

# Metaphor-Based Schemas and Text Representations: Making Connections Through Conceptual Metaphors

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Four experiments were conducted to examine the role of metaphor-based schemas in text comprehension and representation. In Experiment 1, schemas facilitated recognition judgments for schema-related sentences that had been presented in a text. Similar facilitation was found for the recognition of individual words in Experiments 2, 3, and 4. The results are interpreted as evidence for the use of metaphor-based schemas to link elements within a text representation.

From the perspective of cognitive psychology, there are at least two distinct questions that research on metaphor can attempt to answer. One can ask, first, what processes are used to comprehend metaphors, and second, what products result from metaphor use and comprehension (Gibbs & Gerrig, 1989). Much of the experimental literature on metaphor has addressed questions of process. Numerous studies have examined how metaphors are interpreted (Glucksberg, 1991; Glucksberg & Keysar, 1990; Ortony, 1979; Ortony, Vondruska, Foss, & Jones, 1985; Tversky, 1977) and whether metaphor interpretation requires special processing mechanisms in addition to those used to comprehend literal language (Gerrig, 1989; Gerrig & Healy, 1983; Gibbs, 1984; Gildea & Glucksberg, 1983; Glucksberg, Gildea, & Bookin, 1982; Inhoff, Lima, & Carroll, 1984; Ortony, Schallert, Reynolds, & Antos, 1978). Equally important, however, is the question of what the products of metaphor comprehension might be. In this article, we investigate how metaphors can give rise to successful organization of the information in short texts.

A number of theorists have suggested that metaphor may play a special role in organizing conceptual knowledge through the interaction of two different domains (Black, 1954/1981; Gentner, 1983; Kelly & Keil, 1987; Lakoff & Johnson, 1980; Sternberg & Nigro, 1983; Tourangeau & Sternberg, 1981; Verbrugge & McCarrell, 1977). According to some formulations, conceptual metaphors systematically influence the way that their topic domains are understood (Lakoff & Johnson,

1980). The representational structure that maps knowledge about a conceptual metaphor's vehicle domain onto its topic domain is what we have termed a "metaphor-based schema." The domain of love, for example, is often understood through the schema *love is a physical force*, in which conceptual structures associated with physical forces are mapped onto the domain of love, and in the process, influence the way love is understood. The underlying conceptual metaphor can be expressed in a number of linguistic metaphors, such as "Sparks fly when they are together" and "They were magnetically drawn to one another."

Our hypothesis is that the framework created by a conceptual metaphor can aid in the comprehension of new information. For example, a conceptual metaphor such as *Crime is a disease* carries with it implications about the metaphor's topic, crime. Some of the entailments that might follow from the *Crime is a disease* metaphor include "The source of crime can be diagnosed" (it has an identifiable cause) and "Crime has a cure" (there is something that can eliminate crime). Moreover, the entailments of a conceptual metaphor such as this one do not simply make up a list of associated items, but rather are elements in an organized system of knowledge about the metaphor's topic domain, in this case crime (Lakoff & Johnson, 1980).

That conceptual metaphors can provide a schema-like structure for organizing information about a topic is also suggested by Gibbs and his associates (Gibbs, 1992; Gibbs & Gonzales, 1985; Gibbs & Nayak, 1989; Gibbs, Nayak, Bolton, & Keppel, 1989; Gibbs, Nayak, & Cutting, 1989; Gibbs & O'Brien, 1990; Nayak & Gibbs, 1990) in their research on idioms. They found evidence that idiom meanings are motivated by underlying conceptual metaphors and that speakers of English retain some knowledge of these metaphorical underpinnings. Nayak and Gibbs, for example, found that the contextual appropriateness of idioms such as "flip your lid" and "do a slow burn" depended on whether the idiom referred to the correct temporal stage of a metaphorically structured "conceptual prototype" for the concept of anger. This finding suggests that the metaphors provided a schematic structure for organizing information about their topics. Such an organizing function for metaphor-based schemas is consistent with research on other kinds of schemas. Bower, Black, and Turner

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(1979), for example, found that the order of recall for information from texts was organized according to structures specified by the schemas instantiated in the texts (see Alba & Hasher, 1983, for a review of research on schematic structures).

If the structures provided by metaphor-based schemas can be used to help organize information, then it should be possible to demonstrate that such organization affects the way information from a text is represented in memory. If a text contains several sentences that instantiate elements of the metaphor-based schema *Crime is a disease*, for example, one might expect those sentences (or the propositions that make up those sentences) to be connected to one another in a reader's mental representation of the text's meaning, because of this shared relationship. Although previous research has shown that some kinds of schemas can create connections in memory representations for highly familiar information (McKoon, Ratcliff, & Seifert, 1989), such connections were found with more abstract thematic schemas only when participants were explicitly asked to think about the themes as they read (Seifert, Abelson, McKoon, & Ratcliff, 1986). The experiments presented here will provide evidence that connections can be made with metaphor-based schemas even under relatively minimalist processing conditions, without task demands that would focus participants' attention on the metaphors in the experimental materials.

In our characterization of metaphor-based schemas, we have assumed that they are part of the world knowledge that readers bring to the process of text comprehension. This assumption reflects the view of conceptual metaphors that motivated our research, namely, that proposed by Lakoff and Johnson (1980) in linguistics and supported by psychological research on idiom comprehension (Gibbs & O'Brien, 1990;

Nayak & Gibbs, 1990). There is, however, an alternative view of conceptual metaphors. Glucksberg, Keysar, and McGlone (1992) have argued that conceptual metaphors do not reflect preexisting mappings between domains that are part of long-term memory. Rather, they argue that these mappings are created only during the process of metaphor comprehension, through the formation of an ad hoc category to which the topic of the metaphor can be assigned. On this alternative view, metaphor-based schemas are not part of readers' preexisting knowledge, but are instead constructed ad hoc during comprehension. According to this account, the conceptual metaphor *Crime is a disease* is not organized knowledge that partially structures understanding of what crime is, but rather is a way of looking at crime that readers can quickly assimilate when reading a text that uses that metaphor. Although the experiments presented here were not designed to explicitly test the hypothesis that metaphors exist as part of readers' general world knowledge, it would be somewhat surprising if readers were to form memory connections on the basis of conceptual metaphors if knowledge concerning those metaphors was not easily available in memory. This is particularly true when, as in our experiments, readers are not led to adopt goals or strategies that would lead to special emphasis being placed on the metaphors during comprehension.

Our experiments used word and sentence recognition priming to assess the degree to which elements of a text representation were associated with one another in memory. Previous research on text representations has successfully used recognition priming to show connections among text elements (e.g., McKoon & Ratcliff, 1980a, 1980b). In our experiments, the participants read passages that instantiated metaphor-based schemas and then were tested for recognition of either words or sentences from the passages instead (see Table 1 for

Table 1  
Sample Passage and Recognition Items From Experiments 1-3

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*Crime is a disease*

Schema-matching version

The most recent crime statistics confirmed what New Yorkers had suspected.  
All major categories had increased significantly from last year.  
The city's crime epidemic was raging out of control.  
Extra police patrols had been ordered, but they had little effect.  
If anything, they seemed to aggravate the problem.  
Patrols in problem areas only inflicted more violence<sup>a</sup> on neighboring areas.  
Soon, the violence began to infect even "safe" neighborhoods.  
Public officials desperately looked for a cure.

