

*Journal of Psycholinguistic Research, Vol. 14, No. 5, 1985*

## **Processing of Metaphoric Language: An Investigation of the Three-Stage Model of Metaphor Comprehension<sup>1</sup>**

**Raizi A. Janus<sup>2</sup> and Thomas G. Bever<sup>2</sup>**

*Accepted February 20, 1985*

*Recent experiments that have compared processing of metaphoric and literal language in light of the three-stage model have methodological weaknesses. The study reported in this paper was designed to circumvent these weaknesses. Findings of this study demonstrated longer reading times for metaphors when compared to literals. This result lends support to the three-stage model and to the possibility that serial processing occurs during metaphor comprehension.*

Much of the recent research on metaphor comprehension has revolved around the issue of whether it activates cognitive mechanisms that are qualitatively the same as those used for literal processing.

Assertions that metaphors and literal sentences (henceforth “literals”) are processed “using the same cognitive and inferencing machinery” (Glucksberg, Gildea, & Bookin, 1982) are given support by research showing that metaphors require the same processing times as

---

<sup>1</sup>We would like to thank Dr. Andrew Ortony for kindly providing us with the paragraphs used as stimulus materials in this study. We would also like to thank Dr. Herbert Roitblat for his many helpful comments on earlier versions of this paper.

<sup>2</sup>Department of Psychology, Columbia University, New York.

literals (Ortony, Schallert, Reynolds, & Antos, 1978), or that metaphoric meaning is accessed simultaneously with literal meaning (Glucksberg et al., 1982). Such results are taken to imply that understanding metaphor occurs through processes that operate in parallel (Gildea & Glucksberg, 1983). On the other hand, Clark and Lucy (1975) and Gibbs (1981) have demonstrated that figurative language requires longer processing times than literal. This suggests processes that occur serially. The three-stage model of nonliteral processing (Clark & Lucy, 1975; Grice, 1975; Searle, 1979) has been invoked to account for the results of experiments demonstrating longer processing times for metaphors. This model has been the focus for debate on the possible equivalence of mechanisms in literal and metaphoric processing.

According to the three-stage model, comprehension of certain categories of nonliteral language such as metaphors occurs in three stages. These stages proceed in the following order: First, an individual constructs a mental representation of the literal interpretation of a word or sentence. Second, he tests this interpretation against the context to determine its plausibility and appropriateness. If it is plausible and appropriate within the context, it is accepted as the intended meaning. However, if it is not deemed appropriate, it is rejected as the intended interpretation. Third, if rejection occurs, a new interpretation is derived from the literal meaning, and the intended nonliteral or metaphoric meaning is attributed (Clark & Lucy, 1975; Grice, 1975; Searle, 1979).

This paper will argue that the experiments attempting to disprove the three-stage model were unable to do so. This is in principle because of their methodology.

Consider first the experiments of Clark and Lucy (1975) and Gibbs (1981), which support the three-stage model. Clark and Lucy (1975) attempted to provide empirical support for the model by demonstrating that nonliteral language takes longer to process than literal language. Longer processing time for nonliteral language constitutes indirect support for the model by drawing on the implication that more stages require more time. Clark and Lucy (1975) used a sentence verification paradigm in which subjects had to make simple deductions from indirect requests such as "Must you make the circle blue" and "Why not color the circle blue." The criterion for judging the "truth" or "falsity" of the sentences was a colored circle presented along with the sentence to be verified. Response times to press a "yes" or "no" lever was the dependent measure. Clark and Lucy (1975) found that nonliteral language required longer processing times than literal language. However, since the three-stage model postulates that it is the context against which literal meaning must be tested to determine the figurative interpretation, and since Clark

and Lucy provided no context, their findings cannot be considered definitive with respect to the three-stage model.

In a more recent study, Gibbs (1981) corrected for the absence of context. He used context paragraphs in a task requiring comprehension of indirect requests and obtained results that support the model. Gibbs showed that subjects take less time to comprehend and make paraphrase judgments for indirect requests that are "conventional" for a specific context (e.g., "I'll have a hamburger" when ordering food in a restaurant) than for indirect requests that are not conventional for that same context (e.g., "How about a hamburger"). Gibbs took measures of reaction time for reading the target sentence and also took the combined measures of the reaction time for reading the target sentence and performing the paraphrase judgment task. He concluded that there is a continuum moving from highly conventional to nonconventional utterances. Gibbs suggested that the more conventional an utterance, the easier it would be to find an appropriate interpretation in the given context. Thus, nonconventional requests in his experiment required the longest times because they involved additional processing for interpretation. Conventional language in this case would be analogous to literal, and nonconventional to metaphoric.

