

## The Role of Context in Metaphor Comprehension

MAKIKO SHINJO AND JEROME L. MYERS

*University of Massachusetts at Amherst*

The effect of three primes which facilitated metaphor comprehension in a study by P. Gildea and S. Glucksberg (*Journal of Verbal Learning and Verbal Behavior*, 22, 577-590, 1983) was investigated in three experiments. When primes were embedded in a passage context, they affected neither the comprehensibility nor the reading times of the following metaphors. In contrast to Gildea and Glucksberg's findings, some primes interfered with metaphor comprehension when the word prime alone was presented. The primes affected comprehension of literal and metaphorical sentences in a similar manner. This evidence suggests that comprehension processes that integrate a sentence with the preceding context for both metaphorical and literal materials may be very similar. A model of that process is presented and a possible explanation for the discrepancy between Gildea and Glucksberg's and our findings is suggested. © 1987 Academic Press, Inc.

Some metaphors are understood easily in isolation, others are not (Glucksberg, Gildea, & Bookin, 1982). Presumably, context provides the basis for resolution of these difficulties. The present research addresses the question of how context facilitates metaphor comprehension. It also investigates whether manipulations of context affect comprehension of metaphors and literal sentences in the same way.

Consider the metaphor "marriages are iceboxes." Statements such as this consist of a subject, often referred to as the topic, and a predicate, referred to as the vehicle. The metaphor should be readily understood if the vehicle has some property which is salient, that is relevant to the topic, and so links topic and vehicle. That property is referred to as the ground. Con-

text may aid comprehension of metaphors by increasing the salience of the ground. In the example given, the literal coldness of iceboxes is descriptive of at least some marriages and provides a basis for understanding the sentence.

Gildea and Glucksberg (1983) have addressed the question of whether a minimal context designed to prime the metaphor ground would facilitate its comprehension. They used a paradigm developed in an earlier study (Glucksberg et al., 1982). In this task, subjects are asked to decide whether a sentence is literally true or not. It is assumed that comprehension of metaphorical truth interferes with a judgment of literal falseness and slows the subject's response. Therefore, a context that facilitates understanding of the metaphor should result in slower negative judgments in this Stroop-like task.

Gildea and Glucksberg (1983) used a set of metaphors which, because they were hard to understand in isolation, were easily judged to be nonliteral. In the first of two experiments, sentences of the form *some/all X are Y* were either unprimed, or preceded by one of two kinds of primes which differed in their relation to the ground of

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the metaphor. For example, the primes for the metaphor "All marriages are iceboxes" were:

specific-figurative	People are COLD.	(1)
specific-literal	Winters are COLD.	(2)

Here the concept of coldness was presumably the ground of the metaphor. The two primes (1, 2) used this word as predicates of sentences. When a metaphor was not preceded by a prime, it was judged to be literally false as fast as was a scrambled metaphor. The literal-falseness judgment of a metaphor was significantly slower than that of its scrambled counterpart when both followed a prime. Both types of primes interfered more with the literal-falseness judgment of metaphors than with that of scrambled metaphors. Gildea and Glucksberg found no significant effect of the prime type.

These results suggest that both types of primes aided metaphor comprehension, slowing a judgment of literal-falseness. If literal and figurative meanings had been independently activated, the figurative prime should have yielded longer comprehension times than the literal prime because the former is closer to the ground of the metaphor. Instead, the result supports the idea that there is a semantic core meaning common to both literal and figurative meanings; priming either meaning is sufficient to prime the other through the common core.

Further evidence for the semantic core hypothesis was provided in a subsequent experiment which examined still a third type of prime:

general-literal	Summers are WARM	(3)
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This was as effective as the specific-literal prime in facilitating comprehension (i.e., in delaying a judgment of literal-falseness). Therefore, Gildea and Glucksberg concluded that activation of the semantic field of the metaphor ground facilitated the comprehension of a metaphor, slowing the literal-falseness judgment in turn.

The generalizability of the Gildea and Glucksberg (1983) results to other comprehension tasks is unclear. In particular, the interference task seems quite different from normal reading. People do not read a text in order to decide the literal truthfulness of each sentence. Furthermore, what they read in normal circumstances is not a group of unrelated sentences; there is a theme or topic which combines sentences in a meaningful fashion. It is also possible that the existence of universal and existential quantifiers in Gildea and Glucksberg's study may have encouraged subjects to develop a strategy specific to their task (e.g., Holyoak & Glass, 1975).

One purpose of the present experiments was to see if the Gildea and Glucksberg findings generalized to other measures and contexts. In the first experiment, subjects rated comprehensibility of a metaphor preceded by a paragraph context; the critical manipulation involved the sentence preceding the metaphoric sentence. In Experiment 2, time to read the metaphor was measured following the paragraph context of Experiment 1. In Experiment 3, an even more minimal context than Gildea and Glucksberg's—the ground word alone—was used as a prime. Again, time to read the metaphor was the dependent measure.

A second purpose of the present experiments was to provide data relevant to the question of whether metaphors are processed in the same way as literal sentences. Searle (1979) has hypothesized that metaphors are processed differently; more precisely, metaphor comprehension is viewed as a default process that follows a failure to derive a literal meaning. However, Ortony, Schallert, Reynolds, and Antos (1978) and Inhoff, Lima, and Carroll (1984) have found that when the context provided sufficient information metaphor comprehension occurred as quickly as literal sentence comprehension. Only when the context was impoverished did metaphors require more time to be comprehended. That metaphors are comprehended as quickly as lit-

eral sentences when the context is adequate is consistent with the assumption that identical processes are at work in the two conditions. However, it is hardly a decisive finding. Different processes can require the same time and identical processes might differ in the time required depending on the type of sentences. Our experiments provide another approach to this issue.