Nonmatching version

The most recent crime statistics confirmed what New Yorkers had suspected.  
All major categories had increased significantly from last year.  
The city's crime epidemic was raging out of control.  
Though badly needed, police patrols in the city could not be increased.  
A new and virulent strain of pneumonia was plaguing the force.  
Almost a third of the department was infected already.  
The disease had struck at the worst possible time.  
Public officials desperately looked for a cure.

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*Note.* In Experiment 1, the recognition items were "The city's crime epidemic was raging out of control" (prime—old) and "Public officials desperately looked for a cure" (target—old). In Experiments 2 and 3, the recognition items were priming word—*epidemic*, target word—*cure* and priming word—*crime*, target word—*cure*, respectively.

<sup>a</sup>The word *crime* appeared rather than *violence* in Experiments 1 and 2.

examples). In the recognition tests, the critical target items were metaphor-instantiating sentences (or words from those sentences), and they were preceded in the test list by other items that instantiated the same metaphor-based schema. If associations based on the schemas are made during comprehension, then these primed targets should be recognized more quickly than when the prime and target do not both instantiate the schema.

Because the entailments of a conceptual metaphor that form a metaphor-based schema are better captured by phrases or clauses than by single words, we first examined whether associations would be evident between sentences related to the same schema. Experiment 1 tested for facilitation in a sentence-recognition task when metaphor-related sentences were used as primes. Experiments 2, 3, and 4 used word recognition to further examine connections created by metaphor-based schemas. The use of word recognition allowed us to speed up presentation of the primes to rule out strategic processes in the recognition test, and also allowed us to examine the associations more analytically. By selecting different prime and target words, we were able to assess whether the associations were specific to concepts in only one domain or were reflective of connections that spanned both the topic and vehicle domains of the metaphor. Experiment 2 used prime and target words that were both related to the vehicle domain of the metaphor; Experiments 3 and 4 tested whether priming could be found when one member of each prime–target pair was from the metaphor’s vehicle domain and the other was from the topic domain.

### Experiment 1

In this experiment, we tested whether associations mediated by metaphor-based schemas would facilitate sentence recognition. The participants in the experiment read passages that contained instantiations of conceptual metaphors, such as “The city’s crime epidemic was raging out of control” for the metaphor *Crime is a disease* (See Table 1). An unambiguous instantiation such as this was used to invoke a metaphor-based schema early in each passage. The final sentence of each passage was one that could be interpreted in two ways, only one of which would invoke the metaphor-based schema. “Public officials desperately looked for a cure,” for example, could either refer to a crime epidemic, making it related to the *Crime is a disease* schema, or it could refer to a pneumonia epidemic, making it unrelated to the metaphor-based schema. In the schema-matching version of each passage, the context favored an interpretation that would make the final sentence related to the metaphor. In the other (nonmatching) version of the passage, the context favored the interpretation that was not related to the metaphor-based schema.

After reading a block of four passages, the participants were given a recognition test consisting of a list of sentences, some of which had appeared in the passages. Included in each test list were prime–target sentence pairs from the metaphor-instantiating passages. The priming sentence was always the first, unambiguous schema-related sentence from the passage. The immediately following target test sentence was the final

sentence from the same passage. In the schema-matching condition, both the priming and target sentences should have been interpreted as being related to the metaphor-based schema when the passage was read. In the nonmatching condition, only the priming sentence had been related to the metaphor-based schema. We predicted that the participants would be faster to recognize the target sentence when it and the priming sentence shared a connection to the metaphor-based schema than when they did not.

### Method

*Participants.* The participants for Experiment 1 were 24 Northwestern University undergraduates enrolled in an introductory psychology course.

*Materials and design.* Forty brief (seven to nine line) narrative passages were prepared for use in the experiment. Twenty of the passages contained sentences that were related to a metaphor-based schema, such as *Crime is a disease*, with a different schema used in each passage (see Table 1 for an example). Many of the schemas used in the passages corresponded to a list of frequently used conceptual metaphors identified by Lakoff and Johnson (1980). The other 20 passages did not refer to metaphor-based schemas, and they served as fillers.

Two versions were written for each of the experimental passages, one in which the metaphor-based schema was used throughout the passage (the schema-matching version) and another in which the schema was instantiated in the first part of the passage but not at the end of the passage (the nonmatching version). Each passage began with two or three lines that identified the setting of the story. The third or fourth line introduced the metaphor-based schema and later served as the priming sentence in the recognition test. Up to this point, the two versions of each passage were identical. The next three to four sentences of the passage were different in the two versions. In the matching version, these sentences contained one or more additional sentences related to the metaphor-based schema. In the nonmatching version, they instead created a context in which the final sentence of the passage was unlikely to be interpreted as being related to the metaphor-based schema. So, for example, the sentence “Public officials desperately searched for a cure” would be interpreted as being related to the *Crime is a disease* schema when presented after sentences about an increase in crime (matching version), but not if it followed a sentence about police officers contracting pneumonia (nonmatching version). The final sentence of the passage immediately followed the three to four lines of context manipulation. Ten blocks of passages were created, each containing two experimental and two filler passages. The order of presentation was randomized within each block for each participant and each participant read the blocks of passages in a different random order.

Following each block of passages, 16 sentences were presented for recognition. The critical prime and target test items from each experimental passage were the sentence that had introduced the metaphor-based schema, and the passage’s final sentence. Two sentences from each filler passage were also included as old items. Eight unrelated new sentences were also included in each test block. The prime–target pairs of sentences were the same for all participants in the experiment; only the context in which the target sentence had appeared differed across conditions. The order of the test sentences was random within each block, with the constraints that the prime and target sentences from the experimental passages had to occur consecutively and that these prime–target pairs could not occur as the first two items in the list.

*Procedure.* All passages and test items were presented on a 286 IBM-compatible PC with a Goldstar monochrome monitor and all responses were collected by means of the keyboard. Stimulus presentation and response recording were controlled by a real-time computer system.

Each session began with three practice passages followed by a block of test sentences. The practice session began with the words "Press spacebar when ready" appearing on the screen. When the participant pressed the spacebar, the first passage appeared on the screen. The entire passage remained on the screen for a fixed amount of time—the sum of 170 ms for every word, 17 ms for every letter, and 200 ms for every sentence in the passage. This provided ample time for the participants to read each passage and was a reasonable method for adjusting presentation time to account for differences in length between passages. When the time had elapsed, the screen was cleared and there was a pause of 1 s before the next passage was presented. After the last practice passage had been presented, the words "Test Session" appeared on the screen for 3,500 ms to signal the beginning of the test block.

Sixteen sentences were then presented for recognition. The screen was cleared, and 200-ms later, the first test sentence appeared on the screen. The participant then pressed the /? key with his or her right hand to indicate an old judgment or the Z key to indicate a new judgment. We instructed the participants to respond as quickly and accurately as possible. The test sentence remained on the screen until the participant pressed a key, and then the screen was cleared for 200 ms before the next test sentence was presented. After the last test item in the practice session, the words "End of practice session, Wait for further instructions" appeared on the screen. The procedure for the experimental session was the same as for the practice, except that at the end of each test block the words "Press spacebar when ready" appeared, and presentation of the next block of passages began as soon as the participant pressed the spacebar.