In an earlier experiment, Gibbs (1979) had found that when a sentence like "must you open the window" was in a literal-inducing context, it took longer to comprehend than in a context inducing a figurative or indirect meaning. However, it is difficult to assess his conclusions since it is not clear from the samples provided that the context paragraphs were able to induce the interpretation required by the task. In addition, he took reaction times for comprehension of a paraphrase of the target sentence and not for the target sentence itself.

Clark (1979) later modified his original view on the explanatory power of the three-stage model. On the basis of the results of an experiment assessing comprehension of indirect requests, he concluded that neither literal nor figurative meaning is processed prior to the other. Instead he suggested that pragmatic and semantic information is used to compute both meanings "as parts of a single package" (1979). However, the experimental task on which this conclusion was based could not in fact demonstrate the sequence of processes that occurred. The experiment consisted of a telephoned request to local merchants. The merchant answered an indirect request, such as "Could you tell me the time you close tonight?" The responses to this kind of request given by the merchant may not have alluded to the literal meaning. This does not show, however, that literal meaning was not accessed first; it shows only that the response did not allude to it.

Ortony et al. (1978) questioned the relevance of the earlier Clark and Lucy (1975) experiment to the three-stage model on grounds that appropriate context had not been provided; the same point can be made about the Clark experiment (1979). It might be argued that the situation created by a phoned request constituted the pragmatic context, but there was no actual preceding verbal context to induce one interpretation or another. Ortony et al. (1978) designed an experiment using context paragraphs into which target sentences were embedded to test the model.

In this experiment, Ortony et al. (1978) instructed subjects to read paragraphs containing target sentences on the video display of a cathode-ray tube (CRT), and to press a lever as soon as they had comprehended each sentence they read. There was a critical target sentence, for which a metaphorical or literal interpretation was induced by the specific context paragraph into which it had been placed. The dependent measure was reaction time for comprehension of the target sentence. Results of this experiment showed no statistical differences between reaction times for comprehension of the target sentences, although there was a numeric "tendency" for metaphorical processing to take a little longer than literal processing (Ortony et al., 1978).

Glucksberg et al. (1982) also questioned the validity of the three-stage model. They (1982) investigated the assumption that the processing of metaphors and literals draws on "identical cognitive and inferencing machinery" by attempting to demonstrate that the metaphoric meaning of a sentence would be automatically accessed and could not be inhibited since people would be unable "to ignore the meanings of metaphorical statements, even when the literal meanings of those statements are plausible in context" (1982). They reasoned that if metaphoric meaning was accessed simultaneously with literal meaning, the two processes must be governed by the same cognitive operations.

In an experiment using an analogue to the Stroop color-naming word interference technique, they investigated the possibility that metaphoric interpretation analogous to the color name in Stroop's task would interfere with or suppress other cognitive processes (Jensen & Rohwer, 1966). The experiment was a sentence verification paradigm in which subjects read sentences, some of which could be given a metaphorical interpretation as well as a literal one. The function in the experiment of the metaphoric interpretation was analogous to that of the irrepressible color name in Stroop's original task. Glucksberg et al. (1982) hypothesized that the metaphorical interpretation would occur instantaneously and suppress a literal interpretation. Their results indicated that when meaningful metaphoric interpretations of literally false sentences were available, it took subjects significantly longer to decide that the sentences

were in fact false, in a literal sense. From these results they concluded that subjects process both literal and nonliteral meanings of sentences simultaneously, since "we may be unable to inhibit deriving metaphorical interpretations when such interpretations are readily apprehendable, much as we are unable to inhibit reading the name of a color word in a Stroop color word interference task" (Glucksberg et al., 1982).

