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Topic–vehicle interaction in metaphor comprehension

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Property comparison models of metaphor comprehension assume that the topic and vehicle terms in metaphors are both understood to be referring to their conventional literal referents. In contrast, the interactive property attribution model (Glucksberg, McGlone, & Manfredi, 1997) assumes that the vehicle is understood to be referring to a metaphoric category that includes the topic's literal referent as a member. A priming paradigm was used to test the implications of these different models. Prior to interpreting a metaphor, participants read (1) the topic or vehicle concept alone, (2) a sentence ascribing a metaphor-relevant property to one concept, or (3) a sentence ascribing a metaphor-irrelevant property to one concept. All of the prime types facilitated metaphor comprehension with the exception of sentences ascribing metaphor-irrelevant properties to vehicles. The failure of these sentences (but not their topic counterparts) to facilitate metaphor comprehension is attributable to their priming an inappropriate literal interpretation of the vehicle term. These results are consistent with the claim that irrelevant information is suppressed during language comprehension (Gernsbacher, 1990) and support the interactive property attribution model.

The philosopher Max Black (1962, 1979) suggested that the product of metaphor (e.g., *religion is a drug*) comprehension is a complex interaction of the topic (*religion*) and the vehicle (*drug*) concepts. The notion of "interaction" that he described is sufficiently vague as to allow for a variety of interpretations, but the underlying idea is that the metaphor topic is perceived "in terms of" the vehicle. Although intuitively appealing, Black's claim is difficult to evaluate in the absence of an explicit model of the interaction process. In the contemporary psycholinguistic literature on metaphor, two general classes of models have been proposed to describe the interaction: property comparison models (Miller, 1993; Ortony, 1979; Verbrugge & McCarrell, 1977) and property attribution models (Glucksberg, McGlone, & Manfredi, 1997; McGlone, 1996). Although the representational differences between them are subtle, these models entail very different claims about the interactive roles played by the topic and the vehicle concepts in the metaphor interpretation process.

The origin of property comparison models can be traced to Aristotle who in his *Poetics* assumed that metaphors express a comparison (*X is like a Y*) relation since the nominal form of these statements (*X is a Y*) yields a category violation. In this view, a metaphor such as *religion is a drug* is assumed to be an emphatic form of the comparison *religion is like a drug*, because the category named *drug* does not ordinarily include religion as a member. Contemporary proponents of this view have argued that recognizing the comparison implied by a metaphor is the first step in metaphor comprehension (Malgady & Johnson, 1976; Miller, 1993; Ortony, 1979, 1993; Tversky, 1977; Verbrugge & McCarrell, 1977). Once the implicit comparison is recognized, these theorists argue, it is then interpreted in the same manner as a literal comparison statement, by searching for properties that the compared concepts have in common. For example, Tversky accounts for metaphor comprehension in his influential *contrast* model of similarity judgments by assuming that both literal and figurative comparisons (i.e., similes) are understood within a property matching process: "In judgments of similarity one assumes a particular feature space . . . and assesses the quality of the match . . . In the interpretation of similes, one assumes a resemblance . . . and searches for an interpretation of the feature space that would maximize the quality of the match" (p. 349). Like the contrast model, Ortony's (1979, 1993) *salience imbalance* model of metaphor comprehension also assumes that metaphors are understood in terms of matching properties in the topic and vehicle concepts. However, Ortony suggested that metaphor comprehension differs from the comprehension of literal comparisons in that the metaphoric "ground" (i.e., the representation of metaphoric meaning) comprises only those matching properties that are of high salience in the vehicle and of low salience in the topic. The ground of a metaphor such as *religion is a drug*, for ex-

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ample, includes properties such as *soothing* and *euphoria-inducing*, which are presumably of high salience in *drug* and of low salience in *religion.*

Two important assumptions undergird the *salience imbalance* model and the property comparison view in general. The first is that the referential scope of the topic and vehicle terms is restricted to entities that conform to their conventional dictionary definitions. This assumption is what motivated Aristotle to assert that metaphors are covert comparisons in the first place. If it were possible that a vehicle term such as *drug* could be understood as referring to a category that can include *religion* as a member, it would be unnecessary for people to implicitly transform *religion is a drug* into a comparison statement to understand it. There are good reasons to question this assumption, which we will examine in due course. The second assumption is that people are aware of the relevant properties that the topic and vehicle concepts have in common. This assumption is clearly violated by the fact that people are able to interpret informative metaphors. For example, consider *that film was a sermon.* For people who are not familiar with the film in question, there can be no a priori representation of the concept *that film* that includes properties such as *preachy* or *moralistic.* Yet these are exactly the sorts of properties that come to mind upon reading the statement, even when the film is not familiar to the reader. This argument applies with equal force to literal comparisons. If a person knows nothing about Saab sedans, telling her *a Saab is like a BMW* will introduce new properties into her mental representation of Saabs (e.g., hand-built, expensive), rather than produce a match between Saab and BMW properties.

Informative literal comparisons require a property-attribution strategy in order to be understood: The predicate concept (e.g., *BMW*) provides properties that may be attributed to the topic (e.g., *Saab*). In past work, we have suggested that metaphor interpretation may best be understood as a property attribution process (Glucksberg et al., 1997; McGlone, 1996). In this view, the vehicle concept (e.g., *sermon*) provides candidate properties that may be attributed to the topic (e.g., *that film*). Although the notion of property attribution can explain how informative literal comparisons and metaphors are understood, it does not account for a fundamental difference between these statement types. Literal comparisons such as *Saabs are like BMWs* become anomalous when paraphrased as nominal statements (**Saabs are BMWs*). In contrast, metaphors in nominal form such as *that film was a sermon* may be paraphrased as comparisons (*that film was like a sermon*) without losing or changing their meaning. What accounts for the difference in form flexibility between metaphors and literal comparisons?

One possible answer is that the referential scope of the vehicle term in a metaphor is not as limited as Aristotle and other comparison theorists had assumed. We suggest that the statement *that film was a sermon* may be understood as what it appears to be: A category-inclusion assertion in which the topic *that film* is assigned to a category that is named *sermon.* The vehicle term *sermon* is extended to name this category of moralistic discourses that may also include such things as lectures, speeches, novels, as well as veridical sermons. Because of the "dual-reference" capacity of the term *sermon*, the metaphor may be expressed as a category-inclusion assertion or as a comparison (*that film was like a sermon*) interchangeably (Glucksberg & Keysar, 1990; Glucksberg et al., 1997).