**Results and Discussion**

Table 2 presents the mean recognition times and error rates for Experiment 1. Outlying times (more than three standard deviations from the mean, or 2% of the observations) were excluded from the analyses, and only correct responses were included in the reaction time (RT) data. Separate one-way analyses of variance (ANOVAs) were conducted on the subject ( $F_1$ ) and item ( $F_2$ ) means, with story version serving as a within-subject and within-item factor. Throughout these experiments, all reported  $F$  values are reliable at the  $p = .05$  level unless otherwise noted.

Recognition responses were predicted to be faster when the target sentence was related to the metaphor-based schema that had been instantiated in the priming sentence (matching condition) than when the test sentence was not related to the

schema (nonmatching condition). This prediction was confirmed by the finding of a reliable effect of story version, with correct responses to the target sentences being about 130 ms faster in the matching condition than in the nonmatching condition,  $F_1(1, 22) = 16.29, SE = 23$  ms;  $F_2(1, 18) = 23.50$ . There were no reliable effects in the error analyses (all  $F_s < 1$ ). The recognition times and error rates for the priming sentences are also presented in Table 2, and ANOVAs revealed no reliable effect of story version on recognition of the priming sentences,  $F_1(1, 22) = 2.42, ns, SE = 26$  ms and  $F_2(1, 18) = 2.47, ns$ , for the RT data;  $F_1(1, 22) = 2.98, ns$  and  $F_2(1, 18) = 1.60, ns$ , for the error data.

The priming effect found in this experiment suggests that the prime and target sentences were more closely connected within the participants' text representations when they shared a relationship to a metaphor-based schema than when they did not. These metaphor-based connections were, in contrast to the thematic connections examined by McKoon, Ratcliff, and Seifert (1989) and by Seifert et al. (1986), created under relatively minimalist encoding conditions, without any instructions or task demands that would overtly ask participants to focus attention on the metaphors in the passages or on the relationships among sentences that could be based on the metaphors.

**Experiments 2 and 3**

To examine this metaphor-priming effect in more detail, we used single words as primes and targets in the recognition tests in Experiments 2 and 3. Through the use of word recognition, we could examine the connections between a concept from the topic domain of the metaphor and a concept from the vehicle domain (e.g., *crime* and *cure*) and compare them to the connections between two concepts that were both from the vehicle domain (e.g., *disease* and *cure*). In Experiment 2, the prime was a word from the last sentence of the passage that, like the target word, was related to the vehicle domain of the metaphor (e.g., *epidemic*). In Experiment 3, the prime was a word from the last sentence of the passage referring to the topic domain (e.g., *crime*). For both of these experiments, as in Experiment 1, there was a matching condition in which the target was related to the same metaphor-based schema as the prime and a nonmatching condition in which the target was not related to the schema. For both experiments, we predicted faster response time in the matching condition than in the nonmatching condition. In particular, we predicted that the priming would be evident not only between words referring to the same domain, in Experiment 2, but also between words referring to different domains that were related through a conceptual metaphor, in Experiment 3.

**Method**

*Participants.* The participants in Experiment 2 were 26 Northwestern University undergraduates enrolled in an introductory psychology course; 24 participants from the same pool participated in Experiment 3.

*Materials and design.* The same experimental and filler passages from Experiment 1 were used for both Experiment 2 and Experiment

Table 2  
Sentence Recognition Times (in Milliseconds) and Error Rates for Experiment 1

| Sentence type | Version    |             |
|---------------|------------|-------------|
|               | Matching   | Nonmatching |
| Priming       | 1,530 (9%) | 1,593 (13%) |
| Target        | 1,189 (9%) | 1,319 (9%)  |

Note. Error rates are given in parentheses.

3. The materials for the recognition tests in Experiments 2 and 3 consisted of pairs of prime and target words. Four words were selected from each passage. Among these were the critical pairs of schema-related words from the experimental passages, described previously. Two additional words were selected from each passage for use as primes, and each of them was paired with a new test word that did not occur in any of the four passages in that block. A recognition test was given after each block of four stories, as in the previous experiment. Thus, each test block consisted of eight old test words and eight new test words, each preceded by a priming word that had appeared in one of the passages. The order in which the prime-target pairs were presented in each test list was random, except for the constraints that no prime or target words from the same experimental passage as a critical pair preceded the critical pair in the list, and that no critical prime-target pair was the first item in the list.

**Procedure.** Passages were presented in blocks of four, using the same procedure as in Experiment 1. Each test block consisted of a series of words, rather than sentences, that were presented for recognition. Again, each test block was preceded by the words "Test Session" displayed for 3,500 ms. The screen was then cleared, and 500-ms later a row of 11 plus signs ("+++++") was displayed. After another 500 ms, the plus signs were replaced by the priming word of one of the prime-target pairs. The prime was displayed for 250 ms, then it disappeared and the test word appeared one line below the position at which the plus signs and priming word had been written. The test word remained on the screen until the participant pressed a key to indicate whether it had occurred in any of the passages in that block (the /? key for old and the Z key for new). After the participant pressed a key, the screen was blanked and there was a 1,000-ms pause before a row of plus signs signaled the presentation of the next item. We instructed the participants to pay attention to the word preceding the test word and to respond as quickly and accurately as possible when the test word appeared.

### Results and Discussion

The mean RTs and error rates for the critical test words in Experiments 2 and 3 are displayed in Table 3. Outlying times (slower than 1,800 ms, or 2% of the observations in Experiment 2, and less than 1% in Experiment 3) were excluded from the analyses and are not included in these means. The same analyses were conducted for Experiments 2 and 3 as for Experiment 1.

As predicted, recognition times in Experiment 2 were faster in the matching condition, when both the prime and target words came from sentences that instantiated the metaphor-based schema, than in the nonmatching condition, when only the prime came from a schema-instantiating sentence,  $F_1(1, 24) = 6.34$ ,  $SE = 13$  ms;  $F_2(1, 18) = 5.16$ . There were no reliable effects in either of the error analyses ( $F_s < 2.7$ ).

In Experiment 3, the participants were also faster to recognize the test word in the matching condition than in the nonmatching condition,  $F_1(1, 22) = 5.79$ ,  $SE = 15$  ms;  $F_2(1, 18) = 18.6$ , and there were no reliable differences in the error analyses ( $F_s < 2.7$ ). Although the error rate for the matching condition was higher than for the nonmatching condition in Experiment 3, the difference in error rates was not reliable by either subjects or items analyses.

To compare the priming effect with the two different types of priming words, we reanalyzed the combined data from Experiments 2 and 3 in a single ANOVA. Story version was a within-subject and within-item variable in the analyses, and experiment was a between-subjects and within-item variable. The difference in recognition times between the matching and nonmatching conditions was reliable in the combined analysis,  $F_1(1, 46) = 12.14$ ,  $SE = 10$  ms;  $F_2(1, 16) = 16.73$ . There was also an overall difference in RTs between the two experiments,  $F_1(1, 46) = 2.84$ ,  $SE = 29$  ms,  $p < .10$ ;  $F_2(1, 16) = 17.86$ , which probably reflected variations among groups of participants in the two experiments. There was, however, no interaction of story version and experiment ( $F_s < 1$ ,  $ns$ ). Thus, there was no evidence for greater priming when the primes were close semantic associates of the target words (in Experiment 2) than when they were less closely related. There were no reliable effects in the combined error analyses (all  $F_s < 2.6$ ,  $ns$ ).