If the same process is involved in comprehending metaphors and literal sentences, any manipulation that increases the salience of the metaphoric ground may also clarify the predicate of a literal statement which conveys the same meaning. Therefore, if primes have the same pattern of effects upon both metaphoric and literal sentences, the view that both were processed in the same way would be further supported. In order to examine this possibility, the experiments to be presented included both metaphors and their literal paraphrases.

EXPERIMENT 1

In this experiment, subjects read a meaningful context which consisted of a few sentences. The last sentence of each context was either figurative-specific, literal-specific, literal-general, or neutral; this last sentence type did not include any word semantically associated to the vehicle of the target. Literal paraphrases of target metaphors were also included. An example of the context is shown below:

Bob and Mary's marriage was ending.  
They seldom talked to each other these days.  
The happy past was a fading memory.  
She remembered the first time they met.  
She had been feeling unhappy then.

The last phrase of this context was:

specific-figurative	because people around here were COLD.
specific-literal	because that winter was very COLD.
general-literal	because that summer was very HOT.
neutral	because people around her were sad.

The two possible target sentences were:

metaphor	Now, her marriage was an icebox.
literal	Now, her marriage was disastrous.

In the actual experiment, semantically related words were not presented in capital letters.

The subjects' task was to rate the comprehensibility of the target sentence after reading the passage.

Method

*Subjects.* Forty-eight University of Massachusetts undergraduates participated as subjects in partial fulfillment of a course requirement. A session was completed within 20 min.

*Materials.* Each material set consisted of one warm-up passage, twenty experimental, and twenty filler passages. The experimental and filler passages were randomly ordered, and the same order was preserved for all the eight material sets.

The experimental passages consisted of four to six short sentences. A typical passage had three context sentences, a priming sentence, and then a target sentence. There were four priming conditions: specific-figurative, specific-literal, general-literal, and neutral. All subjects read five passages in each prime condition. The assignment of the four sets of five passages to priming conditions was counterbalanced, thus creating four sets of materials. Each of these sets of experimental passages ended with either a metaphoric or literal last sentence. Therefore, there were eight sets of experimental passages, representing variation in the assignment of passages to priming condition and the nature of the target.

Filler passages were constructed so that if the experimental passages were in the metaphor condition, all the last sentences of filler passages were literal, and vice versa. Filler passages were different from the experimental passages in one other re-

spect: they did not involve semantic manipulation of the primes. As the filler passages did not involve the prime manipulation of interest, the ratings of filler passages were not included in the statistical analysis.

The experimental passages were derived from the material used by Gildea and Glucksberg (1983). Their combination of prime, topic, and vehicle were preserved with minor exceptions. Changes were made when a word in their list had a very low frequency count in the word frequency norm (Kucera & Francis, 1967), and when it was impossible to smoothly connect the context to a prime and a target (For the experimental materials see Appendix A). The universal and existential quantifiers were not used in our experiment unless they fit with the preceding context.

*Design.* There were eight groups of six subjects each, differing with respect to the assignment of passages to prime conditions and with respect to whether the target was a metaphoric or a literal sentence. The four prime conditions were levels of a within-subject variable.

*Procedure.* Subjects were run in groups of four to eight. The passages were printed in a booklet with brief instructions on the front page. Subjects were instructed to read the passages in order and were told that there were no relations among passages. Each passage was printed on a separate page with an instruction to rate the difficulty with which the last sentence was

comprehended given the preceding context. Subjects circled a number ranging from 1 to 5 to indicate the difficulty they felt in comprehending the last sentence; a value of 1 denoted "not difficult" and 5 denoted "very difficult."

### *Results and Discussion*

Throughout this paper, *F* ratios for effects involving more than one *df* are based on multivariate analyses of variance employing Wilks' lambda statistic (Myers, 1979). Other multivariate criteria yielded identical or very similar results. Analysis based both on subjects (*F*<sub>1</sub>) and items (*F*<sub>2</sub>) were performed.

The results of the rating study are shown in Table 1. Subjects judged that the metaphoric sentences were slightly more difficult to comprehend than the literal sentences. Although this trend was consistent in every prime condition, the overall effect of the target sentence type was not statistically significant [ $F(1,40) = 2.117, p > .15$ ;  $F(1,38) = 1.290, p > .25$ ]. A separate norming study in which target sentences were presented in isolation has shown that the metaphors were perceived as significantly more difficult to comprehend than the literal sentences ( $p < .01$ ).

