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Priming via relational similarity: A COPPER HORSE is faster when seen through a GLASS EYE

Zachary Estes [a,*], Lara L. Jones [b]

[a] *Department of Psychology, University of Warwick, Coventry CV4 7AL, UK*
[b] *University of Georgia, USA*

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Abstract

Relation priming is a phenomenon in which comprehension of a word pair (e.g., COPPER HORSE) is facilitated by the prior presentation of another word pair (e.g., GLASS EYE) that instantiates the same conceptual relation (i.e., *composed of*). We investigated whether relation priming is contingent on lexical similarity. Study 1 revealed that relational similarity, but not lexical similarity, reliably predicted noun phrase comprehension across several previously published experiments. Study 2 demonstrated relation priming between lexically dissimilar phrases (e.g., STEEL SCISSORS → STRAW HAT). Thus, across both studies, lexical similarity failed to explain relation priming. Rather, comprehension of a target phrase was a function of its relational similarity to the prime phrase. Results are inconsistent with models in which conceptual relations are bound to the particular concepts that instantiate them, and suggest instead that conceptual relations are independent representational units that can be utilized by various and dissimilar concepts.

Keywords: Conceptual combination; Relation priming; Semantic similarity; Relational similarity; Lexical similarity; Thematic relations

Semantic priming is among the most well-documented phenomena in cognitive psychology (e.g., Meyer & Schvaneveldt, 1971; for review, see Hutchison, 2003; Lucas, 2000). Relation priming, on the contrary, is a topic of current dispute. At contention is whether comprehension of a word pair (e.g., COPPER HORSE) can be facilitated by the prior presentation of another word pair (e.g., GLASS EYE) that instantiates the same conceptual relation (i.e., Y *composed of* X). Although several researchers have demonstrated such relation priming (Estes, 2003; Gerrig & Murphy, 1992; Spellman, Holyoak, & Morrison, 2001), others attribute this effect to semantic priming (Gagné, Spalding, & Ji, 2005; see also Gagné, 2001). At the heart of this empirical dispute is a deeper theoretical debate concerning the nature of relational representation.

In this article, we consider the evidence of relation priming in the absence of semantic priming. We introduce *relational similarity* as a critical determinant of relation priming. By "relational similarity" we mean the extent to which the relation instantiated by one phrase is similar to the relation instantiated by another phrase. Relational similarity is contrasted here from "lexical similarity," by which we mean the semantic similarity of the individual lexical concepts. Thus, lexical similarity refers to words (e.g., COPPER and GLASS), while

* Corresponding author.
E-mail address: z.estes@warwick.ac.uk (Z. Estes).

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relational similarity refers to word pairs (e.g., COPPER HORSE and GLASS EYE). After introducing two models of relational representation, we review the extant investigations of relation priming. Then we re-analyze some of the key data to test whether relational similarity does indeed predict comprehension above and beyond any influence of lexical similarity. Finally, we report a novel experiment that demonstrates relation priming in the absence of lexical similarity.

Models of relational representation

Concepts may be related in many ways, such as causally (e.g., ROPE BURN), temporally (e.g., WINTER HOLIDAY), spatially (e.g., TABLE VASE), compositionally (e.g., GLASS EYE), and so forth. The issue of present interest is whether such conceptual relations are represented as independent units in the semantic network, or whether these relations are represented as part of the particular concepts that instantiate them. According to a model of *bound representation* (henceforth the "bound model"), a relation is represented as part of the meaning of whatever concepts entail that relation. For instance, the *composition* relation of COPPER HORSE is represented as part of the meaning of COPPER. Gagné illustrates this position, arguing that "relations are associated with the modifier's representation, rather than existing as independent structures" (2001, p. 247). Alternatively, according to a model of *independent representation* (henceforth the "independent model"), relations constitute representational structures in and of themselves (Estes, 2003; see also Spellman et al., 2001). So, for example, the *composition* relation is represented independent of any particular concept; it is not part of the representation of COPPER, or GOLD, or any given concept. It may be activated by those concepts, but it is not a part of their representation. That is, COPPER may activate the *composition* relation, but that relation may nevertheless constitute an independent representation in and of itself.

The bound and independent models differ dramatically in terms of representational demand. Consider the phrases BEAR PAW and FAN BLADE, both of which instantiate a *part/whole* relation. If relations are bound to their particular concepts of instantiation, then it follows that these concepts (e.g., BEAR, FAN) must represent the *part/whole* relation separately. In fact, every concept that consists of one or more parts must represent the *part/whole* relation separately. Similarly, just about every concept must include the *cause* relation in its representation, since just about any concept can be involved in a causal relation (e.g., LOTTERY RETIREMENT). Stated alternatively, for every concept in one's semantic network, its representation must include every relation that the concept could possibly instantiate (cf. Murphy, 2002, p. 463). So for example, consider just a brief list of relations instantiated by the concept BEAR: BEAR PAW (*part/whole*), BEAR SCARE (*causal*), BEAR SEASON (*temporal*), BEAR TOY (*possessive*), BEAR TRACKS (*from*), BEAR CAVE (*habitat*), BEAR CUB (*subtype*), BEAR FAMILY (*of*), BEAR STORY (*about*), BEAR PLAYGROUND (*for*), etc. Given the variety of different relations that may be instantiated, in conjunction with the number of concepts that may instantiate them, such redundancy would be extremely taxing in terms of representational demand. Moreover, the processing demands entailed by such redundancy would seem to be computationally intractable; as the number of representations increases, so does the time and effort required to search through those representations. In contrast, the independent model does not suffer from this problem of redundancy. Because relations are independent of any particular concept, each relation need be represented only once, and hence the representational demand is minimal.

Thus, theoretical considerations appear to favor the independent model over the bound model. Nonetheless, empirical tests are ultimately necessary to reject either model. We therefore turn to the relation priming paradigm, which can empirically contrast the bound and independent models of relational representation.

Relation priming

In the relation priming paradigm, a target phrase (e.g., COPPER HORSE) is preceded by a prime phrase that uses either the same relation (e.g., GLASS EYE; Y *composed of* X) or a different relation (e.g., GLASS CUT; Y *caused by* X). If the target is comprehended faster and/or more accurately following the same relation prime, then relation priming has occurred. The bound and independent models make opposing predictions with regard to relation priming. According to the bound model, relation priming should only occur if a concept is repeated from prime to target (e.g., GLASS EYE → GLASS HORSE), since relational representations are concept-bound (Gagné, 2001). In contrast, the independent model claims that the same relational representation (e.g., *composition*) is activated by any phrase that instantiates that relation, and hence relation priming may occur without lexical repetition (e.g., GLASS EYE → COPPER HORSE; Estes, 2003). So this issue of relation priming critically discriminates between these alternative models of relational representation.

There have been few direct investigations of relation priming, and the results are mixed. There is clear evidence that relations can be contextually primed, in terms of facilitating relational comprehension in general (Wisniewski & Love, 1998), or of specific relations that occur frequently in a list of stimuli (McKoon & Ratcliff, 1995). Gerrig and Murphy (1992, Experiment 4) embedded critical word pairs in context stories. Some stories con-