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Short article

An asymmetric effect of relational integration on recognition memory

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Two experiments assessed whether conceptual relations (e.g., *contains*: COOKIE JAR) facilitate the retrieval of concepts (e.g., COOKIE and JAR) from long-term memory. The CARIN model of nominal combination asserts that conceptual relations are represented with and selected from the modifier noun (COOKIE). Thus, the model predicts that relational integration will facilitate memory for modifiers but not for head nouns (JAR). In Experiment 1, concepts were studied in pairs and were then tested individually. Recognition accuracy was higher for modifiers than for head nouns. In Experiment 2, the studied concepts (e.g., COOKIE JAR) were tested in the context of a new pair that instantiated either the same relation (e.g., COOKIE plate) or a different relation (e.g., COOKIE crumb). Recognition was again better for modifiers than for head nouns, but only when the same conceptual relation was instantiated at both study and test. Thus, results indicate that conceptual relations (a) facilitate recognition memory, and (b) are associated more strongly with the modifier than with the head noun.

Keywords: Conceptual combination; Associative recognition; Conceptual relations.

Nominal (noun–noun) combinations (e.g., FOOTBALL SOCKS) provide concise reference for a complex concept that would otherwise require lengthy description (SOCKS THAT ARE WORN WHILE PLAYING FOOTBALL). Moreover, the *modifier* (in English, the first word) specifies a subclass of the general category denoted by the *head noun* (i.e., the second word). For instance, CIRCUS LIONS are a specific subclass that differs from the general category of LIONS in important respects (e.g., they are tame). Nominal combinations (TABLE VASE) typically are comprehended by inferring some relation that integrates the two concepts (a VASE *located on* a TABLE). In addition

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to this *locative* relation, concepts may be related in numerous other ways, such as *causally* (WIND BURN), *temporally* (MIDNIGHT SNACK), *compositionally* (STRAW HAT), and so forth. The current study investigates the influence of such conceptual relations on retrieval of concepts from long-term memory (LTM).

Many studies have investigated the short-term representation of conceptual relations. During comprehension, a nominal combination (e.g., MARBLE STAIRS) is decomposed and maintained within working memory (WM) for several seconds as three independent entities (MARBLE, STAIRS, *composed-of*). Hummel and Holyoak (2003) describe a similar process for propositions (e.g., Bill *loves* Mary), whereby propositional relations (e.g., *loves*) are temporarily stored in WM separate from their arguments (e.g., Bill, Mary). The conceptual relation of a nominal combination (*composed-of*; MARBLE STAIRS) may remain active in WM for several seconds. In turn, the comprehension of a subsequent combination (WOOL SWEATER) that instantiates that same relation is facilitated (Estes, 2003; Estes & Jones, 2006; Gagné, 2001; Raffray, Pickering, & Branigan, 2007).

However, such short-term relational representations may differ from the long-term representations of current interest. After the first few seconds of maintenance in WM, the concepts and relations are encoded into LTM, wherein associations are formed to facilitate later retrieval (Cowan, 1988). Consequently, if more than a few seconds have passed, the to-be-remembered (henceforth "target") concepts are retrieved from LTM along with their associated relations. Thus, conceptual relations may facilitate retrieval from LTM by producing elaboration during encoding and by providing a contextual cue during retrieval.

Indeed, previous studies (e.g., Humphreys, 1976) have shown that memory for individual concepts (BOOK) is better when tested in their intact, studied pairs (BOOK DART; LAWN NEST) than when tested in rearranged pairs (BOOK NEST). However, because the rearranged pairs differ in both the context item and the relation between the concepts, it is unclear whether the facilitation observed in intact pairs is due to relational information or to item information. Item information refers to individual stimuli, whereas relational information refers to a semantic or temporal connection between stimuli. Although the effects of item and relational information are additive (Hunt & Einstein, 1981), they differ in both their encoding and retrieval. The encoding of item information focuses on the distinctiveness of each item (Hunt & Einstein, 1981). In contrast, the encoding of relational information reflects the similarities among stimuli or events (Hockley & Cristi, 1996). So whereas item retrieval is based primarily on familiarity, relation retrieval is based on recollection (Hockley & Consoli, 1999).