Because the duration of the priming word was too brief to allow the participants to engage in retrieval strategies, Experiments 2 and 3 provided evidence that the connections responsible for the priming were part of the text representations formed during reading. In addition, the results of these two experiments suggest that these connections span both the topic and vehicle domains of the metaphor. Priming was found both between prime-target pairs from only the vehicle domain in Experiment 2 (*epidemic-cure*) and between topic-vehicle pairs in Experiment 3 (*crime-cure*).

The results of Experiments 1-3 support the conclusion that sentences related to the same metaphor-based schema were better connected in the participants' text representations than were sentences that did not share a relationship to a metaphor-based schema. The possibility remains, however, that something other than the schemas could have been responsible for the better connections. The prime and target sentences in the matching condition share not only a common metaphor but also a common topic. For example, the prime and target sentences in the matching version of the *Crime is a disease* passage were both about crime. In the nonmatching version of

Table 3  
Target Word Recognition Times (RTs) and Error Rates for Experiments 2, 3, and 4

| Matching version |     |         | Nonmatching version |     |         |
|------------------|-----|---------|---------------------|-----|---------|
| Prime-target     | RT  | % error | Prime-target        | RT  | % error |
| Epidemic-cure    | 782 | 22      | Epidemic-cure       | 842 | 22      |
| Crime-cure       | 721 | 20      | Crime-cure          | 778 | 15      |
| Cure-crime       | 825 | 12      | Solution-crime      | 893 | 14      |

Note. RTs are in milliseconds.

that passage, however, the target sentence "Public officials desperately looked for a cure" refers to a pneumonia epidemic rather than to crime. The prime-target pair *crime-cure* could, then, produce faster recognition times in the matching condition because some factor other than the metaphor, such as a change of topic, made the passages in the nonmatching condition less coherent and less integrated than those in the matching condition. Experiment 4 was conducted to address this concern.

#### Experiment 4

In Experiment 4, the same schema-matching version of each passage was used as in Experiment 3. A new neutral version of each passage was created by changing the last sentence of the matching version of the passage so that it no longer instantiated the metaphor. In the *Crime is a disease* passage, for example, the last sentence was changed from "Public officials desperately looked for a cure" in the matching version to "Public officials desperately looked for a solution" in the neutral version (see Table 4; for further examples, see Appendix). Both sentences now referred to crime, but only the sentence in the matching condition instantiated the metaphor-based schema.

The words referring to the topic domains of the metaphors which had served as the primes (e.g., *crime*) in Experiment 3 were used as the target words in the recognition tests in this experiment. The vehicle-domain words that had served as target words (e.g., *cure*) in Experiment 3 became the priming words for the matching condition in Experiment 4. Thus, the prime and target were reversed from topic-vehicle, in Experiment 3, to vehicle-topic in Experiment 4. In the new neutral condition in Experiment 4, the primes were the neutral words that had replaced the vehicle term in the final sentence of each passage (e.g., *solution*). If a change in topic, rather than the presence or absence of the metaphors, were responsible for the priming results we found, then we would not expect there to be any difference in recognition times between the matching and neutral conditions in this experiment, because both priming words came from sentences that were related to the same topic (*crime*, in this case). If, however, the metaphor-based schema shared by the prime and target words in the matching condition were being used to create additional

connections in readers' text representations, we would expect those connections to result in faster recognition times in the matching condition.

#### Method

The participants in the experiment were 24 Northwestern University undergraduates enrolled in Introductory Psychology. Except for the changes in the materials from Experiment 3 described previously, the design and procedure for Experiment 4 were identical to those for Experiment 3. The matching and neutral versions of the passages in Experiment 4 were identical except for the sentence that contained the priming word. This sentence had approximately the same meaning in both versions of the passage, but instantiated the metaphor-based schema only in the matching version. In addition to having the same meaning and referent, this sentence also had nearly the same wording in both versions of the passage, with only the critical metaphor-instantiating portion of the sentence changed for the neutral condition.

Relatedness ratings for the prime-target word pairs in this experiment were collected from 27 Northwestern University undergraduates. The participants rated the two sets of prime-target pairs from Experiment 4, along with prime-target pairs from other unrelated experiments and 20 unrelated prime-target pairs from the filler passages, on a scale of 1 (*unrelated*) to 7 (*highly related*). The prime and target words in the matching condition were judged to be slightly less related than those in the neutral condition, although the difference was not reliable: mean item ratings of 3.4 versus 4.1,  $t(38) = 1.63$ ,  $p > .05$ ,  $SE = 0.411$ . Thus, when presented as isolated pairs of words there was no reliable difference in relatedness in the priming words chosen for the experiment.

Another 16 Northwestern University undergraduates rated the familiarity of the metaphors used in Experiment 4. We gave the participants a booklet that listed the 20 metaphors from the experiment along with 12 other conventional metaphors (e.g., *Anger is insanity*) and 8 less conventional metaphors (e.g., *An argument is a race*) from an unrelated experiment. Each metaphor was listed in nominative form (e.g., *Crime is a disease*) along with an example of how the metaphor might be used ("The city's crime epidemic was raging out of control"). A rating scale numbered from 1 (*unfamiliar*) to 4 (*familiar*) was provided below each item and participants were instructed to circle a number indicating how familiar they found that metaphor. The mean familiarity rating for the metaphors used in Experiment 4 was 3.27, and the item means ranged from 2.4 to 3.8, with a standard error of 0.081.

Table 4  
Sample Passage and Recognition Items From Experiment 4

| <i>Crime is a disease</i>   |
|---|
| The most recent crime statistics confirmed what New Yorkers had suspected.  |
| All major categories had increased significantly from last year.            |
| The city's crime epidemic was raging out of control.                        |
| Extra police patrols had been ordered, but they had little effect.          |
| If anything, they seemed to aggravate the problem.                          |
| Patrols in problem areas only inflicted more violence on neighboring areas. |
| Soon, the violence began to infect even "safe" neighborhoods.               |
| Public officials desperately looked for a cure. [schema-matching version]   |
| Public officials desperately looked for a solution. [neutral version]       |

Note. The recognition items for the schema-matching version and for the neutral version were priming word—*cure*, target word—*crime* and priming word—*solution*, target word—*crime*, respectively.

### Results and Discussion

Mean recognition latencies and error rates for Experiment 4 are presented in Table 3. Responses slower than 1,800 ms (3% of the observations) were excluded, and the subject and item means were analyzed in separate one-way ANOVAs. Prime type (matching vs. neutral) was a within-subject and within-item factor.