The claim that vehicles such as *sermon* have a dual-reference function implies that they may be understood to be referring to different levels of abstraction—that is, to the literal concept (e.g., a veridical sermon) and to the category of things or situations that the concept exemplifies (e.g., moralistic discourses). When such a category is used to characterize a metaphor topic, it functions as an *attributive category,* in that it provides properties to be attributed to the topic. With extensive use, the attributive category exemplified by a vehicle may become part of the term's conventional meaning. When this happens, heretofore nonlexicalized categories, such as "disastrous military interventions," become lexicalized, as in *Cambodia has become Vietnam's Vietnam.* In this statement, the dual reference of the term *Vietnam* is explicit. The term occurs twice, and its intended referent on the first occasion is different from its intended referent on the second occasion. The first refers to the country itself; the second refers to the category of disastrous military interventions that the Vietnam War has come to exemplify.

Our claim that metaphors assert the membership of the topic in a category that is exemplified and named by the vehicle implies that the topic and vehicle play different roles in metaphor interpretation. To illustrate, consider the assertion *her letter was a dagger.* The vehicle term *dagger* can be understood to be referring to an attributive category that may include letters and literal daggers as members. Of all the possible categories that letters and daggers may both belong to (e.g., inanimate things, things produced by humans, etc.), the one in focus is the category that daggers exemplify (i.e., things that may be used to cause harm). The assertion that *her letter* belongs to this category implies that the letter in question should inherit properties from this category. For any metaphor topic in particular, only certain sorts of property attributions will be meaningful and/or relevant. The relevance of a given property to a topic may best be described at the level of dimensions. When the topic is *her letter*, for example, dimensions such as length (short or long), legibility (neat or messy), and emotional impact on the receiver (positive, neutral, or negative) are relevant and meaningful. Dimensions such as color (white, black, blue, etc.) and weight (light or heavy) may also be meaningful, but are irrelevant in most contexts in which letters are discussed.

As described above, the interactive property attribution model of metaphor comprehension (Glucksberg et al., 1997) makes two related claims. The first is that the topic and the vehicle play different roles in the metaphor in-

terpretation process. The topic provides dimensions for attribution, whereas the vehicle provides properties that may be attributed to the topic. The second is that the vehicle term is understood to be referring to a higher level of abstraction than is the topic term. When a term such as *dagger* is used as a vehicle, it is understood to be referring to a superordinate category that may include the topic and the term's literal referent as members.

The available empirical evidence relevant to these claims is equivocal. Wolff and Gentner (2000) investigated the roles played by the topic and the vehicle in metaphor comprehension using a priming paradigm. These researchers reasoned that, if a metaphor comprehension involves matching common topic and vehicle properties, presentation of either the topic or the vehicle term (or both) prior to presenting the complete metaphor should facilitate comprehension of the statement by giving the interpreter a head start on the property extraction process. In accordance with these predictions, Wolff and Gentner found that metaphor comprehension was facilitated by presentation of either term alone or both terms together (relative to a baseline condition in which no information was presented prior to the metaphor). Because the topic and the vehicle produced equivalent priming, Wolff and Gentner inferred that metaphor comprehension begins with a role-neutral alignment of the concepts' relational structures followed by a search for commonalities in these aligned structures. However, the interactive property-attribution model predicts the same pattern of results. Although the model assumes that the topic and vehicle play different roles in metaphor comprehension, both terms are assumed to contribute equally important information to the comprehension process: The topic provides dimensions of attribution, whereas the vehicle provides properties that may be attributed to the topic. In this model, prior exposure to either term should enable the reader to get a head start in comprehending the metaphor. Thus, the results reported by Wolff and Gentner cannot be taken as evidence against the property attribution model.

Can we empirically distinguish between the property comparison and the property attribution models? One possibility centers on Glucksberg et al.'s (1997) claim that metaphor vehicles have a dual-reference capacity. To illustrate, consider the metaphor *Some lawyers are sharks.* We can distinguish between four types of assertions that differ in terms of the information they provide about the ground of this metaphor: those that describe properties of the topic that are relevant (e.g., *Lawyers can be ruthless*) or irrelevant (e.g., *Lawyers can be married*) to the metaphoric ground, and those that describe properties of the vehicle that are ground-relevant (e.g., *Sharks can be ruthless*) or ground-irrelevant (e.g., *Sharks can be blue*). If people encounter sentences of the sort described above prior to interpreting a metaphor, how might this prior exposure influence metaphor comprehension? The property attribution model claims that both the topic and the vehicle concepts contribute important (albeit different) information to overall metaphor meaning. Consequently, sentences that foreground either concept, regardless of whether they describe ground-relevant or irrelevant properties of that concept (or simply mention the concept without describing any of its properties), should give people a head start in metaphor comprehension. Sentences that describe ground-relevant properties of either concept might increase the facilitation produced by foregrounding the concept, particularly when the category exemplified by the vehicle is not transparent (McGlone, 1994). All of these predictions are consistent with property comparison models. If people interpret metaphors as comparisons, advance notice of either the topic or the vehicle concept should give people a head start in the property extraction process, and presentation of these concepts' ground-relevant properties should expedite the search for properties that they share.

The two models make different predictions about how metaphor comprehension will be influenced by sentences that describe ground-irrelevant properties of the topic (e.g., *Lawyers can be married*) and vehicle (e.g., *Sharks can be blue*) concepts. According to the property attribution model, the topic *some lawyers* is understood to be referring to its conventional, literal referent (actual lawyers), whereas the vehicle *sharks* is understood to be referring to a higher level category that sharks exemplify (ruthless, vicious beings). Since literal lawyers can be married, a prime sentence that describes this ground-irrelevant property should not impede the reader from identifying the topic's intended literal referent. The property *can be blue* is a property of literal sharks, but it is not a property of the metaphoric category that sharks exemplify. Consequently, the property attribution model predicts that a prime sentence that introduces this ground-irrelevant property of the vehicle should lead readers to interpret the vehicle *sharks* at an inappropriate level of abstraction and thus impede them from identifying the term's intended category referent. This impedance should significantly reduce the facilitation produced by advance notice of the vehicle term. In contrast, property comparison models assume that the topic and the vehicle terms are both understood to be referring to their conventional, literal referents. According to the logic described above, prime sentences that describe ground-irrelevant properties of either term should not impede the reader in identifying its intended literal referent. In this view, then, ground-irrelevant topic and vehicle primes should influence metaphor comprehension in the same way.

We developed a variation of the priming paradigm used by Wolff and Gentner (2000) to test the divergent predictions of the property comparison and the property attribution models. Prior to interpreting a metaphor, participants read prime sentences that presented (1) the topic or vehicle concepts alone, (2) ground-relevant properties of one concept, or (3) ground-irrelevant properties of one concept. We compared the effect that these various prim-

ing types had on metaphor comprehension time to a baseline condition in which no topic or vehicle information was foregrounded.

METHOD

Participants

One hundred fourteen Lafayette undergraduates were paid for their participation in this experiment. Forty-six participated in the material norming studies, and 68 participated in the experiment proper. All were native English speakers, and none had previously participated in any studies of figurative language.