Nominal combination provides an ideal paradigm for testing the influence of relational information on memory. Because the conceptual relation of a nominal combination is determined by the ordering of the concepts, one may manipulate relational information while holding constant the item information. For example, in Experiment 1 we compared memory for HORSE following exposure to HORSE DOCTOR or DOCTOR HORSE. Any difference in recognition accuracy can be attributed unequivocally to relational information, since the concepts are identical in the two conditions. Additionally, in Experiment 2 we manipulated whether the conceptual relation present at study was also reinstated at test. These experiments were designed to investigate not only whether relational information facilitates item memory, but also whether there is an asymmetry in this presumed relational influence on memory.

The competition among relations in nominals (CARIN) model claims that "relational information is associated with the modifier and not with the head noun" (Gagné, 2001, p. 244; see also Gagné & Shoben, 1997). For instance, the modifier CHOCOLATE frequently instantiates the *composition* relation (CHOCOLATE BAR) and only infrequently instantiates the *sell* relation (CHOCOLATE SHOP). When comprehending any phrase modified by CHOCOLATE, one retrieves several competing relations that vary in frequency of association with the modifier. Only if the more frequent relation (e.g., *composition*) fails does one proceed to the less frequent relations (e.g., *sell*). As a result, combinations are understood faster if they instantiate a relation that is frequent for the modifier than if they instantiate an infrequent modifier relation. Critically, however, Gagné and Shoben (1997) found that the relation frequency of the head noun had no effect on comprehension time. The specificity of the relation frequency effect (i.e., for modifiers only) has also been replicated in Indonesian, a language in which the head noun precedes the modifier (Storms & Wisniewski, 2005). Thus it is the modifier per se, rather than simply the first word encountered, that determines comprehension speed.

Pragmatic considerations also emphasize the contribution of the modifier. Readers (and listeners) tacitly assume that the modifier is *relevant* (Glucksberg & Estes, 2000). That is, the writer (or speaker) is assumed to have some purpose for producing a nominal combination rather than a simple noun—otherwise the simple noun would have been used instead (see also Springer & Murphy, 1992). So when a noun requires modification, that modifier is of particular relevance for comprehension. In summary, because the CARIN model posits that relations are represented with and selected from the modifier, it predicts that relational integration will facilitate recognition memory for modifiers but not for head nouns. We report two experiments that tested this prediction.

EXPERIMENT 1

Experiment 1 investigated whether relational integration differentially affects recognition memory for modifiers and head nouns. The study phase consisted of a sensicality judgement task (Gagné & Shoben, 1997), whereby participants indicate whether each combination makes sense as a phrase. To control word frequency of the individual concepts while manipulating their relational integration, we used combinations that were more easily integrated in one direction (HORSE DOCTOR) than when reversed (DOCTOR HORSE). The test phase consisted of a recognition memory task with modifier and head concepts presented individually. For example, participants first judged whether HORSE DOCTOR (or DOCTOR HORSE) was a sensible phrase, and later they were tested for recognition of HORSE and DOCTOR separately. Participants were not informed that there would be a memory test. Thus, any effect observed in the recognition test was incidental to language comprehension. If relational integration facilitates memory, the same concepts should be recognized with greater accuracy when studied in a (forward) sensible combination than when studied in a (reversed) nonsensical combination. More specifically, the CARIN model predicts preferential recognition of the modifier.

Method

Participants

Participants in both experiments were undergraduates at the University of Georgia, all were native English speakers, and all received partial course credit. A total of 41 undergraduates participated in Experiment 1, and an additional 36 participated in a stimulus rating task.

Materials and design

Stimuli for the sensicality judgement task consisted of 30 combinations. (Materials for both experiments are available from the first author.) To validate the ease-of-integration manipulation, 36 undergraduates participated in a stimulus norming task. Two stimulus lists were created, such that no combination appeared in both directions within the same list. Participants were instructed to rate on a scale of 1 (“nonsensical”) to 6 (“sensical”) the extent to which the words “make sense together”. For each word pair, the direction of presentation that was rated more sensible was assigned to the “forward” condition, and the less sensible direction was assigned to the “reversed” condition. The combinations were significantly more comprehensible when forward ($M = 5.00$, $SE = 0.12$) than when reversed ($M = 2.80$, $SE = 0.17$), $t(29) = 18.12$, $p < .001$.

In the sensicality judgement task, each participant received 15 combinations in the forward order and 15 in the reverse order. All combinations appeared in both orders, counterbalanced across two lists. Stimuli for the recognition task consisted of the 30 modifiers and 30 head nouns from the studied combinations and 60 new nouns serving as lures. “Modifier” and “head noun” refer to the first and second concepts, respectively, of the forward order combination. Thus, the modifier and head noun were presented as the second and first concepts (respectively) in the reverse order combinations. In sum, the recognition test had a 2 (concept: modifier, head noun) × 2 (order: forward, reversed) within-participants factorial design.