We predicted that recognition times would be faster in the matching condition, and this prediction was confirmed,  $F_1(1, 22) = 8.86$ ,  $SE = 16$  ms;  $F_2(1, 18) = 5.35$ . There were no reliable effects in the error analyses ( $F_s < 1.1$ ). The participants recognized the test word faster when it was cued by a word from a sentence that instantiated the metaphor-based schema than when it was cued by a word from a sentence that simply referred to the same topic. This result allowed us to reject the hypothesis that our priming effects resulted simply from topic shifts in the nonmatching condition and confirmed that the connections between the primes and targets were attributable to their shared relationship to a metaphor-based schema, and not merely to shared references to a common subject matter. The results also demonstrated a bidirectionality for metaphor-based priming, with words related to the metaphors' topic domains priming recognition of vehicle-domain words in Experiment 3, and with vehicle-domain primes facilitating recognition of topic-domain words in Experiment 4.

Because different words were used as primes in the matching and neutral conditions, we also examined potential sources for the priming effect in Experiment 4 other than the metaphors. The most obvious possibility, semantic relatedness between the prime and target words, is not a strong possibility because of our pretest relatedness ratings. However, those ratings were collected for the pairs of words presented in isolation, outside of the context of our passages, and it might be argued that the strength of the semantic relations was different in context. Fortunately, we have the further evidence from Experiments 2 and 3 that semantic relatedness in context does not account for the matching versus nonmatching effect, in that the effect was found for both within- and between-domain prime-target pairs.

Another possibility, however, was that in the context of the passages, the sentence containing the neutral priming word might have been understood to refer back to some sentence other than the one that contained the target word, whereas in the matching version the sentence containing the metaphor-related priming word was always understood to refer back to the target sentence. In ratings collected from 17 Northwestern University undergraduates, however, both versions of the prime-containing sentence were judged to refer back to the sentence that contained the target word about equally well. Each participant was given a booklet containing one version of each of the 20 experimental passages from Experiment 4. The sentence containing the target word from the experiment was labeled (A), and the sentence containing the priming word was labeled (B). The participants circled a number on a scale from 1 (*B definitely does not refer to sentence A*) to 4 (*B definitely does refer to sentence A*) for each passage. Fifteen participants

completed a booklet of 20 passages, and 2 participants each completed half of one booklet. The mean ratings were 3.8 for the matching versions of the passages and 3.7 for the neutral condition,  $t(16) = -0.26$ , *ns*,  $SE = 0.22$ , for the by-subjects analysis;  $t(19) = 0.74$ , *ns*, for the by-items analysis. Thus, there was no evidence that the priming in Experiment 4 depended on differences in reference or relatedness that could be attributed to factors other than metaphor-based schemas.

We also conducted further analyses based on the familiarity of the metaphors used in our materials. Although the familiarity ratings indicated that our participants were generally well acquainted with the metaphors from the passages, we wanted to determine whether differences in familiarity had any effect on priming in Experiment 4. We separated the items into two groups of 10 on the basis of their mean familiarity ratings, with mean ratings of 2.97 and 3.56 for the two groups. Reanalysis of the recognition latency data using high versus low familiarity as a within-item variable revealed no significant main effect or interaction for familiarity (all  $F_s < 1$ ). Thus, at least for the metaphors in this experiment, the relative degree of familiarity had no effect on priming. The absence of any effect of familiarity, together with the relatively high overall familiarity ratings, is consistent with the assumption that the participants had considerable experience with the metaphor-based schemas from the passages before they encountered them in the experiment.

### General Discussion

The results of these experiments support the conclusion that metaphor-based schemas can be used during reading to link one element of text to another. In Experiments 1–3, identical pairs of text elements were more closely linked in memory when both had been related to the same metaphor-based schema when they were read. In Experiment 4, a metaphor-related word in the final sentence of a text linked the sentence to earlier elements of the text better than did a neutral word that was not related to the metaphor. "Officials looking for a cure," for instance, was more strongly linked to *crime epidemic* than was "Officials looking for a solution," as shown by faster response times for *crime* primed by *cure* than for *crime* primed by *solution*. We argue that this was not due to greater semantic association between *cure* and the crime epidemic than between *solution* and the epidemic, both because of the absence of a difference in the relatedness ratings in Experiment 4, and because of the results of Experiments 2 and 3. These three experiments showed no significant difference in priming as a result of preexperimental semantic association; the priming effect we attribute to metaphor-based links was as large for the strongly related test words such as *epidemic* and *cure* in Experiment 2 as it was for the preexperimentally less related test words such as *crime* and *cure* in Experiment 3.

A striking implication of this result becomes apparent when it is compared with results obtained for other kinds of schemas. Metaphor-based schemas lead to consequences for text comprehension similar to those of the well-known "restaurant" types of schemas (Schank & Abelson, 1977). McKoon, Ratcliff, and Seifert (1989) showed that elements of texts can be linked

together by connections based on well-known information from schemas, such as typical characters, events, and objects. Their experiments used the same minimalist procedure as in the current experiments: normal reading times, no specific instructions about integrating or comparing related elements of the texts, and a fast paced retrieval task that allows no extra time for conscious retrieval strategies. Thematic schemas, in contrast, do not lead to the automatic formation of script-based connections. Seifert et al. (1986) found that connections that were based on a shared theme, such as "the blind leading the blind" were formed only when participants were explicitly asked to rate similarities between the stories, thus drawing their attention to the shared thematic content. It is, therefore, somewhat surprising that metaphor-based schemas, which resemble thematic schemas in that they encode information that is fairly abstract or analogical, do not require extensive elaborative processing to create connections among text elements the way that thematic schemas do.

Because our priming results provide evidence that only text elements instantiating the same metaphor are associated in memory, but not for how those text elements might fit into the structure of a metaphor schema, it could be suggested that the concept of a schema is not really needed to explain our results. A simpler explanation might be that readers formed connections because the items were related to one another, without reference to any metaphor schema. In what way could the items in our experiments be said to be related? Crime and disease, for example, are not close semantic associates; they are only related through a conceptual metaphor. Furthermore, previous research supports the idea that conceptual metaphors correspond to schema-like structures. The temporally structured conceptual prototypes that Nayak and Gibbs (1990) found to be related to idiom meanings are a good example. Given that there are already reasons to think of conceptual metaphors in terms of schemas, we think that the best way to characterize the relationships between the text elements in our experiments is with reference to metaphor-based schemas.

The similarity of metaphor schemas to the well-known restaurant type of schemas in providing a basis for connections among text elements is a good reason to argue that metaphor schemas are part of the world knowledge that readers bring to the process of text comprehension. This is the view of conceptual metaphors that motivated our research (Gibbs, 1992; Lakoff & Johnson, 1980). As we noted in the introduction, however, other researchers have proposed that conceptual metaphors do not exist as knowledge structures in long-term memory, but rather are merely a reflection of mappings that are created ad hoc during the process of metaphor comprehension (Glucksberg, Brown, & McGlone, 1993; Glucksberg, Keysar, & McGlone, 1992). Either possibility—that the schemas were created during comprehension or were available as preexisting knowledge structures—is, in principle, consistent with our results. There are, however, several lines of evidence that would seem to indicate that conceptual metaphors are not merely ad hoc. A number of linguistic analyses have pointed to the use of conceptual metaphors to structure understanding of such domains as communication (Reddy, 1979), causation (Turner, 1987), and emotion (Kovecses, 1986, 1988, 1990;

Lakoff & Kovecses, 1987; Lakoff & Turner, 1989). Also, Sweetser (1990) has provided evidence that even word meanings and changes in meaning over time reflect the influences of conceptual metaphors. Across several languages, words referring to the body, or external self, often come to refer to the mind, or internal self (see also Johnson, 1987). Perceptual words such as *see*, for example, often come to refer to mental activities such as knowing. The coherence of these instances of polysemy within the framework of a mind-as-body metaphor, together with their consistency across languages, strongly suggests a metaphorical motivation for these word meanings. Although there are a number of reasons to believe that conceptual metaphors have more than a transitory existence as organized knowledge structures, this is an issue that remains to be resolved by future research.