Materials

Thirty-five metaphors drawn from the figurative language literature (Gentner & Clement, 1988; Gildea & Glucksberg, 1983; Glucksberg, Gildea, & Bookin, 1982; Glucksberg et al., 1997; Wolff & Gentner, 2000) were used as stimuli in this experiment. These items were chosen from a larger pool of metaphors on the basis of comprehensibility ratings, which were provided by a group of 20 participants in a pilot study. The items chosen for the priming experiment were those that the pilot participants perceived as highly comprehensible, which we operationalized as those metaphors receiving mean ratings of 4 or above on an ordinal scale of 1 (*completely incomprehensible*) to 7 (*perfectly comprehensible*) used by the pilot participants. The mean comprehensibility rating for the 35 items chosen was 5.70 (*SD* = .81). These metaphors are presented in the Appendix.

Seven types of primes were created for each stimulus metaphor (e.g., *Some lawyers are sharks*). Term-alone primes were constructed by replacing the vehicle (e.g., *Some lawyers are ****) or topic (*Some **** are sharks*) in each metaphor with a row of asterisks. Baseline primes (e.g., *Some **** are ****)* were constructed by replacing both the topic and the vehicle with rows of asterisks. Ground-relevant property primes were constructed that ascribed a property relevant to the metaphoric ground to either the topic (e.g, *Lawyers can be ruthless*) or to the vehicle (e.g., *Sharks can be ruthless*) concepts. The property ascribed to the concept (e.g., confining) was the same in both sentences within each topic and vehicle pair. Ground-irrelevant property primes were constructed that ascribed a property irrelevant to the ground to either the topic (e.g., *Lawyers can be married*) or to the vehicle (e.g., *Sharks can be blue*). Although it would be ideal to ascribe the same ground-irrelevant property to both concepts within each prime sentence pair, the different natures of the topics and vehicles across the metaphor stimuli made it impossible to do this uniformly (e.g., what common ground-irrelevant property may be ascribed to the topic and the vehicle in *Sarcasm can be a veil?*). Consequently, we ascribed different properties to the two concepts in all 35 pairs of ground-irrelevant property primes.

The fact that the ground-irrelevant property primes ascribed different properties to the topic and the vehicle in each metaphor obligated us to investigate whether these properties differed in ground relevance. To this end, we asked 16 Lafayette undergraduates to rate the relevance of each pair of these properties, as well as the ground-relevant properties, to the metaphoric ground. Booklets were constructed that presented each metaphor followed by terms denoting the ground-relevant property (e.g., *ruthless*) and the two ground-irrelevant properties (e.g., *married* and *blue*) used in the prime sentences. The order in which these properties appeared was randomized for each metaphor/property set. The participants were instructed to read each metaphor carefully and then to rate the relevance of each property term to the metaphor's meaning on a scale of 0 (*not at all relevant*) to 7 (*very relevant*) scale. Ground-relevant properties received a mean rating of 6.25 (*SD* = .75), indicating that the participants perceived these properties as highly relevant to metaphor meaning. The ground-irrelevant properties ascribed to topics and vehicles received mean ratings of 1.13 (*SD* = 1.08) and 1.44 (*SD* = .89), respectively. Thus, the properties we deemed ground-irrelevant were perceived as such by our participants. The slightly lower ratings for the topic compared with the vehicle properties suggests that our ground-irrelevant property prime sentences were, if anything, weighted *against* the property attribution hypothesis.

In creating both the metaphor stimuli and the prime sets for each metaphor, the initial quantifier terms and verb phrases (e.g., *a, some, many, is, can be*) were varied in order to produce a modest amount of stimulus novelty. However, the quantifier used for any prime containing information about the topic also appeared in its vehicle counterpart so that we might avoid confounding quantifier choice with the term (i.e., topic or vehicle) variable. A complete list of the primes created for each metaphor is presented in the Appendix.

Stimulus lists were created in which each metaphor was paired with one of the seven primes created for it. In each stimulus list, there were five metaphors paired with each of the seven prime types for a total of 35 prime–metaphor pairs. Seven such stimulus lists were created with the restrictions that each metaphor appeared only once in a list and was preceded by only one of the primes created for it.

Design and Procedure

The experiment employed a 7 × 7 mixed design with prime type (topic alone, topic/ground-relevant property, topic/ground-irrelevant property, vehicle alone, vehicle/ground-relevant property, vehicle/ground-irrelevant property, and baseline) as a within-subjects factor and stimulus list as a between-subjects factor.

The participants were tested in groups of 2 or 3 in a single experimental session. The experimental stimuli were presented via a computer. At the beginning of the sessions, each participant was randomly assigned to one of the seven stimulus list conditions and then was seated in front of an Insight Pentium PC with a standard keyboard. Instructions were presented to the participants on the computers. The instructions indicated that the experiment was an investigation of how people interpret metaphoric language and explained the sequence of events that would occur on each trial.

The participants started each trial by pressing the space bar. At the beginning of each trial, a fixation cross appeared in the middle of the screen with the words "Get ready for the next trial" immediately below it. After 1,500 msec, the fixation cross was replaced by one of the seven primes (e.g., *Some lawyers are ****) for a given metaphor. The participants were told to read the prime carefully so that they might gain a head start in interpreting the subsequently presented metaphor. The prime remained on the screen for 2,000 msec and was then replaced by the corresponding metaphor (e.g., *Some lawyers are sharks*). The participants were told to read the metaphor carefully and to press the space bar when they felt they understood it. Three measures were taken to discourage the participants from pressing the space bar prior to their fully understanding the metaphor. First, they were told that there would be a test following the computer task in which they would be asked to recall information about the sentence pairs (i.e., the primes and their corresponding metaphors) and answer questions about the meanings of the metaphors. Second, the participants were told that metaphors often have complex meanings that may take a few seconds to fully comprehend. Third, the participants were explicitly encouraged to wait until they had a well-articulated interpretation of the metaphor before they pressed the space bar. The dependent measure was the time between screen onset of the metaphor and the pressing of the space bar. After the space bar was pressed, the metaphor was replaced by a fixation cross and the next trial began.

After the participants had read through the instructions, they completed a brief practice session that comprised 4 trials (comprehension times on these trials were not recorded). Following the practice session, the participants were presented with the 35 experimental trials. The experimental trials were presented in a different

Table 1
Mean Metaphor Comprehension Times (in Milliseconds) by Term and Prime Type

	Term Type			
	Topic		Vehicle	
Prime Type	*M*	*SD*	*M*	*SD*
Term alone	2,039	+237	2,101	+175
Relevant property	2,006	+270	2,049	+227
Irrelevant property	2,075	+201	2,397	−121
Baseline (no prime)	2,276	0		

random order to each participant. After completing the on-line task, each participant completed a 10-item paper-and-pencil questionnaire that measured retention of the sentence stimuli. Each page of the questionnaire presented a metaphor in which either the topic or the vehicle was omitted. Half (5) of the items omitted topics (e.g., *Many _____ are jails*), and half omitted vehicles. The participants were instructed to fill in the omitted term in the blank space and then to write a brief description of the completed metaphor's overall meaning. After completing the questionnaire, the participants were debriefed about the purpose of the experiment. On average, the participants completed the experiment in 20 min.