The prime had a significant effect on the ease with which the target sentences were understood when tested against subject variability [ $F(3,38) = 4.648, p < .01$ ], but this effect was not significant when tested

TABLE 1  
DIFFICULTY IN TARGET COMPREHENSION

Target	Prime				Average
	SF	SL	GL	N	
Metaphoric	2.242 (0.727)	2.250 (0.593)	2.550 (0.683)	2.550 (0.828)	2.398
Literal	2.200 (0.641)	2.175 (0.706)	2.400 (0.695)	1.917 (0.457)	2.173
Average	2.221	2.212	2.475	2.233	2.286

*Note.* A rating of 1 denoted "not difficult" and 5 "very difficult." Abbreviations used: SF, specific-figurative; SL, specific-literal; GL, general-literal; N, neutral. Standard deviations of the means are given in parentheses. Standard deviations are based on subject analyses.

against item variability [ $F(3,36) = 1.912$ ,  $p > .10$ ]. Averaging over both metaphoric and literal targets, the general-literal prime yielded higher ratings (lower comprehension) than the other three prime conditions. Using Bonferroni  $t$  tests ( $df = 40$ ) to control familywise error rate, the difference between mean ratings for the general-literal and specific-literal and general-literal and figurative-literal were significant at the .05 level. The differences between general-literal and neutral conditions was significant at the .10 level.

There is a slight difference in the patterns of prime effects in the two target conditions: the neutral condition is more easily comprehended when the target is literal. For this reason, there is a significant interaction between target and prime conditions [ $F(3,38) = 6.836$ ,  $p < .01$ ;  $F(3,36) = 3.975$ ,  $p < .05$ ]. Because of this interaction, we carried out pairwise comparisons among the priming conditions separately for the two target conditions. In the metaphor data, the specific-figurative and specific-literal both had significantly lower ratings than the neutral, using a familywise criterion of .05 in subject analysis. Although the mean ratings were identical for the neutral and general-literal conditions, the latter did not differ significantly from the other prime conditions; the standard error of those differences was greater than for the differences involving the neutral condition. In the literal condition, the only contrast meeting the .05 familywise criterion was that between the general-literal and neutral primes; the latter received significantly lower ratings. Item analysis has provided a similar result with a lesser magnitude.

In summary, there are two effects of the context manipulation upon rating data. First, metaphoric targets appear to be more difficult to comprehend than literal targets, but this trend was clearly attenuated by the presence of context. Second, contrary to Gildea and Glucksberg's (1983) results using the literal-falseness judgment task,

the general-literal prime does not appear to aid metaphoric comprehension. It actually appears to impede the comprehension of target sentences.

It is possible that ratings are relatively insensitive to variations in comprehension caused by the priming condition. It is also possible that a judgment of comprehensibility is affected differently from the comprehension process itself. Therefore, reading times may reflect a different pattern of effects of priming conditions. Experiment 2 investigates this possibility.

## EXPERIMENT 2

In this experiment, the subject's task was to read sentences for comprehension. The reading time for each sentence was the measure of comprehension difficulty. Several plausible patterns of priming effects upon metaphor comprehension might be observed. First, as in the rating data, metaphor comprehension may be aided by prior presentation of a sentence containing the ground word, whether in its literal or figurative sense. A word in the same semantic field as the ground (the general-literal prime) would not have a facilitative effect.

A second possibility is that the reading time data may corroborate Gildea and Glucksberg's (1983) view that metaphor comprehension is aided by activation of a semantic core common to the three non-neutral primes. Assuming that this effect manifests itself even in the presence of a more extensive context than they employed, we would expect target metaphors to be read equally quickly after the non-neutral primes but faster than after the neutral prime.

A third possibility is that figurative and literal meanings of a word (such as "cold") are stored separately. Further assuming that semantic relatedness plays a role in the priming effect, we would expect the degree of facilitation of metaphor reading time to be greatest for specific-figurative, next for specific-literal, and least for general-literal. There was a hint of such a pattern in the

rating data but the differences were very small and the statistical test result was far from significant.

One other pattern of results is conceivable given the findings of Ortony et al. (1978): when the preceding context provided sufficient information for target sentence comprehension, a metaphor was as quickly understood as a literal sentence. Given the lengthy context preceding the priming sentence, the ground of the metaphor may be adequately established before the priming sentence is encountered. In that case, the semantic primes should not vary in effect nor have any advantage over the neutral prime.

Whether or not the priming sentence has an effect upon comprehension of the literal target would seem to depend upon whether the adjective substituted for the metaphoric vehicle is at all ambiguous. For example, again consider "Mary's marriage is disastrous." If the prime enables the reader to focus on one particular sense of disaster, it may affect the time required to comprehend this literal target.

### *Method*

*Subjects.* Sixty-four University of Massachusetts undergraduates participated in the experiment in partial fulfillment of a course requirement.

*Materials and design.* The same materials were used as in Experiment 1. Three additional passages were written and a total of four passages were used in practice trials at the beginning of each experimental session. As in the first experiment, there were eight groups of subjects varying with respect to the target (metaphoric or literal) and the assignment of passages to priming conditions. Again, each subject experienced five passages in each of the four priming conditions.

*Procedure.* Subjects were run individually. The presentation of each passage began with the word "READY" on a video monitor screen at the position where the

first word of each sentence would appear. Subjects pressed a trigger to initiate the presentation of a passage. All materials were displayed sentence by sentence on the video monitor which was controlled by a Zenith Z100 microcomputer. Reading of each sentence was self-paced. Subjects were instructed to press the response trigger as soon as they understood a sentence. Reading times for each sentence were automatically recorded by the computer.

Comprehension questions followed half of the passages; ten of them were about the experimental passages, the rest were about the filler passages. These questions typically required recall of an early part of the context sentences. This was done to ensure that subjects read sentences for comprehension and to discourage subjects from pressing the trigger without comprehending sentences. Subjects orally answered "Yes" or "No" through an intercom which connected the subject room and the experimental room. The experimenter in the experimental room gave feedback to subjects and recorded their answers. Then a row of asterisks appeared in the center of the video monitor for 2 sec, and then another "READY" signal replaced it to indicate the start of a new passage. Subjects required approximately 20 min to read the entire material and answer comprehension questions.

