193.
- Meier, B. P., & Robinson, M. D. (2004). Why the sunny side is up: associations between affect and vertical position. *Psychological Science*, 15(4), 243–247.
- Richardson, D. C., Spivey, M. J., Barsalou, L. W., & McRae, K. (2003). Spatial representations activated during real-time comprehension of verbs. *Cognitive Science*, 27(5), 767–780.
- Riskind, J. H. (1983). Nonverbal expressions and the accessibility of life experience memories: A congruence hypothesis. *Social Cognition*, 2(1), 62–86.

- Šetić, M., & Domijan, D. (2007). The influence of vertical spatial orientation on property verification. *Language and Cognitive Processes*, 22(2), 297–312.
- Tracy, J. L., & Matsumoto, D. (2008). The spontaneous expression of pride and shame: Evidence for biologically innate nonverbal displays. *Proceedings of the National Academy of Sciences*, 105(33), 11655–11660.
- Van Ackeren, M., Casasanto, D., Bekkering, H., Hagoort, P., & Rueschemeyer, S. A. (2012). Pragmatics in action: Indirect requests engage theory of mind areas and the cortical motor network. *Journal of Cognitive Neuroscience*, 4(11), 2237–2247.
- Willems, R. M., & Casasanto, D. (2011). Flexibility in embodied language understanding. *Frontiers in Psychology*, 2(116), 1–11.
- Zwaan, R. A., & Yaxley, R. H. (2003a). Spatial iconicity affects semantic relatedness judgments. *Psychonomic Bulletin and Review*, 10(4), 954–958.
- Zwaan, R. A., & Yaxley, R. H. (2003b). Hemispheric differences in semantic-relatedness judgments. *Cognition*, 87(3), B79–B86.