Results

The initial stage of analysis involved the identification of those participants who failed to achieve 80% accuracy in recalling the omitted metaphor terms in the retention test. The participants' answers were scored as accurate only if they recalled the exact word that appeared in the original metaphor. This strict scoring criterion was used in order to ensure that the comprehension time data included in the analysis was drawn from the participants who carefully read and comprehended the stimulus metaphors. Five of the original 63 participants failed to achieve the 80% accuracy criterion and were replaced with 5 additional participants who did meet the criterion. Inspection of the participants' descriptions of each metaphor's meaning indicated that all of the participants interpreted the stimulus metaphors in very similar ways; thus, no participants' data were excluded from analysis on the basis of their descriptions.

Metaphor comprehension times longer than 10,000 msec (approximately 3%) were excluded from the analyses. The mean comprehension times in each of the seven prime conditions are presented in Table 1. To evaluate the facilitation produced by each prime type, the mean comprehension times in each of prime conditions for the topic and the vehicle (term alone, ground-relevant property, ground-irrelevant property) were subtracted from the mean comprehension time for the baseline prime condition. This procedure produced deviation scores that directly reflected the amount of comprehension facilitation (indicated by positive scores) produced by each prime type. The deviation scores are shown in Figure 1.

Initial analyses indicated no main effect or interactions of stimulus list condition with the factors of primary interest, so subsequent analyses were conducted collapsing across this factor. Two 2 × 3 analyses of variance (ANOVAs) were conducted with term (topic or vehicle) and prime type (term alone, ground-relevant property, or ground-irrelevant property) as within-subjects factors: one in which the participants were treated as a random factor (F_p), and a second in which items were treated as a random factor (F_i). These analyses revealed a reliable effect of term [$F_p(1,62) = 4.81, p < .05$; $F_i(1,34) = 4.26, p < .05$]. Overall, primes that presented topic information produced more facilitation on average (236 msec) than those that presented vehicle information (94 msec). In addition, there was a reliable main effect of prime type [$F_p(2,124) = 7.31, p < .01$; $F_i(2, 68) = 4.57, p < .05$]. Pairwise comparisons indicated that both the term-alone and ground-relevant property primes produced greater mean facilitation (206 and 249 msec, respectively) than did the ground-irrelevant property primes (40 msec, $p < .05$ in both cases). The facilitation produced by the term-alone primes did not, however, significantly differ from that produced by the ground-relevant property primes [$t_p(124) = 1.04, p > .10$; $t_i(68) < 1$].

There was also a significant term × prime type interaction [$F_p(2,124) = 4.67, p < .05$; $F_i(2,68) = 4.33, p < .05$]. As illustrated in Figure 1, metaphor comprehension was appreciably facilitated by all prime types with one exception: Vehicle ground-irrelevant property primes yielded comprehension times that were on average 121 msec longer (i.e., in the direction of interference rather than facilitation) than the baseline mean comprehension time. The Neuman–Keuls procedure (Keppel, Saufley, & Tokunaga, 1992) was used to perform comparisons between the means. This analysis indicated that the comprehension facilitation produced by the vehicle ground-irrelevant property primes was significantly lower than that for all other prime types ($p < .01$). There were not, however, any significant differences in facilitation among the other five prime types.

The analyses above suggest that, overall, the primes reliably facilitated metaphor comprehension with the exception of those ascribing ground-irrelevant properties to the vehicle, which appeared to actually impede comprehension. However, these analyses do not take into account the degree to which the vehicles varied in conventionality. Previous research has demonstrated marked differences in the processing of metaphors with conventional and novel vehicles (Blasko & Connine, 1993; Bobrow & Bell, 1973; Wolff & Gentner, 2000). For example, Wolff and Gentner (Experiment 3) found that vehicle primes produced greater facilitation of metaphor comprehension when the vehicles were conventional (e.g., *That baby is an* angel) than when they were relatively novel (e.g., *That slum is a* tumor). These researchers interpreted the advantage of conventional vehicle primes to be evidence that the metaphorical meaning of a conventional vehicle is retrieved (rather than constructed) as an alternative sense of the vehicle term. This interpretation is consistent with our claim that metaphor vehicles are understood to have dual reference to their literal and metaphorical senses. Our concern in the present study was whether the observed impedance in metaphor comprehension produced by vehicle ground-irrelevant property primes would vary as a function of vehicle conventionality.

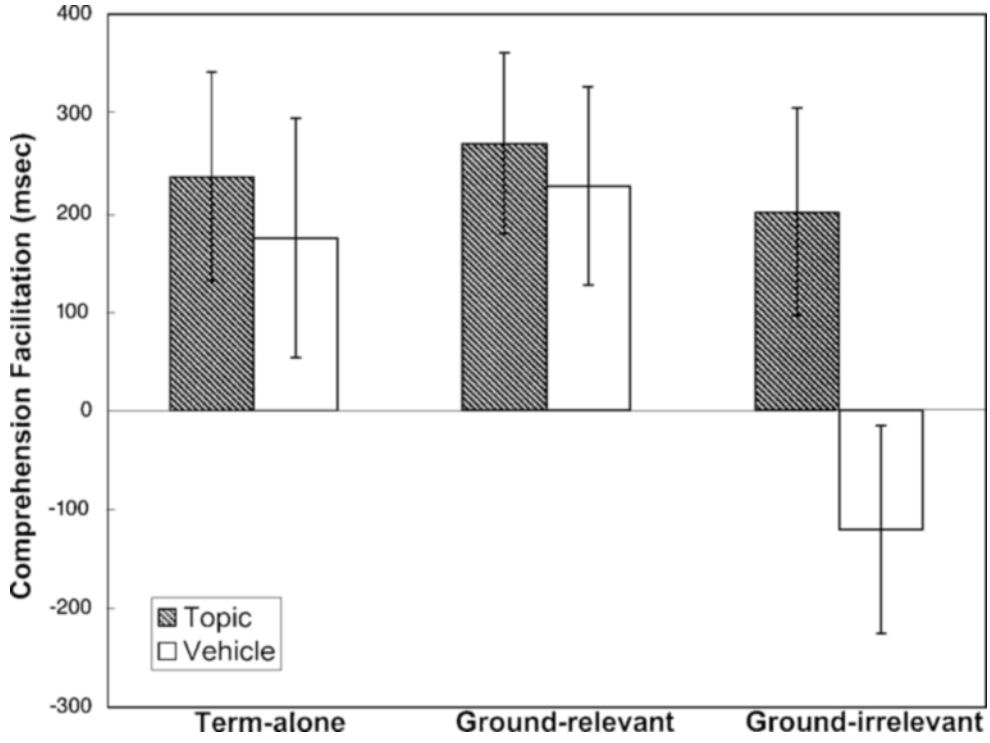

Figure 1. Comprehension facilitation by term and prime type.