Thus, using different experimental techniques, Ortony et al. (1978) and Glucksberg et al. (1982) attempted to demonstrate the equivalence of processing mechanisms for literal and metaphoric comprehension and to repudiate the three-stage model. In fact, in correcting for the absence of context in the Clark and Lucy (1975) experiment, Ortony et al. (1978) did appear to invalidate the three-stage model insofar as it implies longer reading times to comprehend metaphors, and Glucksberg et al. (1982) further demonstrated that metaphoric meaning is accessible along with a literal meaning. However, the methodology used by each was inappropriate to assess the postulates of the three-stage model.

In particular, the experiment of Glucksberg et al. (1982) consisted of a sentence verification paradigm without any context. This is precisely the problem in the Clark and Lucy experiment (1975) that supported the model. Recall, it is the juxtaposition of context and the literal meaning of a word that creates the "recognition problem" (Miller, 1979) characterized in the first two stages of the three-stage model. Thus, by definition, just as the experiment of Clark and Lucy (1975) could not address the model, neither could that of Glucksberg et al. (1982). The absence of context in the Glucksberg et al. experiments is in fact incongruent with their own statement that they are investigating the elicitation of metaphoric meaning when "the literal meaning of these statements is plausible in CONTEXT" (1982). While it is possible that Glucksberg et al. have conceived of the experimental task as the pragmatic context provided by background knowledge, it is not clear that this would meet the intent of the three-stage model.

Glucksberg attributed the longer latencies elicited by metaphors in the verification task to an "interference effect" when presumed simultaneous accessibility of metaphoric meaning with literal impeded comprehension of the latter. However, one might argue the contrary; to wit, increased latencies occurred because of serial processes activated by novel metaphors. Since this experiment presented sentences in isolation, without context paragraphs, metaphoric sentences may have appeared "anomalous" (Fraser, 1979; Pollio & Burns, 1977) to the subjects. Even in the absence of context, subjects presented with anomalous sentences that may be potentially interpreted metaphorically will attempt to do so (Fraser, 1979; Pollio & Burns, 1977). *Even if people "cannot inhibit"*

*their understanding of metaphors, one cannot conclude that these automatic processes are governed by parallel operations.* The latencies observed as the “interference effect” may have been the result of additional effort and time required for serial processing in the interpretation of anomalous sentences as metaphors.

While the Ortony et al. (1978) experiments did use novel metaphors and explicitly included context, the ability of their methodology to assess the three-stage model with precision must be questioned. The problem concerns the locus for measurement of lexical processing times. Ortony et al. (1978) measured reading times at the end of target sentences, i.e., once the entire sentence had been comprehended. They could not isolate the point where the metaphor was first encountered and the “recognition problem” (Miller, 1979) initially occurred. However, while they did not demonstrate significant differences between reading times for comprehension of metaphoric and literal target sentences, a “tendency” toward differences was evidenced by slightly longer latencies for metaphoric sentences. It is conceivable that this tendency might have reached significance were it not that the word or phrase that ends a sentence in text is routinely subject to a specific elongation of attention. The extra processing at the ends of sentences due to “contextual integration processes” (Abrams & Bever, 1969; Just & Carpenter, 1980) may have masked differences in processing times for comprehension of literal sentences compared to metaphoric ones because of greater intrasentence variance in the case of metaphors. Difficulties in processing a metaphor would be most salient at the point in the sentence-constituent structure where the metaphor is first encountered. This is the point at which the metaphor imposes its greatest cognitive demands by creating a “recognition problem” (Miller, 1979) and by requiring that an initial figurative interpretation be derived.

Thus, looking at processing times within sentences at the boundaries of constituent units, rather than at the ends of sentences, might be more likely to expose significant differences in latencies for comprehension of metaphoric as compared to literal sentences. There is substantial empirical evidence that processing of sentences proceeds phrase by phrase (Fodor & Bever, 1965; Graf & Torrey, 1966; Levelt, 1970) and that critical processing for a clause has taken place by the end of that clause (Abrams & Bever, 1969; Bever & Townsend, 1979; Caplan, 1972; Foss, 1969; Jarvella, 1971). It has been shown that semantic and syntactic decisions are made sequentially at the ends of constituent units, with a cumulative wrap-up at the end of the entire sentence (Just & Carpenter, 1980). Moreover, research in polysemy (Cairns & Kamerman, 1975; Conrad, 1975; Seidenberg, Tanenhaus, Leiman, & Bienkowski, 1982)

and other work in clausal processing (Bever, Garrett, & Hurtig, 1973) suggest that within 500 msec (Seidenberg et al., 1982), or roughly two words after a target (Cairns & Kamerman, 1975), or by the end of a clause (Bever et al., 1973), but certainly by the end of a sentence (Conrad, 1974), increased latencies resulting from greater cognitive load have disappeared.