### *Results*

Three out of sixty-four subjects who gave five or more wrong answers to probe questions were replaced. Reading time data were trimmed using two rules: (1) any reading time which exceeded an average reading time for an individual by more than three standard deviations was not used in the later analysis (14 out of 1280, 1.904%); (2) any reading time longer than 5000 ms was also omitted from a further analysis (16 out of 1280, 1.250%). A total of 27 reading times (2.109%) were discarded from the

data. There was no systematic trend in the way the data points were discarded. The average reading times of the target sentence as a function of the target and the prime are shown in Table 2.

The metaphoric target sentences were read more slowly than their literal paraphrases, and this was true for all prime types. This result was similar to that observed in the difficulty ratings. However, just as this effect was not significant in the difficulty ratings, it was also not significant in the reading times ( $F_1$ ,  $F_2 < 1$ ).

There was virtually no effect of the prime on the reading time of a target sentence ( $F_1$ ,  $F_2 < 1$ ). Nor were any of the subsequent pairwise comparisons among different primes significant. Having a semantically related word in a priming sentence did not speed up target comprehension.

It was conceivable that comprehension of each prime sentence affected the target sentence reading time differently. In order to test this possibility, reading times of prime sentences were analyzed. Table 3 shows mean reading times for each prime type.

A comparison of reading times for the neutral prime with the average for the three other priming conditions indicates that the former were processed more quickly [ $t(59) = 4.449$ ,  $p < 0.01$ ]. It is possible that a part of the target reading time reflected continued processing of the previous sentence. O'Brien and Myers (1985) have presented evidence for such spillover effects: reading

TABLE 3  
MEAN PRIME READING TIMES (ms) IN EXPERIMENT 2

Prime	SF	SL	GL	N
Reading time	2163 (672)	2136 (669)	2167 (627)	2010 (688)

*Note.* Standard deviations of the means are given in parentheses and are based on subject analyses. Abbreviations used: SF, specific-figurative; SL, specific-literal; GL, general-literal; N, neutral.

times of sentences were longer when a preceding sentence was difficult to understand than when a preceding sentence was easy. If this is the case here, then a possible facilitative effect of the semantically related primes (specific-figurative, specific-literal, general-literal) might have been canceled by the greater spillover effect from these same primes.

An analysis of covariance was done on the target sentence reading time to examine this possibility; the covariate was prime sentence reading times. Even after adjusting for the effect of the prime sentence reading time, the effect of the prime was not significant ( $p > 0.30$ ). This further supported the conclusion that semantic activation did not affect target comprehension.

### Discussion

The experiment has shown that metaphors are as quickly understood as literal sentences when a supportive context is present. However, in contrast to Gildea and Glucksberg's (1983) finding, the se-

TABLE 2  
MEAN TARGET READING TIMES (ms) IN EXPERIMENT 2

Target	Prime				Average
	SF	SL	GL	N	
Metaphoric	1941 (572)	2010 (671)	1926 (631)	1998 (679)	1969
Literal	1845 (464)	1894 (451)	1906 (419)	1859 (546)	1876
Average	1893	1952	1916	1928	1922

*Note.* Standard deviations of the means are given in parentheses and are based on subject analyses. Abbreviations used: SF, specific-figurative; SL, specific-literal; GL, general-literal; N, neutral.

mantically related primes had no effect on target comprehension in our experiment. This is true for both metaphoric and literal targets. There are two possible reasons why the primes did not affect target comprehension in our experiment: (1) when the context sets up the ground for subsequent metaphor comprehension, semantic relations did not add a further facilitative effect; or (2) Gildea and Glucksberg's finding was specific to their experimental paradigm (i.e., literal-falseness judgment).

One possible reason why the semantically related primes did not facilitate the comprehension of target sentences in our experiment but it did in Gildea and Glucksberg's study is that there is a sentential context in our experiment but not in theirs: the context may have sufficiently supported comprehension of a following metaphor in our experiment so that the semantic manipulation did not affect the target comprehension. Perhaps the context made the meaning of a metaphor so apparent that subjects may not have needed much help from a prime.

Another possible reason may also lie in the difference between Gildea and Glucksberg's experiment and ours. It is possible that their judgment task and our reading task involve different mechanisms, and are thus susceptible to different factors. Their materials were also different from ours. In their experiment, metaphoric targets may have been understood differently when they followed prime sentences, because the prime sentences they used were syntactically different from the rest of their material (noun + adjective and noun + noun, respectively). Though there is no evidence that an adjective sentence creates more spillover effect than a noun sentence, it is conceivable that subjects slowed down in their judgment of a metaphor after reading a prime sentence simply because they had to read a different kind of sentence. Therefore it could have boosted the effect of the primes on the literal-falseness judgment of a metaphor.

### EXPERIMENT 3

The third experiment was designed to test the possibility that the prime in Experiment 2 did not facilitate target comprehension because the context already set up a ground that enabled the comprehension. In this condition, neither a possible difference among different primes nor a possible difference between metaphoric and literal comprehension was immediately apparent. If this was because of the presence of the sentential context, the prime should affect the ease of target comprehension in the absence of the context. In order to avoid a possible spillover effect from reading a priming sentence to cancel a possible facilitative effect, we also removed the priming sentence. Only a word, semantically related or unrelated to the target sentence, was presented as a prime. The subjects' task was still to read a sentence for comprehension.