To explore this possibility, we asked 10 additional Lafayette undergraduates to rate the conventionality of the vehicles in our 35 stimulus metaphors on a scale of 1 (*not at all conventional*) to 7 (*very conventional*). On the basis of these ratings, we classified the 10 lowest rated metaphors (mean = 3.59) as *low conventional* and the 10 highest rated (mean = 5.81) as *high conventional.* Next, we reanalyzed the comprehension priming data for these items in a $2 \times 3 \times 2$ mixed ANOVA, with term and prime type as within-items factors and vehicle conventionality (low and high) as a between-items factor.[1] Consistent with the initial analysis, this analysis revealed a main effect of term [$F_i(1,18) = 4.47$, $p < .05$], moderated by a term × prime type interaction [$F_i(2,36) = 5.11$, $p < .05$]. Overall, topic primes facilitated metaphor comprehension more than did vehicle primes (+251 vs. +122 msec, respectively), a pattern due primarily to the low facilitation (in the direction of interference) produced by vehicle ground-irrelevant property primes (−76 msec). In addition, there was a marginal prime type × vehicle conventionality interaction [$F_i(2,36) = 4.05$, $p < .06$]. The relevant means (and deviation scores) are presented in Table 2.

A Neuman–Keuls multiple comparison test among the means in this interaction yielded three important findings. The first was that, as in the initial analysis, the comprehension facilitation produced by term-alone (+196 msec) and ground-relevant property primes (+245 msec) was greater than that produced by ground-irrelevant property primes (−76 msec), irrespective of the vehicle's conventionality ($p < .05$ in all cases). Second, term-alone and ground-relevant property primes for high conventional vehicles produced slightly, but not significantly, greater facilitation (+225 and +259 msec, respectively) than did those for low conventional vehicles (+166 and +230 msec, respectively; $p > .05$ in both cases). Third, this pattern was reversed for ground-irrelevant property primes: Ground-irrelevant property primes for high conventional vehicles produced less comprehension facilitation (in the direction of interference) than did those for low conventional vehicles (−143 and −8 msec, respectively, $p < .05$). Taken as a whole, these findings suggest that conventionality moderated the influence that advance information about the vehicle had on metaphor comprehension. Primes that presented the vehicle alone or with a ground-relevant property facilitated comprehension to a greater degree when

Table 2
Mean Comprehension Times (in Milliseconds) for a Subset of Metaphors Employing Low- or High-Conventional Vehicles By Vehicle Conventionality and Prime Type

	Vehicle Conventionality			
	Low		High	
Prime Type	*M*	*SD*	*M*	*SD*
Term alone	2,151	+166	2,092	+225
Relevant property	2,087	+230	2,058	+259
Irrelevant property	2,325	−8	2,460	−143
Baseline (no prime)	2,317	0		

Note—This baseline represents the mean comprehension time for the 10 low- and 10 high-conventional metaphors preceded by blank primes (i.e., neither topic nor vehicle) examined in the reanalysis.

the vehicle was highly conventional than when it was less conventional. This result is consistent with previous investigations of conventionality in metaphor comprehension (Blasko & Connine, 1993; Wolff & Gentner, 2000) and suggests that metaphoric meanings can be retrieved for conventional vehicles but are constructed for novel ones. The reduction in comprehension facilitation produced by ascribing a ground-irrelevant property to the vehicle in advance of the metaphor supports this interpretation. When the vehicle was conventional (e.g., *Libraries can be goldmines*), ground-irrelevant property primes (e.g., *Many libraries are public*) led the reader to initially consider the inappropriate literal sense of the term, rather than to retrieve the stock metaphoric category that the vehicle exemplifies (valuable things). Switching from the term's literal sense to its stock category sense severely reduced the comprehension facilitation produced by advance notice of the term and in fact appeared to interfere with comprehension relative to the baseline condition. For more novel vehicles (e.g., *Dancers can be* butterflies), switching of this sort did not occur because their category senses had to be constructed from properties of their literal senses rather than retrieved. Thus, although ground-irrelevant property primes (e.g., *Some butterflies are orange*) impeded this construction process (by focusing the readers' attention on the wrong properties of the literal sense), the comprehension interference they produced for metaphors with more novel vehicles was less severe.

DISCUSSION

The pattern of priming results suggests that the topic and the vehicle terms in metaphors are understood to be referring to different levels of abstraction. Primes that presented either the topic or the vehicle terms alone, or ascribed ground-relevant properties to these concepts, reliably facilitated comprehension (relative to the baseline prime condition) of the subsequently presented metaphor. These results are predicted by both property comparison and property attribution models and are not all that surprising. Both the topic and the vehicle contribute important information to overall metaphor meaning; consequently, advance notice of either term, as well as properties relevant to the metaphoric ground, should facilitate comprehension. It is somewhat surprising that the ground-relevant property primes did not produce facilitation above and beyond that produced by presenting either term alone. However, recall that the metaphors we chose had been rated by an independent group of participants as being highly comprehensible. The use of this criterion in choosing our metaphor stimuli may have artificially reduced the degree of uncertainty the participants had when reading the isolated topic or vehicle, about which properties of these concepts would ultimately be ground-relevant. Thus the comparability of the facilitation effects produced by the term-alone and ground-relevant property primes may not be generalizable to less comprehensible metaphors.

For our purposes, the critical finding was the differential influence of the topic and the vehicle ground-irrelevant property primes: The former produced reliable comprehension facilitation, whereas the latter produced comprehension times that were on average equal to (for novel vehicles) or slower than (for conventional vehicles) the baseline prime condition. The differential influence of these prime types is inconsistent with standard property comparison models. These models (e.g., Ortony, 1979) assume that metaphor topics and vehicles are understood to be referring to the same level of abstraction (i.e., the conventional literal referents associated with the terms). Sentences that describe ground-irrelevant properties of the topic or vehicle should prime readers to interpret the term at this literal level. If this level of abstraction is appropriate for both terms, there is no reason to expect the prime types to have different influences on subsequent metaphor processing. In contrast, the property attribution model assumes that the literal level of abstraction is appropriate only for the topic term. The vehicle term is understood at a higher level of abstraction—specifically, a superordinate category that (1) the vehicle exemplifies and (2) can include the topic as a member. When the vehicle has a conventional metaphoric meaning (e.g., *Some jobs are* jails), this category can be retrieved as an alternate sense of the vehicle term. When the vehicle does not have a conventional metaphoric meaning (e.g., *Some beards are* forests), the category must be constructed from the literal properties of the vehicle that can be attributed to the topic. According to the property attribution model, consideration of ground-irrelevant properties of the vehicle prior to reading a metaphor leads the reader to interpret the vehicle in a literal manner, thereby thwarting the retrieval or construction of its metaphoric category. This claim is supported by the large reduction in comprehension facilitation (to a level at or below baseline) that occurred when primes introduced ground-irrelevant properties of the vehicle term, relative to primes in which the vehicle was presented alone.