In summary, while differences between processing times of metaphoric sentences compared to literal ones may be attenuated at the termination of sentences because of "contextual integrative processes" extraneous to the metaphor processed (Just & Carpenter, 1980), or simply may have disappeared, this difference might have become more salient in a phrase-by-phrase measure. Therefore, Ortony et al. (1978) may have found no differences between literal and metaphor processing times, not because none exist, but because they did not observe reaction times at the point most likely to reveal these differences.

Contrary to the conclusions from Glucksberg et al. (1982) and Ortony et al. (1978), there may indeed be differences between metaphors and literals, if context is provided and if a phrase-by-phrase measure is used. The study described below was designed to include context and to focus on the metaphor at the specific point where its contrast with antecedent context would cause a "recognition problem," and require construal of a metaphoric interpretation. Longer processing times for metaphors in the first phrase unit of constituent structure, where they are encountered, would lend support to a serial processing model such as the three-stage model (Clark & Lucy, 1975; Grice, 1975; Searle, 1979) since it would suggest either that they do indeed cause a "recognition problem" or that they require an additional process of interpretation, or both.

## METHOD

### *Subjects*

There were eight subjects in the reading phase of the experiment, three men and five women, all students at Teachers College Columbia. An additional six subjects rated the critical phrases for predictability. Subjects were paid for their participation in the experiment.

### *Materials and Apparatus*

The independent variable was target phrase type (literal or metaphoric). There were nine target phrases, each embedded in a target sentence.

Each target sentence containing the independent variable was assigned to two paragraphs. One of the paragraphs to which the target sentence was assigned was intended to induce a metaphorical interpretation of the target sentence and its embedded target phrase, and the other paragraph was intended to induce a literal interpretation. Thus, there were nine target phrases but 18 experimental paragraphs. Two groups of stimuli were constructed from these 18 paragraphs so that when interpretation of a target phrase was metaphoric in Group A, interpretation of an identical target phrase would be literal in Group B. Similarly, when interpretation of a target phrase was literal in Group A, interpretation of an identical target phrase in Group B was metaphoric. Thus, as in the experiment performed by Ortony et al. (1978), "targets requiring a metaphorical interpretation in list A were interpretable literally in list B and vice versa."

The target sentences and paragraphs were the ones used by Ortony et al. in their experiment (1978). However, one modification was performed on them. In order to investigate the processing times at constituent boundaries, target sentences were parsed into their constituent structure according to the following guidelines: (1) Each phrase consisted of no less than two and no more than five words; (2) each sentence was initially divided into subject/predicate; (3) predicates were then subdivided into verb/object or verb/adverbial-prepositional-phrase in order to conform to the two- to five-word phrase limit.

In summary, there were nine target sentences parsed into phrases. Each target sentence was embedded in two different paragraphs and could be interpreted literally or metaphorically depending on the context paragraph preceding it.

In addition, there were 11 filler paragraphs that were the same for both Groups A and B.

All metaphors used in this experiment are *sentential metaphors*, in which the topic is implied in preceding context. An example of a target sentence and its two context paragraphs is as follows:

TARGET SENTENCE: "The fabric, had begun, to fray."

Commas mark off phrase divisions as they appeared in the experiment.

The phrase "the fabric" is the vehicle phrase of the metaphor. All target phrases constituted the vehicle of the sentential metaphor in which they appeared.

The context paragraph inducing a *metaphorical* interpretation is as follows:



Lucy and Phil, needed a marriage counselor. They had once, been very happy, but after several years, of marriage, they had become discontented, with one another. Little habits, which had at first been endearing, were now irritating, and caused many senseless and heated arguments.

THE FABRIC HAD BEGUN TO FRAY.

It was necessary to do something, about it.

The context paragraph inducing a *literal* interpretation is as follows:

The old couch, needed re-upholstering. After two generations, of wear, the edges of the couch, were tattered and soiled. Several buttons, were missing, and the material, around the seams, was beginning, to unravel. The upholstery, had become very shabby.