Whether metaphor-based schemas turn out to be preexisting or ad hoc structures, our experiments have shown that such schemas can be used as a basis for relating and connecting pieces of information in a text representation, in a way that simple semantic associations do not account for. Experiments demonstrating facilitated recognition judgments for schema-related words and sentences provided evidence that the use of metaphors can have a measurable influence on how information related to those metaphors is represented. This finding points to a role for metaphor in fostering coherence within readers' text representations and contributes to the growing body of research in psychology and linguistics exploring the role of metaphor in structuring both thought and language.

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## Appendix

## Experimental Materials

This appendix contains all of the passages used in the experiments. The exact wording is that of the passages used in Experiments 3 and 4, but the versions used in Experiments 1 and 2 were very similar. The prime and target sentences from Experiment 1 are in italics. The prime and target words from Experiments 2, 3, and 4 are preceded by an asterisk, and the final sentence from the nonmatching version of each passage in Experiment 4 is included in parentheses following the matching version.

## An argument is a war

*Schema-matching version:*

Mike and Brad ate lunch together every day.  
As usual, they were \*arguing heatedly.  
*Mike and Brad were \*battling over politics.*  
Mike was a New-deal Democrat, Brad a Reagan Republican.  
Whenever the subject of politics came up, a debate was sure to ensue.  
Today was certainly no exception.  
Neither combatant was willing to back down from his position.  
*Both sides were now brining out their heavy \*artillery.*  
(Both sides were now bringing out their main \*points).

*Nonmatching version:*

Mike and Brad ate lunch together every day.  
As usual, they were \*arguing heatedly.  
*Mike and Brad were \*battling over politics.*  
Mike said that U.S. intervention always causes more fighting.  
He cited the conflict in Central America as an example.  
Before the U.S. got involved, there were just border skirmishes.  
With U.S. involvement, the fighting inevitably intensified.  
*Both sides were now bringing out their heavy \*artillery.*

## Thinking is machinery working

*Schema-matching version:*

Math had never been Bob's best subject.  
He was only taking Calculus because it was required for his major.  
The homework assignments alone took him hours to finish.  
*He needed to \*grind through some more problems, but his \*mind was in neutral.*  
He was getting tired and it was hard to concentrate.  
He forced himself to turn the page and begin the next problem.  
Fumbling with his pencil, Bob tried to think through the problem.  
It was no use, his brain wasn't working at all.  
*The \*gears just wouldn't turn anymore.*  
(The \*answers just wouldn't come.)

*Nonmatching version:*

Math had never been Bob's best subject.  
He was only taking Calculus because it was required for his major.  
The homework assignments alone took him hours to finish.  
*He needed to \*grind through some more problems, but his \*mind was in neutral.*  
He was afraid he might doze off and oversleep.  
He needed to set his alarm so he could finish in the morning.  
As he reached for the alarm clock, he noticed the hands weren't moving.  
He tried rewinding it, but nothing happened.  
*The \*gears just wouldn't turn anymore.*

## Ideas are physical objects

*Schema-matching version:*

Professor Queeg was ten minutes into the Monday morning lecture.  
His students were gazing at him with expressions of confusion.  
*He had tried to \*compress \*ideas from two lectures into one class period.*  
Some of the material was difficult to convey, though.  
It was clearly just too much at one time for the students.  
Professor Queeg's meaning just wasn't getting across.  
*He had tried to \*pack too many things in at once.*  
(He had tried to \*say too many things at once.)

*Nonmatching version:*

Professor Queeg was ten minutes into the Monday morning lecture.  
His students were gazing at him with expressions of confusion.  
*He had tried to \*compress \*ideas from two lectures into one class period.*  
He decided to give them handouts on the material he had to leave out.  
Reaching under the desk, he grabbed his over-stuffed briefcase.  
When he opened it, papers spilled out everywhere.  
*He had tried to \*pack too many things in at once.*

## Love is a physical force

*Schema-matching version:*

John and Martha met at a party about a month ago.  
It was \*love at first sight.  
*The \*electricity between John and Martha was overwhelming.*  
They spent the whole evening in a corner by themselves talking.  
After the party, John walked with Martha to her apartment.  
They made plans to meet again the next day for dinner.  
Then, as if magnetically drawn to one another, their lips met.  
*Suddenly, \*sparks were flying.*  
(Suddenly, \*excitement filled the air.)

*Nonmatching version:*

John and Martha met at a party about a month ago.  
It was \*love at first sight.  
*The \*electricity between John and Martha was overwhelming.*  
They spent over three hours by themselves on the sofa talking.  
Finally, John got up to get some more punch.  
He was so distracted that he did not see where he was going.  
He accidentally tripped, knocking a lamp into the punchbowl.  
*Suddenly, \*sparks were flying.*

(Appendix continues on next page)

## Appendix (continued)

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To see something is to touch it or hold it

*Schema-matching version:*

Lt. Delaney had followed the suspect's car to a pawn shop downtown. The police were certain this was the thief, but had no hard evidence. They could only watch and hope that the criminal made a mistake. *As Delaney \*stared at him, the suspect looked up and their eyes \*locked.* They stood there for a moment, caught in one another's gaze. The suspect now realized that he had been followed. He knew he was in danger of being caught. For a long moment, the suspect seemed unable to take his eyes off Delaney. *Finally, he broke \*loose and ran.*  
(Finally, he made up his \*mind and ran.)

*Nonmatching version:*

Lt. Delaney had followed the suspect's car to a pawn shop downtown. The police were certain this was the thief, but had no hard evidence. They could only watch and hope that the criminal made a mistake. *As Delaney \*stared at him, the suspect looked up and their eyes \*locked.* Realizing he had been followed, the suspect tried to flee. He tripped and fell, and Delaney grabbed him. As Delaney tried to put the handcuffs on, the suspect struggled to escape. Delaney was not strong enough to handle him, but held on for several minutes. *Finally, he broke \*loose and ran.*

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Knowing is seeing

*Schema-matching version:*

Kathy and Joseph had been married for nearly fifteen years. For most of those fifteen years Joseph had been having an affair. Kathy had never suspected a thing. *Kathy must have been \*blind not to \*know about Joseph's infidelity.* Kathy never would have discovered it if Joseph had not finally confessed. It seems that everyone except Kathy saw what was going on. In retrospect, Kathy could now remember clues that should have tipped her off. Apparently, she had overlooked things that she just didn't want to see. *She was never able to get the \*picture*  
(She was never able to get the whole \*story).