If a metaphor is understood differently from a literal sentence in the absence of the context, reading times for them should show either an overall difference as a function of sentence type or a difference as a function of prime or both. It is expected from the results of Experiment 1 and 2 that a metaphor may be understood more slowly than a literal sentence. However, an identical process can result in different reading times; only the difference in comprehension difficulty may cause the difference in reading times. If the two processes are different from each other, then it is likely that the primes may affect the comprehension of sentences in a different manner. Thus one of the primary interests in the third experiment is to see if the primes affect the two types of targets differently.

Because we no longer used a sentence for a prime, there was no way to differentiate a specific-figurative prime from a specific-literal prime; we used only one kind, a specific prime. The general-literal prime of Experiment 2 will be referred to as a gen-



eral prime. In place of a neutral prime, the word "blank" was used. We added a new type of prime in which a word was semantically related to the topic of the following metaphor (topic prime). This was done to compare topic and vehicle priming effects on comprehension of a metaphor. As a result, we had four priming conditions as before. For example, when the target metaphor is "Mary's marriage was an icebox", subjects read the word "cold" prior to it in the specific prime condition, "warm" in the general, or "bridal" in the topic prime condition. The word was always "blank" in the blank prime condition.

Gildea and Glucksberg's (1983) data supported the idea that priming the semantic field in general is as effective as priming the specific value of the semantic field. If this is true, then the general prime should be as effective as the specific prime in reducing comprehension time. Alternatively, if semantic relatedness is the main source of facilitation in comprehension, the specific prime should reduce metaphor reading times more than the general prime.

It is even possible that the general prime would result in interference. Again consider the target "Mary's marriage is an icebox." If comprehension involves relating the vehicle to the preceding prime, the general prime "warm" may cause difficulties; an icebox is hardly warm. From this perspective, the general prime would not help selection of the appropriate feature: it may be rather confusing in relation to the metaphoric ground. Reading times after the general prime may be even slower than after the blank for this reason. Thus the effect of the general prime relative to the blank is not immediately clear.

### Method

*Subjects.* Forty-eight University of Massachusetts undergraduates participated in the experiment in partial fulfillment of a course requirement.

*Materials.* Subjects read a priming word

before a target sentence; an example of the prime conditions was:

(specific prime)	cold
(general prime)	warm
(base line)	blank
(topic prime)	bridal

The target sentence was either metaphoric or literal and a subject read all experimental target sentences either in metaphoric or literal condition. An example of each type is shown below:

(metaphoric)	Mary's marriage is an icebox.
(literal)	Mary's marriage is disastrous.

A metaphor sentence typically consisted of a proper name, and two nouns which did not have a category-instance relation between them. A literal sentence was a paraphrase of the metaphor, and it shared the same proper name and the subject noun phrase. Instead of the vehicle, the literal paraphrase had an adjective to complete a sentence. The adjective was selected so that the sentence preserved the gist of the metaphor and that the adjective was not semantically related to the metaphoric ground.

Subjects read a total of 44 word-sentence pairs: 4 practice, 20 experimental, and 20 filler items. The experimental and filler items were randomly ordered, and the same order was preserved throughout the experiment. Filler items were constructed the same way as the experimental items. Filler sentences were used such that when subjects read experimental targets in the metaphoric condition, they read the filler sentences in the literal condition, and vice versa. Counterbalancing the target and the prime conditions resulted in eight material sets.

The experimental materials were again derived from the Gildea and Glucksberg (1983) study. Their combination of prime, topic, and vehicle was preserved with minor exceptions (The experimental materials are presented in Appendix B). Changes were made when a word in their material had a very low frequency count in

the Kucera & Francis word frequency norm (1967) and when the experimenters felt that subjects might not understand the word meaning.

The specific prime was the same as the specific-figurative and specific-literal primes; the general prime was the same as the general-literal prime of Experiments 1 and 2. In place of the neutral prime in the previous experiment, the word "blank" was used to establish a base line. The topic prime consisted of words that were judged to be semantically related to the topic but unrelated to the ground of the target metaphor.

*Procedure.* Subjects were run individually in an experimental session that lasted approximately 15 min. Subjects saw a brief presentation of a prime word, read a sentence, and answered a comprehension question.

All the materials were displayed on a video monitor which was controlled by a Zenith Z100 microcomputer. Subjects engaged in their task in one room while the experimenter supervised the progress of the experiment in an adjacent room using another video monitor and an intercom.

Each trial began with the word "READY" on the screen. Subjects pressed a response trigger to initiate the presentation. A prime word immediately replaced the word "READY" and remained on the screen for 350 ms. Then a target sentence replaced the word and subjects read it, then pressed the trigger when they understood it. Reading time for the sentence was automatically recorded by the computer.

After reading a target sentence, a row of question marks signaled the onset of a comprehension question. This appeared on the screen replacing the question marks after 1 s. Subjects gave either a "Yes" or "No" response orally through the intercom; the experimenter gave them immediate feedback and recorded their responses.

Subjects were instructed to pay attention to the words as well as to the sentences be-

cause some of the words were related to the following sentences and they would help comprehend the sentences. It was made clear in the instruction that the word "blank" was never related to the following sentence so that subjects would not try to relate the word "blank" to the following sentence.