THE FABRIC, HAD BEGUN, TO FRAY.

It was necessary, to do something, about it.

#### *Phrase Predictability Measure*

Six naive subjects read the passages in one of the experimental groups (A or B), presented phrase by phrase. At the critical literal or metaphoric phrase, they judged the likelihood of the phrase in the context of what they were reading. The metaphoric phrases were consistently judged as less predictable than the corresponding literal phrases ( $T = 3.50$ ,  $p < .01$ , with a one-tailed  $t$ -test for dependent samples).

#### *Design*

Each subject was randomly assigned to either Group A or Group B, with phrase interpretation (metaphoric or literal) as a within-subject variable. The dependent measure was Reading Time (RT) required for comprehension of metaphoric and literal target phrases.

#### *Procedure*

All subjects received the same instructions, and were tested in individual sessions lasting about 1/2 hour. They were told by the experimenter that they were participating in a study dealing with reading comprehension. They were then seated in front of the cathode-ray tube (CRT) screen of a TRS 80 microcomputer on which the following instructions for operating the computer were provided phrase by phrase.

(The length of each phrase in the instructions as they actually appeared on the screen is indicated by commas in the text below.)

“In this experiment, you will be presented, with several paragraphs. The paragraphs will appear, phrase by phrase, in this manner. As soon as you have read, the phrase, press the “/” key, and the next phrase, will appear. Respond as quickly, as you can, but be sure you understand, what you read. Some of the paragraphs, will be followed by a question, which you will be required to answer, by saying yes or no. There will be a short delay, before each paragraph, is presented. At this point, please wait, until an “X” appears, in the center of the screen, before pressing the “/” key.

The purpose of the questions that followed some of the paragraphs was to guarantee insofar as possible that subjects had indeed comprehended the phrases they were reading on the screen before pressing the key. Answers were recorded by the experimenter.

All subjects received the 11 filler items and 9 experimental items without interruption.

After the testing session, subjects were given a debriefing in which the purpose of the experiment was explained and their questions regarding their participation were answered.

## RESULTS

Metaphoric target phrases required significantly longer reading times than literal target phrases. This finding was confirmed by a one-tailed *t* test for Dependent Samples comparing the literal condition with the metaphoric,  $t = 2.00$ ,  $p < .05$ , and by a one-tailed *t* test for Dependent Samples performed on the reading time scores within subject for metaphoric and literal target phrases,  $t = 2.77$ ,  $p < .01$ .

The purpose of comparing the literal and metaphoric conditions was to investigate differences in reading time for identical phrases that differed in interpretation. A comparison of mean reading time scores for identically worded literal and metaphoric target phrases is displayed in Table I in standard scores. The mean for the literal condition was 96 centiseconds and for the metaphoric 116 centiseconds. (Standard scores were used in order to adjust for between-subject variability in reading times. The standard scores were computed by the following procedure: For each subject the mean reading time per phrase was computed along with its standard deviation. The standard deviations were then used to compute the standard score of the reading speed for the target phrase. It should be noted that the phrases used to compute the standard deviations

**Table I.** Comparison of Mean Standard Scores of Reaction Times in Literal and Metaphoric Conditions by Target Phrase<sup>a</sup>

Vehicle of target phrase	Literal ( <i>N</i> = 36)	Metaphoric ( <i>N</i> = 36)
Hens	-.31	.23
Troops	-.50	.70
Avalanche	-.08	-.37
Fabric	-.93	-.17
Soil	.13	.55
Road	-.09	.12
Wall	-.71	-.58
Portraits	-.83	.27
Waves	-.31	-.64
$\bar{X}$	-.36	.01

<sup>a</sup>Conditions compared are designated as follows: Literal = literal reading task, Metaphoric = metaphoric reading task.

**Table II.** Comparison of Mean Standard Scores of Reaction Times and Literal Conditions by Subject (*N* = 8) in Centiseconds

Pair	Literal	Metaphoric
1	73	101
2	71	74
3	129	162
4	73	97
5	129	116
6	121	136
7	64	92
8	119	136
$\bar{X}$	97	114

<sup>a</sup>Conditions compared are designated as follows: Literal = literal reading task, Metaphoric = metaphoric reading task.

were often longer than the vehicle target phrases and may therefore have had relatively large means.)