Although our findings are incompatible with models that characterize metaphor comprehension as a process of property matching between the literal topic and vehicle concepts (i.e., "pure" property comparison models such as Ortony's 1979, 1993, salience imbalance model), they can be explained by a *hybrid* model that postulates both matching and attribution processes. One such model is the *structure-mapping* framework developed by Gentner and her colleagues (Bowdle & Gentner, 1997; Gentner, 1988, 1989; Gentner & Clement, 1988; Wolff & Gentner, 2000). According to this model, metaphor comprehension begins with a matching process in which identical predicates and nonidentical predicates with similar relational structures in the topic and the vehicle are identified. These matches are then merged into one or more interpretations that maximize the structural consistency between the representations of the topic and the vehicle concepts. For each interpretation generated, predicates in the vehicle that are not part of the a priori representation of the topic

become candidate inferences that might be attributed to the topic. Wolff and Gentner (2000) also postulate a "career of metaphor" in which the figurative interpretation of a given vehicle can become an alternate sense of the term with frequent use in metaphoric contexts. Thus, despite differences in certain processing assumptions, the property attribution and structure-mapping models both offer similar accounts of topic–vehicle interaction and are both compatible with the present results. In structure-mapping terms, we would suggest that the interpretation of a nominal metaphor that maximizes the structural consistency of the topic and vehicle concepts is typically the one that is consistent with the statement's sentential form (i.e., an assertion that the topic belongs to a category named by the vehicle term).

Our claim that metaphor vehicles are understood to be referring to superordinate categories raises the question of how these categories are retrieved or constructed on line. The *X is a Y* form of nominal metaphors clearly can serve as a cue to readers to search for the relevant metaphoric category. For highly conventional metaphor vehicles such as *pig*, the category (*unclean* and/or *gluttonous entities*) may simply be retrieved as an alternate sense of the term. Note that this alternate sense of *pig* does not retain literal pig properties such as *have hooves*, *live on farms*, and so on, which would constitute ground-irrelevant properties in a metaphor such as *My uncle is a pig*. How is the metaphoric category determined when the vehicle is not conventional? One possibility is suggested by Gernsbacher's (1990) structure-building model of language comprehension. Gernsbacher has suggested that during language comprehension, conceptual information that is relevant to the ongoing discourse is "enhanced" (i.e., in a state of high activation) and irrelevant information is "suppressed" (i.e., in a state of below-normal activation) in order to generate coherent discourse representations. Enhancement and suppression phenomena have been documented in several studies of literal language comprehension (cf. Gernsbacher & Faust, 1990; Hasher & Zacks, 1988; Simpson & Kang, 1994). Gernsbacher, Keysar, and Robertson (1995) demonstrated that such phenomena occur in metaphor comprehension as well. These researchers asked participants to read sentences one at a time and to decide whether or not each statement made sense. Embedded in the sentences were metaphors such as *my lawyer is a shark* and nonsense (Experiment 1) or literal (Experiment 2) counterpart sentences such as *my lunch box is a shark* or *the hammerhead is a shark*. The metaphors and their nonsense and literal counterparts served as primes for probe sentences that ascribed a metaphor-relevant (*sharks are vicious*) or metaphor-irrelevant (*sharks are good swimmers*) property to the metaphor vehicle. The time it took to judge whether the probe sentence made sense served as a measure of property accessibility. Metaphor-relevant probe sentences were responded to more quickly following metaphors than were either the nonsense or the literal control sentences. In contrast, metaphor-irrelevant probe sentences were responded to more slowly following metaphors than were the control sentences. Gernsbacher et al. interpreted the latter finding as evidence that metaphor-irrelevant properties do not remain inert during metaphor comprehension but are actively suppressed.

Gernsbacher et al.'s (1995) results suggest that the search for a category named by a less conventional metaphor vehicle is predicated on suppression/enhancement mechanisms that operate during literal and nonliteral language comprehension. For example, when people interpret *my lawyer is a shark*, the metaphoric category named *shark* is a product of the enhancement of ground-relevant shark properties (e.g., vicious, predatory) coupled with the suppression of ground-irrelevant properties (e.g., good at swimming, can be blue, etc.). The results of the present study complement Gernsbacher et al.'s study by demonstrating that ground-irrelevant vehicle properties not only "drop out" of the discourse representation that is produced when a metaphor is understood, but also may interfere with the construction of this representation when they are contextually foregrounded.

Ground-irrelevant properties of the topic presumably drop out of the discourse representation as well; why, then, did foregrounding of these properties not produce comprehension interference? We suggest that this asymmetry reflects the category-inclusion relationship between the topic and the vehicle terms. Whereas ground-irrelevant properties of the vehicle preclude the topic from being an exemplar of its literal referent, ground-irrelevant properties of the topic do not preclude its membership in the metaphoric category that the vehicle exemplifies. Thus, lawyers cannot belong to the category of sharks who can be blue, have fins, live in the ocean, and so on; however, lawyers can belong to the category of *vicious beings* that sharks exemplify, regardless of whether these lawyers are male or female, short or tall, married or unmarried, and so forth.

REFERENCES

Black, M. (1962). *Models and metaphors.* Ithaca, NY: Cornell University Press.

Black, M. (1979). *More about metaphor.* In A. Ortony (Ed.), *Metaphor and thought* (pp.19-43). Cambridge: Cambridge University Press.

Blasko, D. G., & Connine, C. M. (1993). Effects of familiarity and aptness on metaphor processing. *Journal of Experimental Psychology: Learning, Memory, & Cognition,* **12**, 295-308.

Bobrow, S. A., & Bell, S. M. (1973). On catching on to idiomatic expressions. *Memory & Cognition,* **1**, 343-346.

Bowdle, B., & Gentner, D. (1997). Informativity and asymmetry in comparisons. *Cognitive Psychology,* **34**, 244-286.

Gentner, D. (1988). Metaphor as structure-mapping: The relational shift. *Child Development,* **59**, 47-59.

Gentner, D. (1989). The mechanisms of analogical learning. In S. Vosnaidou & A. Ortony (Eds.), *Similarity and analogical reasoning* (pp. 199-241). New York: Cambridge University Press.

Gentner, D., & Clement, C. (1988). Evidence for relational selectivity in the interpretation of analogy and metaphor. In G. H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 22, pp. 307-358). San Diego: Academic Press.

Gernsbacher, M. A. (1990). *Language comprehension as structure building.* Hillsdale, NJ: Erlbaum.

Gernsbacher, M. A., & Faust, M. (1990). The role of suppression in sentence comprehension. In G. B. Simpson (Ed.), *Understanding word and sentence* (pp. 97-128). Amsterdam: North-Holland.