The comprehension questions were used to ensure that subjects understand sentences before pressing the trigger. These questions required positive and negative responses equally often. When subjects gave a wrong answer, the experimenter asked them to explain how they arrived at their answer. Subjects answered in a few sentences describing their reasoning. This was done to further ensure that subjects would do their best to comprehend the sentences.

### *Results and discussion*

The overall average reading time for the first 48 subjects was 2230 ms with a standard deviation of 601 ms. Twelve subjects were replaced because reading times for at least two out of the five items in at least one condition exceeded 4033 ms, three standard deviations above the mean. Reading times of under 700 ms were omitted from the data (3 out of 1920, 0.16%). The resulting average reading times are presented as a function of target and prime in Table 4.

The metaphoric target sentences were read more slowly than the literal paraphrases, and this was true for all prime types. An analysis of variance showed this effect to be significant [ $F(1,40) = 14.626$ ,  $p < .01$ ;  $F(1,38) = 35.890$ ,  $p < .01$ ]. The effect of the prime on target reading times was also significant [ $F(1,38) = 6.001$ ,  $p < .01$ ;  $F(2,36) = 3.857$ ,  $p < .02$ ]. The interaction between the target and the prime did not approach significance ( $F(1, F(2) < 1$ ).

Using the Bonferroni procedure and a familywise criterion of .05, two pairwise comparisons proved significant: Sentences were read more slowly following the gen-

TABLE 4  
MEAN TARGET READING TIMES (ms) IN EXPERIMENT 3

Target	Prime				Average
	S	G	B	T	
Metaphoric	2293 (572)	2627 (671)	2404 (632)	2516 (679)	2460
Literal	1867 (464)	2031 (451)	1837 (419)	1967 (546)	1926
Average	2080	2329	2121	2242	2193

*Note.* Standard deviations of the means are given in parentheses and are based on subject analyses. Abbreviations used: S, specific; G, general; B, blank; T, topic.

eral prime than following the specific prime [ $t_1(40) = 3.894$ ;  $t_2(36) = 3.256$ ] or the blank prime [ $t_1(40) = 3.228$ ;  $t_2(36) = 2.766$ ]. The slow responses following the general prime are consistent with the rating data of Experiment 1 but differ from Gildea and Glucksberg's (1983) finding that the general prime is facilitative in their judgment task. Reading times for sentences following the topic prime were slower than in the specific or blank conditions but those  $t$  statistics were not significant against the conservative familywise criterion of .05.

The prime may affect either an encoding or a subsequent postlexical stage. There are two reasons to doubt that encoding is the process affected. First, there is no reason to expect interference with an encoding stage by the general prime. Second, we ran a control experiment (see Appendix C for further details) in which subjects read aloud a list of words presented one at a time. The topic and vehicle words from Experiment 3 were preceded either by their primes or the word "blank." If the encoding stage is the primary locus of the priming effect, vehicle primes should be more effective than topic primes. In fact the opposite result was obtained: the topic was named 12 ms faster following its prime than following a blank prime [ $F(1,42) = 7.127$ ,  $p < .01$ ] whereas the vehicle was named 3 ms slower following its prime than following a blank prime. Although we would not claim that there is no lexical priming effect in the third experiment, it

does appear that the postlexical stage is the primary locus of the effects.

#### GENERAL DISCUSSION

There are three major findings in these studies. First, when a sentential context aids comprehension of a target sentence, there is no effect of semantically related primes. It appears that a coherent context as a whole established the ground for comprehending a target sentence sufficiently so that the priming sentence was not relevant to reading times. The primes affected reading times of target sentences only in a minimal context condition.

Second, the most obvious effect of the primes in the minimal context of Experiment 3 is interference. The general prime leads to slower comprehension than the blank prime and the topic prime has almost as large an interfering effect when measured against the blank baseline. In contrast, the specific primes exhibit a small nonsignificant facilitation effect when contrasted with the blank baseline.

The third major point is that the interference due to the general and topic primes is true for both metaphor and literal sentence comprehension. This pattern of interference effects suggests a process in which the reader attempts to understand the sentence by integrating it with the prime. Furthermore, the lack of an interaction between target and prime supports the view that the process is much the same for literal and

metaphor targets. Let us now consider these points in more detail.

In an effort to account for the priming effects, we have assumed four components of the comprehension process: encoding, retrieval, selection, and integration. By "encoding" we mean perceptual encoding of a target sentence; this process is involved in all priming conditions. Retrieval is a post-lexical process involving the foregrounding of the prime word. Selection is defined as selection of a feature of the vehicle (or predicate). Integration is the attempt to attach the prime concept, or the selected feature, to the topic (or subject).

Different combinations of the four components may explain the different effects of the primes on target comprehension. Possible combinations are shown in Table 5. We make no assumption about order of components within each bracketed set. However, in the general and topic conditions the second bracketed set is assumed to follow the first.

When a specific prime precedes a target sentence, subjects first encode the target and retrieve the prime word. Because the prime is the appropriate feature of the vehicle to attach to the topic, integration takes place smoothly and successfully. In contrast, when the preceding word is either a general or topic prime, this integration fails. Neither "warm" nor "bridal" aids the reader's understanding of the relation between "marriage" and "icebox." In these conditions subjects have to select an appropriate feature of the vehicle themselves and try to integrate them after the initial integration attempt fails. They may

have to repeat this process more than once if the second try is also unsuccessful.