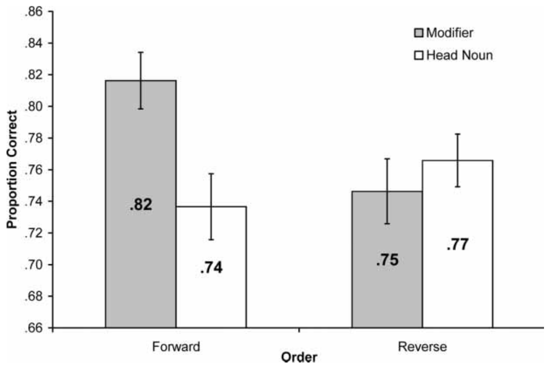

Figure 1. *Recognition accuracy (mean* ± SE*), Experiment 1.*

Procedure

For both study and test, stimuli were presented in 22-point red font centred on a black background. In the sensicality judgement (i.e., study) task, the “J” key was used to indicate that the combination had a sensible interpretation and the “F” key to indicate that it did not. A total of 10 practice trials preceded the 30 experimental trials. The surprise recognition test followed immediately, with participants indicating on each of the 120 trials whether they had seen the presented word during the study phase by pressing “Y” for “yes” or “N” for “no”. Trial order was randomized across participants at both study and test.

Results and discussion

In corroboration of the sensicality rating pretest, the combinations were more likely to be judged sensible in their forward order ($M = 0.82$, $SE = 0.02$) than when reversed ($M = 0.19$, $SE = 0.02$), $t_p(40) = 18.35$, $p < .001$, and $t_i(29) = 17.03$, $p < .001$. The sensicality judgements were also faster forward ($M = 1{,}323$, $SE = 39$) than reversed ($M = 1{,}628$, $SE = 60$), $t_p(40) = 6.43$, $p < .001$, and $t_i(29) = 6.92$, $p < .001$.

Recognition accuracies are shown in Figure 1. A 2 (order) × 2 (concept) repeated measures analysis of variance (ANOVA) revealed a significant interaction, $F_p(1, 40) = 10.13$, $p < .01$, and $F_i(1, 58) = 7.45$, $p < .01$. That is, when presented in their sensible (forward) order, modifiers were more likely to be recalled than head nouns, $t_p(40) = 3.45$, $p = .001$, and $t_i(58) = 2.17$, $p < .05$. But when presented in their nonsensical (reversed) order, modifiers and head nouns were equally likely to be recognized (both $p > .30$). Accuracy for the “new” lures was high ($M = 0.86$, $SE = 0.01$), indicating a false-alarm rate of only 14%.

Relational integration did indeed facilitate recognition, specifically for the modifier concept. For example, prior comprehension of HORSE DOCTOR facilitated recognition of HORSE but not DOCTOR. This finding cannot be attributed to any lexical or semantic factor of the individual words, such as frequency. If HORSE were somehow more memorable than DOCTOR, then HORSE would have been preferentially recognized in the reverse condition as well. Moreover, it is notable that the combinations were studied for significantly less time in their forward order. Hence, the preferential recognition of forward-presented modifiers is rather striking. This finding supports the CARIN model (Gagné & Shoben, 1997), which posits that conceptual relations are more strongly associated with modifiers than with head nouns.

EXPERIMENT 2

Experiment 2 tested whether reinstatement of the same relation at study and test differentially affects recognition of modifiers and head nouns. For generality we used a different set of stimuli in this experiment. As in Experiment 1, participants judged the sensicality of a series of combinations (COOKIE JAR) during the study phase. The recognition test was adapted from Klein and Murphy (2001). The target concept (indicated in ALL CAPS) was presented in a combination having either the same relation (COOKIE plate) or a different relation (COOKIE crumb) from the study phase, and participants indicated whether this target had been presented during the study phase. This recognition paradigm also allowed us to test whether the results of Experiment 1 would replicate when relational processing occurred at both study and test (i.e., with transfer-appropriate processing). Because the CARIN model claims that the modifier provides the relations for integration, this model predicts that relation consistency should affect recognition of modifiers more than of head nouns.