Gernsbacher, M. A., Keysar, B., & Robertson, R. R. (1995). *The*

role of suppression in metaphor interpretation. Paper presented at the 36th Annual Meeting of the Psychonomic Society, Los Angeles.
GILDEA, P., & GLUCKSBERG, S. (1983). On understanding metaphor: The role of context. *Journal of Verbal Learning & Verbal Behavior,* **22**, 577-590.
GLUCKSBERG, S., GILDEA, P., & BOOKIN, H. (1982). On understanding nonliteral speech: Can people ignore metaphors? *Journal of Verbal Learning & Verbal Behavior,* **21**, 85-96.
GLUCKSBERG, S., & KEYSAR, B. (1990). Understanding metaphorical comparisons: Beyond similarity. *Psychological Review,* **97**, 3-18.
GLUCKSBERG, S., MCGLONE, M. S., & MANFREDI, D. (1997). Property attribution in metaphor comprehension. *Journal of Memory & Language,* **36**, 50-67.
HASHER, L., & ZACKS, R. T. (1988). Working memory, comprehension, and aging: A review and new view. In G. H.Bower (Ed.), *The psychology of learning and motivation* (Vol. 22, pp. 193-255). San Diego: Academic Press.
KEPPEL, G., SAUFLEY, W. H., & TOKUNAGA, H. (1992). *Introduction to design and analysis* (2nd ed). New York: W. H. Freeman.
MALGADY, R. G., & JOHNSON, M. G. (1976). Modifiers in metaphors: Effects of constituent phrase similarity on the interpretation of figurative sentences. *Journal of Psycholinguistic Research,* **5**, 43-52.
MCGLONE, M. S. (1994). *Love, journeys, and traveling things: Analogies, metaphors, and categories.* Unpublished doctoral dissertation, Princeton University.
MCGLONE, M. S. (1996). Conceptual metaphors and figurative language interpretation: Food for thought? *Journal of Memory & Language,* **36**, 50-67.
MILLER, G. A. (1993). Images and models, similes and metaphors. In A. Ortony (Ed.), *Metaphor and thought* (2nd ed., pp. 186-201). Cambridge: Cambridge University Press.
ORTONY, A. (1979). Beyond literal similarity. *Psychological Review,* **86**, 161-180.
ORTONY, A. (1993). *Metaphor and thought* (2nd ed.). Cambridge University Press.
SIMPSON, G., & KANG, H. (1994). Inhibitory processes in the recognition of homograph meanings. In D. Dagenbach & T. H. Carr (Eds.), *Inhibitory processes in attention, memory, and language* (pp. 359-378). San Diego: Academic Press.
TVERSKY, A. (1977). Features of similarity. *Psychological Review,* **84**, 327-352.
VERBRUGGE, R. R., & MCCARRELL, N. S. (1977). Metaphor comprehension: Studies in reminding and resembling. *Cognitive Psychology,* **9**, 494-533.
WOLFF, P., & GENTNER, D. (2000). Evidence for role-neutral initial processing of metaphors. *Journal of Experimental Psychology: Learning, Memory, & Cognition,* **26**, 529-541.

NOTE

1. Because vehicle conventionality was not explicitly manipulated in the design of the stimulus lists, there were unequal numbers of the prime type × vehicle conventionality pairings across lists. This imbalance renders F_p uninformative, because participants in the different list conditions were not exposed to equal numbers of the prime types preceding metaphors with low or high conventional vehicles. Thus we report only the results of the items analysis (F_i).

APPENDIX
Metaphor and Prime Sentence Stimuli

B = baseline prime
TA = topic-alone prime
VA = vehicle-alone prime
TGR = topic ground-irrelevant prime
VGR = vehicle ground-irrelevant prime
TGI = topic ground-irrelevant prime
VGI = vehicle ground-irrelevant prime

M:	Some stomachs are barrels^{H}.
B:	Some **** are ****.
TA:	Some stomachs are ****.
VA:	Some **** are barrels.
TGR:	Stomachs can be large.
VGR:	Barrels can be large.
TGI:	Stomachs can have ulcers.
VGI:	Barrels can be wooden.

M:	A rooster is an alarm clock^{L}.
B:	A **** is an ****.
TA:	A rooster is an ****.
VA:	A **** is an alarm clock.
TGR:	Roosters can wake you up.
VGR:	Alarm clocks can wake you up.
TGI:	Roosters can be red.
VGI:	Alarm clocks can be electric.

M:	Many jobs are jails.
B:	Many **** are ****.
TA:	Many jobs are ****.
VA:	Many **** are jails.
TGR:	Some jobs are confining.
VGR:	Some jails are confining.
TGI:	Some jobs are temporary.
VGI:	Some jails are historic.

M:	Some lectures are sleeping pills.
B:	Some **** are ****.
TA:	Some lectures are ****.
VA:	Some **** are sleeping pills.
TGR:	Lectures can cause drowsiness.
VGR:	Sleeping pills can cause drowsiness.
TGI:	Lectures can be well attended.
VGI:	Sleeping pills can be addictive.

M:	Some cats are princesses^{H}.
B:	Some **** are ****.
TA:	Some cats are ****.
VA:	Some **** are princesses.
TGR:	Cats can be pampered.
VGR:	Princesses can be pampered.
TGI:	Cats can be siamese.
VGI:	Princesses can be married.

M:	A rumor is a virus.
B:	A **** is a ****.
TA:	A rumor is a ****.
VA:	A **** is a virus.
TGR:	Some rumors are communicable.
VGR:	Some viruses are communicable.
TGI:	Some rumors are false.
VGI:	Some viruses are dangerous.

M:	Billboards are warts.
B:	**** are ****.
TA:	Billboards are ****.
VA:	**** are warts.
TGR:	Billboards can be ugly.
VGR:	Warts can be ugly.
TGI:	Billboards can be expensive.
VGI:	Warts can be removed.

APPENDIX (Continued)

M: Some smiles are magnets.
B: Some **** are ****.
TA: Some smiles are ****.
VA: Some **** are magnets.
TGR: A smile can attract.
VGR: A magnet can attract.
TGI: A smile can be fake.
VGI: A magnet can be weak.

M: Skin can be sandpaper.
B: **** can be ****.
TA: Skin can be ****.
VA: **** can be sandpaper.
TGR: Some skin is rough.
VGR: Some sandpaper is rough.
TGI: Some skin is freckled.
VGI: Some sandpaper is brown.

M: Dancers can be butterflies[L].
B: **** can be ****.
TA: Dancers can be ****.
VA: **** can be butterflies.
TGR: Some dancers are graceful.
VGR: Some butterflies are graceful.
TGI: Some dancers are men.
VGI: Some butterflies are orange.

M: Libraries can be goldmines[H].
B: **** can be ****.
TA: Libraries can be ****.
VA: **** can be goldmines.
TGR: Many libraries are valuable.
VGR: Many goldmines are valuable.
TGI: Many libraries are public.
VGI: Many goldmines are old.