*Nonmatching version:*

Kathy and Joseph had been married for nearly fifteen years. For most of those fifteen years Joseph had been having an affair. Kathy had never suspected a thing. *Kathy must have been \*blind not to \*know about Joseph's infidelity.* Then one day she happened to drive by a motel as her husband was leaving it. Hurt and angry, Kathy decided to get photographic evidence to use in court. The next day, she waited for them outside the motel with her camera. When they arrived, she was so upset that she couldn't focus the camera. *She was never able to get the \*picture.*

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A business is a living organism

*Schema-matching version:*

Unicorp used to be the undisputed leader of the cardboard industry. In recent years, however, many other producers had entered the market. Increased competition has brought the company close to bankruptcy. *Because of declining \*profits, the company is slowly starving to \*death.* Company executives have been predicting an upturn in sales this quarter. Overall cardboard usage has been on the increase for several months. Almost all of the extra orders have gone to overseas producers, though. The blossoming sales predicted for Unicorp have not materialized. *Slow \*growth continues to be a problem.*  
(Lack of consumer \*interest continues to be a problem.)

*Nonmatching version:*

Unicorp used to be the undisputed leader of the cardboard industry. In recent years, however, many other producers had entered the market. Increased competition has brought the company close to bankruptcy. *Because of declining \*profits, the company is slowly starving to \*death.* If increased competition weren't enough, there were also supply problems. Timber production on Unicorp-owned land was below average last year. Cardboard output can not be increased without adequate supplies of pulp wood. Exceptionally low rainfall this year has not helped the situation. *Slow \*growth continues to be a problem.*

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Crime is a disease

*Schema-matching version:*

The most recent \*crime statistics confirmed what New Yorkers had suspected. All major categories had increased significantly from last year. *The city's \*crime \*epidemic was raging out of control.* Extra police patrols had been ordered, but they had little effect. If anything, they seemed to aggravate the problem. Patrols in problem areas only inflicted more violence on neighboring areas. Soon, the violence began to infect even "safe" neighborhoods. *Public officials desperately looked for a \*cure.*  
(Public officials desperately looked for a \*solution.)

*Nonmatching version:*

The most recent \*crime statistics confirmed what New Yorkers had suspected. All major categories had increased significantly from last year. *The city's \*crime \*epidemic was raging out of control.* Though badly needed, police patrols in the city could not be increased. A new and virulent strain of pneumonia was plaguing the force. Almost a third of the department was infected already. The disease had struck at the worst possible time. *Public officials desperately looked for a \*cure.*

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## Appendix (continued)

## A theory is a building

*Schema-matching version:*

Dr. Yost, a physicist, was speaking to a Congressional subcommittee. He was trying to get funding for a new research center. He needed to justify both the scientific value and practicality of the center.  
 Yost was first asked about his recent rejection of his own previous ideas.  
 He explained why he had *\*redesigned his \*theory*. Recent experimental evidence had necessitated the changes, he explained.  
 New data from particle accelerators had undermined the old formulation.  
 The new data also provided the framework for the revised version, though.  
 It provided a much better *\*foundation on which to build*.  
 (It suggested important basic *\*principles*.)

*Nonmatching version:*

Dr. Yost, a physicist, was speaking to a Congressional subcommittee. He was trying to get funding for a new research center. He needed to justify both the scientific value and practicality of the center.  
 Yost was first asked about his recent rejection of his own previous ideas.  
 He explained why he had *\*redesigned his \*theory*. Recent experimental evidence had necessitated the changes, he explained.  
 He also addressed concerns about the building site chosen for the center.  
 He had found a new location, without the erosion problems of the initial site.  
 It provided a much better *\*foundation on which to build*.

## Time is money

*Schema-matching version:*

Veronica was worried about her upcoming German exam. The final was in two weeks, and she was not ready for it.  
 She had *\*wasted countless \*hours that should have been spent studying*. With so little time left, she would have to get started right away. She set up a strict schedule for herself and budgeted her time carefully. Veronica spent almost every spare minute studying.  
 When she took the test, she could tell the time had been well spent.  
 Her *\*investment had paid off*.  
 (Her hard *\*work made the difference*.)

*Nonmatching version:*

Veronica was worried about her upcoming German exam. The final was in two weeks, and she was not ready for it.  
 She had *\*wasted countless \*hours that should have been spent studying*. With so little time left, she desperately needed help. Although it was expensive, she decided to hire a tutor.  
 The tutorial sessions cost Veronica all her spending money for the month.  
 When she took the test, she could tell the money had been well spent.  
 Her *\*investment had paid off*.

## A goal is a place

*Schema-matching version:*

Theresa had always known what she wanted to do. She planned to be a judge, just like her grandfather had been.  
 The *\*road to her chosen \*career was a long one for Theresa*. Law school was more difficult than she could have imagined. She passed her bar exam, though, and became a prosecuting attorney. It took a long time before Theresa's diligence was rewarded.  
 After years of hard work, though, she made it all the way to a federal court.  
 At last the *\*journey was over*.  
 (At last she felt truly *\*successful*.)

*Nonmatching version:*

Theresa had always known what *\*career she wanted*. She planned to be a judge, just like her grandfather had been.  
 The *\*road to her chosen \*career was a long one for Theresa*. But, after years of waiting, an appointment to a federal court finally came.  
 She had to travel to Washington immediately to be officially sworn in. Theresa was anxious to get there and assume her new office.  
 It seemed as though the train ride to Washington took forever.  
 At last the *\*journey was over*.

## Emotional intimacy is physical proximity

*Schema-matching version:*

Felicia had been dating Philip for several months. She really liked him, but there was often conflict in the relationship. Felicia wanted Philip to talk more about his feelings, but he refused.  
 His fear of *\*intimacy kept him from getting too \*close to her*. Felicia was terribly frustrated by this.  
 She tried again and again to get him to be more emotionally responsive.  
 She was never able to break down the wall between them.  
 He continued to keep his *\*distance from her*.  
 (He continued to remain *\*cool towards her*.)

*Nonmatching version:*

Felicia had been dating Philip for several months. She really liked him, but there was often conflict in the relationship. Felicia wanted Philip to talk more about his feelings, but he refused.  
 His fear of *\*intimacy kept him from getting too \*close to her*. This frustrated Felicia terribly, and eventually led to a heated argument.  
 Felicia became so angry that she began to throw things. Philip, hiding behind the couch, remained cautious even after she calmed down.  
 He continued to keep his *\*distance from her*.

## Appendix (continued)

## Anger is heat

*Schema-matching version:*

Edward was conducting a safety inspection at a nuclear power plant. He was infuriated by the carelessness of the plant's personnel. Such extreme negligence and incompetence was inexcusable. *Edward felt his \*temperature rising as his \*anger increased.* The operation of the plant was posing a very real threat to the community. Edward expressed his concerns to the plant manager. The manager's nonchalant attitude made him even hotter. When the manager then accused him of being too harsh, Edward's face reddened. *An \*explosion appeared to be imminent.* (A shouting \*match appeared to be imminent.)