Method

Participants

A total of 70 undergraduates participated in the experiment; 28 participated in a relational similarity pretest, and 28 participated in a semantic similarity posttest.

Materials and design

The study phase included 80 sensible combinations (COOKIE JAR) and 80 nonsensical combinations (ANSWER SKY). See Table 1 for examples of experimental items. Unlike the previous experiment, the combinations were not presented in reverse order. Here the nonsensical combinations served as fillers and were not presented at test. In the test phase, the modifiers from 40 of the sensical combinations were presented with a new head noun, such that the test combination instantiated either the same relation (COOKIE PLATE) or a different relation (COOKIE CRUMB). Likewise, the head nouns from 40 of the sensical combinations (HORSE TRAIL) were presented with a new modifier, such that the test combination instantiated either the same relation (BIKE TRAIL) or a different relation (DIRT TRAIL). To validate this manipulation, 28 undergraduates participated in a relational similarity pretest (see Estes & Jones, 2006). Using a forced-choice task, each of the 80 experimental combinations (COOKIE JAR) was presented with its same-relation (COOKIE PLATE) and different-relation (COOKIE CRUMB) test combinations. Participants were instructed to select the option (i.e., of the two test combinations) that was more relationally similar to the target (i.e., the study combination). Relational similarity was defined and contrasted from featural similarity. Across all 80 triads, the same-relation combination was chosen 87% of the time ($SE = 1\%$), thus confirming their greater relational similarity to the study combinations.

A total of 40 lures were also created for each relation condition, such that the studied modifier (COOKIE) or the studied head noun (TRAIL) was not the target word. The experimental combinations were counterbalanced across four lists. Thus, a 2 (relation: same, different) × 2 (target concept: modifier, head noun) within-participants design

Table 1. *Examples of Experiment 2 stimuli*

		Test pair	
Target	*Study pair*	*Same relation*	*Different relation*
Modifier	piano strings	PIANO pedal	PIANO lesson
	jungle swamp	JUNGLE bird	JUNGLE fever
	fish tank	FISH pond	FISH food
Head noun	insect rash	heat RASH	ankle RASH
	horse trail	bike TRAIL	dirt TRAIL
	laugh wrinkle	sun WRINKLE	face WRINKLE

was used. The target modifiers ($M = 52$, $SE = 13$) and head nouns ($M = 52$, $SE = 16$) were equally frequent in the Kučera–Francis norms.

Procedure

The procedure was identical to that of Experiment 1, except that same- or different-relation combinations containing the target word were presented at test. Test combinations appeared in all lower case for 2 seconds (cookie plate), and then the target word changed to ALL CAPS (cookie PLATE; cf. Klein & Murphy, 2001). The stimulus remained onscreen until the participant responded. Participants were instructed to indicate whether the word in all caps was old or new by pressing the "Y" or the "N" key, respectively.

Results and discussion

The experimental combinations exhibited a high comprehension rate at study ($M = 0.87$, $SE = 0.01$). Recognition accuracies were submitted to a 2 (relation) × 2 (concept) repeated measures ANOVA. The main effect of relation was nonsignificant (both ps $> .18$). A main effect of concept suggested preferential recognition of the modifiers ($M = 0.79$, $SE = 0.01$) over the head nouns ($M = 0.75$, $SE = 0.02$), $F_p(1, 69) = 3.89$, $p = .05$, though the difference was unreliable by items, $F_i(1, 78) = 1.97$, $p = .16$. Although the interaction was nonsignificant, $F_p(1, 69) = 2.96$, $p = .09$, and $F_i(1, 78) = 2.62$, $p = .11$, the pattern of results was consistent with the prediction of the CARIN model (see Figure 2). Specifically, planned comparisons revealed that when a different relation was instantiated at test, recognition was equivalent for modifiers and head nouns (both ps $> .79$). But when the same conceptual relation from study was reinstated at test, recognition accuracy was significantly higher for modifiers than for head nouns, $t_p(69) = 2.74$, $p < .01$, and $t_i(78) = 2.04$, $p < .05$. Analyses with corrected recognition accuracies (hits − false alarms) produced the exact same pattern of results.