M: Some divorces are storms[L].
B: Some **** are ****.
TA: Some divorces are ****.
VA: Some **** are storms.
TGR: Divorces can be destructive.
VGR: Storms can be destructive.
TGI: Divorces can be costly.
VGI: Storms can be tropical.

M: A lake can be a mirror[H].
B: A **** can be a ****.
TA: A lake can be a ****.
VA: A **** can be a mirror.
TGR: Lakes can be reflective.
VGR: Mirrors can be reflective.
TGI: Lakes can be deep.
VGI: Mirrors can be metal.

M: Some lawyers are sharks.
B: Some **** are ****.
TA: Some lawyers are ****.
VA: Some **** are sharks.
TGR: Lawyers can be ruthless.
VGR: Sharks can be ruthless.
TGI: Lawyers can be married.
VGI: Sharks can be blue.

M: Grandparents can be donkeys[L].
B: **** can be ****.
TA: Grandparents can be ****.
VA: **** can be donkeys.
TGR: Some grandparents are stubborn.
VGR: Some donkeys are stubborn.
TGI: Some grandparents are retired.
VGI: Some donkeys live on ranches.

M: Many stores are jungles[H].
B: Many **** are ****.
TA: Many stores are ****.
VA: Many **** are jungles.
TGR: Stores can be bustling.
VGR: Jungles can be bustling.
TGI: Stores can be exclusive.
VGI: Jungles can be humid.

M: Some teachers are encyclopedias[H].
B: Some **** are ****.
TA: Some teachers are ****.
VA: Some **** are encyclopedias.
TGR: Teachers are informative.
VGR: Encyclopedias are informative.
TGI: Teachers have students.
VGI: Encyclopedias have indexes.

M: Some desks are junkyards.
B: Some **** are ****.
TA: Some desks are ****.
VA: Some **** are junkyards.
TGR: Desks can be messy.
VGR: Junkyards can be messy.
TGI: Desks can be square.
VGI: Junkyards can be large.

M: Some beards are forests[L].
B: Some **** are ****.
TA: Some beards are ****.
VA: Some **** are forests.
TGR: Beards can be dense.
VGR: Forests can be dense.
TGI: Beards can be gray.
VGI: Forests can be beautiful.

M: Ideas can be diamonds[H].
B: **** can be ****.
TA: Ideas can be ****.
VA: **** can be diamonds.
TGR: Some ideas are valuable.
VGR: Some diamonds are valuable.
TGI: Some ideas are complex.
VGI: Some diamonds are cut.

M: Insults are razors.
B: **** are ****.
TA: Insults are ****.
VA: **** are razors.
TGR: Insults can cause harm.
VGR: Razors can cause harm.
TGI: Insults can be ignored.
VGI: Razors can be disposable.

APPENDIX (Continued)

M:	Some voices are sirens[L].	M:	Anger is a volcano.
B:	Some **** are ****.	B:	**** is a ****.
TA:	Some voices are ****.	TA:	Anger is a ****.
VA:	Some **** are sirens.	VA:	**** is a volcano.
TGR:	Voices can be shrill.	TGR:	Anger can be explosive.
VGR:	Sirens can be shrill.	VGR:	A volcano can be explosive.
TGI:	Voices can be familiar.	TGI:	Anger can be longlasting.
VGI:	Sirens can be turned off.	VGI:	A volcano can be dormant.
M:	Some fashion models are twigs[H].	M:	Love is a journey.
B:	Some **** are ****.	B:	**** is a ****.
TA:	Some fashion models are ****.	TA:	Love is a ****.
VA:	Some **** are twigs.	VA:	**** is a journey.
TGR:	Many fashion models are thin.	TGR:	Love can take time.
VGR:	Many twigs are thin.	VGR:	A journey can take time.
TGI:	Many fashion models are young.	TGI:	Love can be painful.
VGI:	Many twigs have leaves.	VGI:	A journey can be on foot.
M:	A slum is a tumor.	M:	Crime is a disease.
B:	A **** is a ****.	B:	**** is a ****.
TA:	A slum is a ****.	TA:	Crime is a ****.
VA:	A **** is a tumor.	VA:	**** is a disease.
TGR:	Slums can be dangerous.	TGR:	Crime can be damaging.
VGR:	Tumors can be dangerous.	VGR:	A disease can be damaging.
TGI:	Slums can be urban.	TGI:	Crime can be investigated.
VGI:	Tumors can be round.	VGI:	A disease can be medicated.
M:	Sarcasm is a veil.	M:	Cocaine is a timebomb[H].
B:	**** is a ****.	B:	**** is a ****.
TA:	Sarcasm is a ****.	TA:	Cocaine is a ****.
VA:	**** is a veil.	VA:	**** is a timebomb.
TGR:	Sarcasm can be used to conceal.	TGR:	Cocaine can kill unexpectedly.
VGR:	A veil can be used to conceal.	VGR:	A timebomb can kill unexpectedly.
TGI:	Sarcasm can be witty.	TGI:	Cocaine can be smuggled.
VGI:	A veil can be fashionable.	VGI:	A timebomb can be programmed.
M:	Many cities are beehives[L].	M:	Insurance is an umbrella[L].
B:	Many **** are ****.	B:	**** is an ****.
TA:	Many cities are ****.	TA:	Insurance is an ****.
VA:	Many **** are beehives.	VA:	**** is an umbrella.
TGR:	Cities are often crowded.	TGR:	Insurance can be protective.
VGR:	Beehives are often crowded.	VGR:	An umbrella can be protective.
TGI:	Cities are often zoned.	TGI:	Insurance can be expensive.
VGI:	Beehives are often in trees.	VGI:	An umbrella can be black.
M:	Some runners are cheetahs.	M:	Some surgeons are butchers[H].
B:	Some **** are ****.	B:	Some **** are ****.
TA:	Some runners are ****.	TA:	Some surgeons are ****.
VA:	Some **** are cheetahs.	VA:	Some **** are butchers.
TGR:	Runners can be fast.	TGR:	Some surgeons are incompetent.
VGR:	Cheetahs can be fast.	VGR:	Some butchers are incompetent.
TGI:	Runners can be professional.	TGI:	Some surgeons are wealthy.
VGI:	Cheetahs can be caged.	VGI:	Some butchers are heavyset.
M:	Music can be medicine[L].	M:	Memory is a warehouse[L].
B:	**** can be ****.	B:	**** is a ****.
TA:	Music can be ****.	TA:	Memory is a ****.
VA:	**** can be medicine.	VA:	**** is a warehouse.
TGR:	Some music is soothing.	TGR:	Memory is used for storage.
VGR:	Some medicines are soothing.	VGR:	A warehouse is used for storage.
TGI:	Some music is recorded.	TGI:	Memory can decline with age.
VGI:	Some medicines are injected.	VGI:	A warehouse can be rented.

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