Because subjects were instructed that blank primes were not useful in the reading task, we assume that retrieval does not occur following such primes. Selection of an appropriate feature of the vehicle and integration would occur directly following the encoding. Because there is no clue as to what feature is appropriate, subjects may choose the most salient feature of the vehicle and try to integrate the topic and the vehicle. The most salient feature of the vehicle often is the metaphor ground (e.g., "cold" for "icebox"). Thus integration may proceed as smoothly as in the specific prime condition. Assuming retrieval and selection require a similar amount of time, the failure to find a clear facilitation effect in the specific condition when compared to the blank baseline makes sense.

Experiment 3 has shown that target comprehension is slower after a general prime than after a specific prime. We have argued that integration difficulties account for this. Then why did the two primes show the same effect on judgment time in Gildea and Glucksberg's study? As their subjects were not asked to integrate two sequentially presented sentences, they may have been engaged in a different process from ours. However their data clearly show that comprehension of metaphors was affected by the prime words in preceding sentences as was the case in our experiment. One possibility is that their judgment task involves a decision stage in addition to the encoding and comprehension stages we have described above. When a prime was a specific one a long latency may have been produced in the decision stage for the reason Gildea and Glucksberg assumed: because the metaphoric truth interfered with a judgment of literal-falseness. When a prime was a general one, the long latency may have been produced in the comprehension stage as we have assumed in accounting for our own data. Thus the two primes may have exhibited the same overall effect on target judgment time by quite different mechanisms.

TABLE 5  
COMPREHENSION MECHANISMS

Prime	Comprehension Components <sup>a</sup>
Specific	[(E), (R), (I)]
General	[(E), (R), (I)] + [(S), (I)]
Topic	[(E), (R), (I)] + [(S), (I)]
Blank	[(E), (S), (I)]

<sup>a</sup> Abbreviations used: E, encoding of target; R, retrieval of a prime; S, selection of a feature; I, integration.

The last point we wish to consider is that the prime had a similar effect on metaphors and on literal sentences. This result would appear to bear on the validity of Searle's (1979) dual-process model. This model assumes that metaphor comprehension involves an extra stage after literal comprehension fails. In the context of this model, priming can (1) influence only the second, metaphor comprehension, stage; (2) influence only the first, literal comprehension, stage; or (3) influence both stages. The first and third variants of the model would predict an interaction between target type and prime type. As we noted, the *F* ratio was less than 1.0. The second possibility seems highly implausible because it requires variation in the relation of the prime to the metaphor ground to have an effect upon the literal stage but not upon the metaphoric. It seems more reasonable to assume that there is only a single process for both literal and metaphoric sentences.

Why should the priming condition influence comprehension of literal sentences? We suggest that a metaphor is merely a point upon a continuum and that many words we view as literal are open to a variety of interpretations. For example, when someone says "Mary's marriage is disastrous," we may immediately understand that her marriage is unhappy. However, the way her marriage is unhappy is not readily apparent. Mary's marriage can be in financial trouble, or her mother-in-law may be distressing her. When this same sentence is preceded by the word "cold," we may arrive at a more specific knowledge of Mary's marital problem: the interpersonal relation is cold. The fact that the prime affected both literal and metaphoric comprehension similarly strongly suggests that comprehension mechanisms may be very similar.

#### APPENDIX A

Priming sentences and target sentences in Experiment 2 are shown in the order of specific-figurative, specific-literal, general-literal, neutral, metaphoric, and literal. Semantically related words in the priming

sentences are capitalized here for the sake of presentation.

< 1>

because people around her were COLD.  
because that winter was very COLD.  
because that summer was very HOT.  
because people around her were sad.

Now, her marriage was an icebox.

Now, her marriage was disastrous.

< 2>

He thought his wife was SPOILED.  
He thought the fish was SPOILED.  
He wanted to keep the fish FRESH.  
He thought his wife was unfair.

His cat was a princess.

His cat was very fussy.

< 3>

His remarks were very SHARP.  
His fingernails were SHARP.  
His fingernails were DULL.  
His remarks were quite rude.

His smile was a razor.

His smile frightened her.

< 4>

Staring at the rat, she felt TRAPPED.  
The rat was unlucky to be TRAPPED.  
The rat struggled hard to be FREE.  
She wouldn't dare to touch the rat.

Her job was a jail.

Her job was boring.

< 5>

His fingers were CRUDE.  
His manners were CRUDE.  
He was obsessively NEAT.  
He was very unpleasant.

They said the surgeon was a butcher.

They said the surgeon was incompetent.

< 6>

She thought that his ideas were MESSY.  
She thought that his bedroom was MESSY.  
She thought his bedroom should be TIDY.  
She looked for the assignment paper.

His desk was a junkyard.

His desk was disorganized.

< 7>

His presentation was just BRILLIANT.  
The glow of his bulb was BRILLIANT.  
The glow of the old bulb was DIM.  
His presentation was successful.

His idea was a diamond.  
His idea may save them.

< 8>

The streets are very UNHEALTHY,  
The people there are UNHEALTHY,  
Only the mice there are HEALTHY,  
The people are always hungry,

and the criminals are germs.  
and the criminals thrive there.

< 9>

The cost of her negligence was HEAVY.  
All the course books were very HEAVY.  
All her notebooks were very LIGHT.  
She regretted what she had done.