A potential concern is that the superior recognition accuracy for the modifier in the same-relation

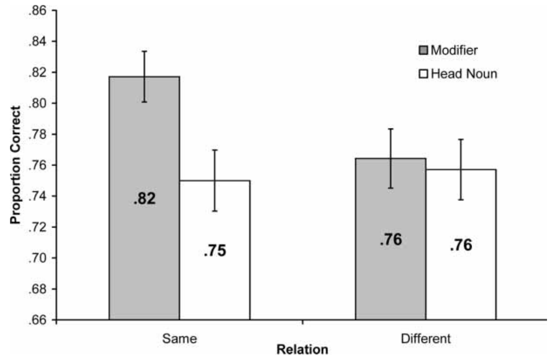

Figure 2. *Recognition accuracy (mean ± SE), Experiment 2.*

condition (Figure 2) could be attributable to greater semantic similarity between the study and test nontarget concepts (e.g., COOKIE jar and COOKIE plate) in that condition than in the other conditions (e.g., COOKIE jar and COOKIE crumb). To investigate the plausibility of this explanation, 28 additional undergraduates participated in a semantic similarity posttest. Participants rated the similarity of the study (e.g., jar) and test (e.g., plate) nontarget concepts on a scale from 1 (not at all similar) to 7 (very similar). Semantic similarity ratings for these nontarget concepts were not correlated with recognition accuracies within the modifier condition ($r = .01$, $p = .90$), within the head noun condition (r equals; .16, $p = .15$), or collapsed across all conditions ($r = .08$, $p = .29$). Thus, the effect observed in recognition accuracy cannot be explained by semantic similarity.

Experiment 2 corroborated the preferential recognition of modifiers, but only when the studied relation was reinstated at test. For example, when initially exposed to COOKIE JAR, recognition of the modifier COOKIE was better in COOKIE PLATE (same relation) than in COOKIE CRUMB (different relation). But when initially exposed to CHOCOLATE CAKE, recognition of the head noun CAKE was equal in CARROT CAKE (same relation) and BIRTHDAY CAKE (different relation). Thus, the consistency of relations at study and test affected modifiers but not head nouns. These results indicate that relational integration selectively facilitates recognition of the modifier and therefore support the CARIN model (Gagné & Shoben, 1997).

GENERAL DISCUSSION

In Experiment 1, recognition accuracies were higher for modifiers than for head nouns, but only for the forward (sensible) combinations. In Experiment 2, recognition was again better for modifiers than for head nouns, but only when the same conceptual relation was instantiated at both study and test. Thus, results indicate that (a) relational integration facilitates recognition memory, and (b) conceptual relations are associated more strongly with the modifier than with the head noun. Methodologically, these experiments demonstrate that nominal combination provides a useful paradigm for investigating the relative contributions of item and relational information in recognition memory. In Experiment 1, relational information was manipulated by the ordering of the concepts while holding constant the item information. This experiment provides the strongest evidence to date that relational information facilitates item memory. These results also support the CARIN model of nominal combination, which asserts that conceptual relations are represented with the modifiers that instantiate them (Gagné & Shoben, 1997). The model thus predicts facilitated recognition of modifiers, as observed in both experiments.

Although these results indicate that conceptual relations are *associated* more strongly with the modifier than with the head noun, they do not necessarily imply that those relations are *represented* as part of the meaning of the modifier, as assumed by the CARIN model (Gagné & Shoben, 1997). Recall that understanding a nominal combination (e.g., WOOL SWEATER) entails decomposing it into a modifier, head noun, and relation (cf. Hummel & Holyoak, 2003). Prior research on relation priming has demonstrated that if a subsequent combination instantiates this same, preactivated relation (e.g., STEEL SCISSORS), its comprehension is facilitated (Estes, 2003; Estes & Jones, 2006). Thus, conceptual relations appear to be represented independently of the constituent concepts of the combination (see also Raffray et al., 2007). The present experiments demonstrate that conceptual relations nevertheless are associated more strongly with the modifier concept in LTM. It is therefore important to distinguish between the short-term maintenance of conceptual relations (as in relation priming) and the long-term representation of those relations (as in recognition memory).

Why are conceptual relations associated more strongly with the modifier? A functional analysis of the different communicative roles performed by the modifier and the head noun may explain this asymmetry. The head noun denotes the general class (TABLE), whereas the modifier (KITCHEN) specifies the subclass (KITCHEN TABLE). Moreover, when a simple noun is modified by another noun, one assumes that the modifier is relevant for communication (Glucksberg & Estes, 2000; Springer & Murphy, 1992). In this example, the modifier narrows the basic category TABLE to a TABLE *located* in a given room. A different modifier would produce a different subcategory (WOOD TABLE) based on a different criterion (*composition* rather than *location*). So by this analysis, it is the modifier that distinguishes the intended referent (e.g., a kitchen table) from other potential referents (e.g., a wood table, a coffee table, etc.). Thus, principles of referential communication emphasize the modifier, which consequently is encoded preferentially.