*Nonmatching version:*

Edward was conducting a safety inspection at a nuclear power plant. He was infuriated by the carelessness of the plant's personnel. Such extreme negligence and incompetence was inexcusable. *Edward felt his \*temperature rising as his \*anger increased.* The operation of the plant was posing a very real threat to the community. Edward was alarmed to discover that a coolant pump was malfunctioning. In spite of the \*danger, the plant manager refused to shut the reactor down. Pressure was building up in the core of the reactor. *An \*explosion appeared to be imminent.*

## Responsibilities are heavy weights

*Schema-matching version:*

Zina never should have agreed to do the decorations for the PTA fundraiser. She was already planning to serve as master of ceremonies for the event. *She had a habit of \*overburdening herself with heavy \*responsibilities.* Zina just didn't know how to say no. She was heavily involved in several other organizations as well as the PTA. Zina donated time to the local soup kitchen, her church, and other charities. She had recently agreed to take on yet another volunteer job as well. *She was clearly trying to \*carry too much at once.* (She was clearly trying to \*manage too much at once.)

*Nonmatching version:*

Zina never should have agreed to do the decorations for the PTA fundraiser. She was already planning to serve as master of ceremonies for the event. *She had a habit of \*overburdening herself with heavy \*responsibilities.* As a result, she had very little time to get the decorations done. She rushed back and forth from the florist to the banquet hall. Zina had purchased dozens of flower arrangements for the tables. Pressed for time, she tried to take them all in her car in one trip. *She was clearly trying to \*carry too much at once.*

## An idea is food, and accepting it is eating it

*Schema-matching version:*

Zantec Chemical Company was trying to develop an artificial sweetener. One of the new chemists in the lab suggested a radically new formula. He said it could cut production costs in half without sacrificing quality. *The senior chemist found the \*idea a little hard to \*swallow.* She didn't like cutting corners. She had built her reputation on a commitment to careful, high-quality work. Still, she gave him a chance to change her mind before she said no. He tried in vain to make the proposal more palatable to her. *She still found it quite \*distasteful.* (She still found it quite \*unsatisfactory.)

*Nonmatching version:*

Zantec Chemical Company was trying to develop an artificial sweetener. One of the new chemists in the lab suggested a radically new formula. He said it could cut production costs in half without sacrificing quality. *The senior chemist found the \*idea a little hard to \*swallow.* In spite of her skepticism, though, she approved the project. When she sampled the product, she regretted the risk she had taken. The new formula had created a sweetener with a terribly bitter after-taste. Subsequent adjustments to try to improve the formula did not help. *She still found it quite \*distasteful.*

## An activity is a container

*Schema-matching version:*

Ken had once been a real big-shot in Hollywood. As a technical consultant, he had worked on several major films. Several years ago, however, he decided that he was tired of Hollywood. *He made an abrupt \*exit from the movie \*business.* Now, after years of retirement, Ken wanted to get back into filmmaking. The studio refused to let him back into his old job, though. He tried to get back into consulting several times, but it was no use. *Every \*entry was blocked.* (He was thwarted at every \*opportunity.)

*Nonmatching version:*

Ken had once been a real big-shot in Hollywood. As a technical consultant, he had worked on several major films. Several years ago, however, he decided that he was tired of Hollywood. *He made an abrupt \*exit from the movie \*business.* Now, years later, Ken decided he wanted his old job back. Studio executives refused to even set up a meeting with him, though. When Ken went down to the studio, he couldn't even get into the building. *Every \*entry was blocked.*

## Appendix (continued)

## Negative emotions are physical pain

*Schema-matching version:*

Shari and her roommate Kim had always gotten along quite well, until today.  
They had lived together for eight months without any serious problems. In fact, they had become very close friends during that time.  
*As a result, Shari felt especially \*wounded by Kim's \*betrayal.*  
Kim had snatched up the job that she knew Shari was applying for. Shari could not believe Kim would do such a thing to her. She never would have tried to steal an opportunity from Kim like that.  
Shari had never been stabbed in the back like that before.  
*She was very badly \*hurt.*  
(She was very \*disappointed).

*Nonmatching version:*

Shari and her roommate Kim had always gotten along quite well, until today.  
They had lived together for eight months without any serious problems. In fact, they had become very close friends during that time.  
*As a result, Shari felt especially \*wounded by Kim's \*betrayal.*  
Kim had snatched up the job that she knew Shari was applying for. Shari was so angry when she found out that she just had to leave the house.  
She jumped in the car and took off, tires squealing. Racing out of the driveway without looking, Shari had a serious accident.  
*She was very badly \*hurt.*

## A machine is an animate being

*Schema-matching version:*

Jerry's dinner party had been a big success. After he said goodnight to the last guest, he started cleaning up. Jerry enjoyed cooking, but he hated cleaning up afterwards.  
*He hoped that the garbage \*disposal would not be \*misbehaving this evening.*  
Sometimes it worked just fine, but sometimes it refused to do anything at all.  
After gathering up all the scraps, he crossed his fingers and turned it on. Nothing happened.  
*It was being \*stubborn again.*  
(It was \*broken again.)

*Nonmatching version:*

Jerry's dinner party had been a big success. After he said goodnight to the last guest, he started cleaning up. Jerry enjoyed cooking, but he hated cleaning up afterwards.  
*He hoped that the garbage \*disposal would not be \*misbehaving this evening.*  
Sometimes it worked just fine, but tonight it wasn't working at all. Jerry cursed the \*disposal, but then remembered the dog hadn't been fed yet.  
He put the scraps down for the dog, but it wouldn't eat.  
*It was being \*stubborn again.*

## A group working together is an athletic team

*Schema-matching version:*

Homecoming was always the biggest event of the year at the local high school.  
Even more important than the game itself was the dance that followed.  
The student council was responsible for organizing the dance.  
*Bill, the \*president of the council, called all the \*plays for the project.*  
Unfortunately, Bill wasn't very good at delegating responsibility. He tried to make everything happen by himself.  
The other council members were not very good at working together, either.  
Their lack of teamwork caused the dance to be a terrible failure.  
*They were really out of their \*league.*  
(They were really in over their \*heads).

*Nonmatching version:*

Homecoming was always the biggest event of the year at the local high school.  
Even more important than the game itself was the dance that followed.  
The student council was responsible for organizing the dance.  
*Bill, the \*president of the council, called all the \*plays for the project.*  
The dance was a great success.  
If only the game had gone as well.  
The other team was the defending state champion.  
The game was so one-sided that it was embarrassing for the home team.  
*They were really out of their \*league.*

## Information is a physical object

*Schema-matching version:*

Everything related to Project Alpha was classified as top secret. The defense department was taking extraordinary security precautions.  
They knew that the new weapon was a target for enemy espionage.  
*They couldn't let \*information about the weapon fall into the wrong \*hands.*  
Enemy agents were already at work, though. They had somehow tapped into the Pentagon's internal communication lines.  
The enemy now had possession of valuable knowledge about the weapon's design.  
*They \*grabbed it before the Pentagon knew what was happening.*  
(They \*copied the files before the Pentagon knew what was happening.)

*Nonmatching version:*

Everything related to Project Alpha was classified as top secret. The defense department was taking extraordinary security precautions.  
They knew that the new weapon was a target for enemy espionage.  
*They couldn't let \*information about the weapon fall into the wrong \*hands.*  
Enemy agents found a weak link in the Pentagon's security precautions, though.  
They secretly infiltrated a convoy carrying components of the new weapon.  
A great deal of valuable hardware was stolen.  
*They \*grabbed it before the Pentagon knew what was happening.*