The reality was a sledgehammer.  
The reality looked very bleak.

<10>

The winter was SHARP.  
The axes were SHARP.  
The axes were DULL.  
The axes were heavy.

The icicles were swords.  
The icicles were dangerous.

<11>

The hours there were IMPERSONAL..  
Their letters were IMPERSONAL.  
All the teachers were FRIENDLY.  
He explained his idea to them.

The office was an iceberg.  
The office was unpleasant.

<12>

His college years were INVESTMENTS.  
The stocks he bought were INVESTMENTS.  
The stocks he bought were WORTHLESS.  
His college years had been pleasant.

The diploma was money.  
The diploma was precious.

<13>

His opinions were PAINFUL.  
The burns were PAINFUL.  
The water was COMFORTING.  
The wounds looked terrible.

John's words were daggers.  
John's words were harsh.

<14>

Her expression was FROZEN.  
Her meat was still FROZEN.  
Her soup was sizzling HOT.  
Her soup was oddly sour.

Ray thought she was made of ice.  
Ray thought she was very unkind.

<15>

Ron's words needed to be more AGGRESSIVE.  
Ron's tactic was far from AGGRESSIVE.  
Ron's tactic must have been PASSIVE.  
Ron's tactic wasn't effective at all.

The salesman was a bulldozer.  
The salesman was relentless.

<16>

The mother's song was SOOTHING.  
The cool crisp sheet felt SOOTHING.  
The fever was less IRRITATING.  
The boy dozed off into a dream.

The mother's songs were medicine.  
The mother's songs sounded lovely.

<17>

Everyone's nerves began SCREAMING.  
People in the cars began SCREAMING.  
Allen wished the cars would be SILENT.  
Allen tried to ignore the beeping.

The highway was a zoo.  
The highway was noisy.

<18>

Her morning was becoming TANGLED.  
Her shoe laces were a little TANGLED.  
Her hat was not on quite STRAIGHT.  
She should have gone to bed earlier.

Her hair was still spaghetti.  
Her hair looked very messy.

<19>

Her father stared at her VIOLENTLY.  
Her father shut the door VIOLENTLY.  
Her father shut the door SILENTLY.  
Her father shut the door in a hurry.

His rage was a volcano.  
His rage was apparent.

<20>

Her feelings became COMPLICATED.  
The map of the city looked COMPLICATED.  
Her friend's explanation was too SIMPLE.  
She had to ask direction repeatedly.

The New York subway was a maze.  
The New York subway was confusing.

## APPENDIX B

The priming words and target sentences in Experiment 3 are shown in the following order: specific, general, topic, metaphoric, and literal.

round/thin/hungry

Danny's stomach is a barrel.

Danny's stomach is stuffed.

spoiled/fresh/furry

Phil's cat is a princess.

Phil's cat is very fussy.

crude/neat/medical

Some surgeons are butchers.

Some surgeons are incompetent.

brilliant/dim/thoughtful

Tony's idea is a diamond.

Tony's idea is excellent.

noisy/silent/commercial

The highway was a zoo.

The highway was jammed.

messy/tidy/old

Judy's desk is a junkyard.

Judy's desk is unorganized.

soothing/irritating/dexterous

Mothers' hands are medicine.

Mothers' hands are helpful.

unhealthy/healthy/dishonest

Criminals are germs.

Criminals are spreading.

cold/warm/bridal

Mary's marriage is an icebox.

Mary's marriage is unhappy.

impersonal/friendly/business

Joe's office is an iceberg.

Joe's office is unpleasant.

dangerous/safe/paved

This road is a snake.

This road is winding.

violent/peaceful/angry

Ron's rage was a volcano.

Ron's rage was apparent.

sharp/dull/frozen

Icicles are knives.

Icicles are dangerous.

trapped/free/clerical

Ann's job is a jail.

Ann's job is boring.

sharp/dull/laughing

Sandy's smile is a razor.

Sandy's smile is frightening.

precious/worthless/graduate

Ed's diploma was money.

Ed's diploma was important.

private/open/merciful

Kate's heart is a closet.

Kate's heart is lonely.

tangled/straight/blond

Jane's hair was spaghetti.

Jane's hair was very messy.

painful/comforting/verbal

John's words are daggers.

John's words are harsh.

aggressive/passive/travelling

That salesman is a bulldozer.

That salesman is very pushy.

## APPENDIX C

Forty-four subjects individually engaged in a naming task. Forty word pairs (prime-target) were derived from the material in Experiment 3. A target word to name was either the topic or the vehicle of a metaphor. The specific prime and the topic prime were used to prime each target respectively. The word "blank" was also used as a prime to establish the baseline.

A prime word was presented for 350 ms on a video monitor until a target word automatically replaced it. Subjects read the target word aloud as quickly and accurately as possible. A latency in naming was recorded automatically by a microcomputer. Naming times of less than 200 ms or more than 1000 ms were discarded as results of possible microphone malfunctioning (3.63%). A naming time that exceeded the mean latency for each prime condition by more than three standard deviations was also discarded (1.89%, total of 5.52%). The result is shown below.

Target:	Vehicle		Topic	
	Prime:	Specific	Blank	Topic
Naming time		473	470	451
Facilitation		- 3	—	+ 12

*Note.* Average number of syllables for topic and vehicle was 1.65 and 1.95, respectively. It appears this difference in length contributed to the difference in naming latency between two targets.

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