It should be noted that, despite this memorial advantage for modifiers, the head noun also plays a critical role in comprehension. The head noun provides the base set of attributes for modification, and it constrains the set of possible modifiers. In fact, schema models of nominal combination describe relational integration as the modifier concept filling a relational slot of the head noun (Murphy, 1990, 2002; Wisniewski, 1997). To illustrate, ROBIN SNAKE is understood by filling the *eats* slot of SNAKE with the modifier ROBIN (i.e., "a snake that eats robins"; Storms & Wisniewski, 2005). Such a snake is assumed to possess other attributes typical of its head noun category (e.g., slender body, scaly skin, forked tongue, etc.), and it may be modified only in particular ways (e.g., the *eats* slot may only accept modifiers that are edible). This process of schema modification may complement the relational approach of the CARIN model (Storms & Wisniewski, 2005). From this perspective, the modifier selects whatever relational slot of the head noun is most likely to be modified, based on that modifier's combinatorial history. But it is the semantics of the head noun that constrains whether the modifier can plausibly fill the selected relational slot. So for example, upon interpretation of PAPER CUT, the *made of* relation may be activated first due to its high frequency of use with the PAPER modifier. However, because cuts cannot be *made of* paper, the next most frequent relation will become activated. This process of plausibility checking will continue until a plausible fit is found between the modifier and a given relational slot of the head noun (e.g., *causal*). The modifier's association with its conceptual relations thus may guide its integration within the head noun schema (Storms & Wisniewski, 2005).

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REFERENCES

Cowan, N. (1988). Evolving conceptions of memory storage, selective attention, and their mutual constraints within the human information processing system. *Psychological Bulletin*, *104*, 163–191.

Estes, Z. (2003). Attributive and relational processes in nominal combination. *Journal of Memory and Language*, *48*, 304–319.

Estes, Z., & Jones, L. L. (2006). Priming via relational similarity: A copper horse is faster when seen through a glass eye. *Journal of Memory and Language*, *55*, 89–101.

Gagné, C. L. (2001). Relation and lexical priming during the interpretation of noun-noun combinations. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*, 236–254.

Gagné, C. L., & Shoben, E. J. (1997). Influence of thematic relations on the comprehension of modifier-noun combinations. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *23*, 71–87.

Glucksberg, S., & Estes, Z. (2000). Feature accessibility in conceptual combination: Effects of context-induced relevance. *Psychonomic Bulletin & Review*, *7*, 510–515.

Hockley, W. E., & Consoli, A. (1999). Familiarity and recollection in item and associative recognition. *Memory & Cognition*, *27*, 657–664.

Hockley, W. E., & Cristi, C. (1996). Tests of encoding tradeoffs between item and associative information. *Memory & Cognition*, *24*, 202–216.

Hummel, J. E., & Holyoak, K. J. (2003). A symbolic-connectionist theory of relational inference and generalization. *Psychological Review*, *110*, 220–263.

Humphreys, M. S. (1976). Relational information and the context effect in recognition memory. *Memory & Cognition*, *4*, 221–232.

Hunt, R. R., & Einstein, G. O. (1981). Relational and item-specific information in memory. *Journal of Verbal Learning and Verbal Behavior*, *20*, 497–514.

Klein, D. E., & Murphy, G. L. (2001). The representation of polysemous words. *Journal of Memory and Language*, *45*, 259–282.

Murphy, G. L. (1990). Noun phrase interpretation and conceptual combination. *Journal of Memory and Language*, *29*, 259–288.

Murphy, G. L. (2002). *The big book of concepts.* Cambridge, MA: MIT Press.

Raffray, C. N., Pickering, M. J., & Branigan, H. P. (2007). Priming the interpretation of noun-noun combinations. *Journal of Memory and Language*, *57*, 380–395.

Springer, K., & Murphy, G. L. (1992). Feature availability in conceptual combination. *Psychological Science*, *3*, 111–117.

Storms, G., & Wisniewski, E. J. (2005). Does the order of head noun and modifier explain response times in conceptual combination? *Memory & Cognition*, *33*, 852–861.

Wisniewski, E. J. (1997). When concepts combine. *Psychonomic Bulletin & Review*, *4*, 167–183.