There was no correlation between the predictability ratings and the reading time scores for the target phrases,  $r = -.03$ ;  $p > .1$ .

A one-tailed *t* test for Dependent Samples was performed on the subjects' standard scores for the nine metaphoric and literal sentences.

This analysis performed on the entire sentence indicated no significant differences in reading times for literal and metaphoric sentences,  $t = .85$ ,  $p > .1$ . This result was consonant with Ortony's finding.

All of the comprehension questions following the paragraphs were responded to correctly.

## DISCUSSION

The hypothesis stated that metaphors would require longer processing times than literals but this difference would be significant only if reading time measures were taken at the end of target phrases rather than at the end of the target sentences in which the phrases were embedded. This hypothesis was born out by statistical analyses of the data. Moreover, these data may have also provided an explanation for the "tendency" Ortony et al. (1978) had noted for metaphoric sentences to require longer processing times than literals. It was the significant difference between processing time of metaphoric and literals, demonstrated at the vehicle phrases, that may have augmented overall processing times for the metaphoric sentences in their entirety.

The experiment reported above and those of Ortony et al. (1979), Clark and Lucy (1975), Gibbs (1981), and Glucksberg et al. (1982) tested the three-stage model indirectly by investigating one of its implications; to wit, metaphors should require longer processing times than literals. Longer processing times result because metaphors are processed serially in three stages, which depend on access of literal meaning and the consequent recognition that it is inappropriate in context. Focusing on the processing pattern that is imposed by constituent structure highlighted this "recognition problem" (Miller, 1979): A comparison of ratings of predictability for the literal and metaphoric target phrases showed that literal phrases were more predictable from context than were their metaphoric counterparts. This suggests that for the metaphors, a literal meaning was attributed first and was recognized to be inappropriate in context. This is *prima facie* evidence for the validity of the three-stage assertion that literal meaning is computed before metaphorical. Had the metaphoric meaning been initially attributed, then metaphors would have been as appropriate in context as literal phrases and would have received similar predictability ratings. It is because a literal interpretation for a metaphor is inappropriate in context that a reader is subject to the recognition problem and subsequently reinterprets a phrase read literally as a metaphor. It is important to note that the measured predictability

difference, however, does not account for the reading time differences: There was no overall correlation between phrase predictability and reading time. Thus, the predictability of a phrase, whether literal or metaphoric, was not a significant source of variance in reading times. This lends further support to the possibility that the longer times for metaphors resulted from the demands of serial processing and not simply because they were less predictable in context than literals.

The finding of our experiment supports the possibility of serial processing. The issue of identity of cognitive machinery does not necessarily depend on serial versus parallel processing, as Glucksberg et al. (1982) imply, since both may occur in the same system. In fact, the occurrence of serial processing for some cases of linguistic usage and parallel for others may simply mean that the identical cognitive machinery operates with variable initiation and termination points for different language processes.

We used materials designed critically to contrast metaphoric and literal processing. We do not doubt that situations can be constructed in which metaphorical interpretations are comprehended directly without the mediation of a literal interpretation. "Frozen metaphors" are surely examples of such stimuli. Therefore, the difference between literal and metaphor processing is not necessarily a difference in the "cognitive and inferencing machinery" (Glucksberg et al., 1982) but in the number of demands that novel metaphors ordinarily make on this machinery when compared to literals. Both literal and metaphoric language pose lexical and pragmatic recognition problems, as Glucksberg has pointed out (Glucksberg & Gildea, 1983). Both may pose problems of ambiguity requiring context for disambiguation. But while the same machinery may be used for both, novel metaphors as a linguistic category may consistently need more input in the form of contextual supports or require operation of the machinery at greater capacity, first to compute a literal interpretation.

In summary, one may agree with Glucksberg et al. (1982) and Ortony et al. (1978) that the same "cognitive and inferencing machinery" is used by both literal and metaphoric processes, and still assert that despite the identity of machinery, the processes involved may often be qualitatively different.

## REFERENCES

- Abrams, K., & Bever, T. G. (1969). Syntactic structure modifies attention during speech perception and recognition. *Quarterly Journal of Experimental Psychology*, 21, 280-290.

- Bever, T., Garrett, M., & Hurtig, R. (1973). The interaction of perceptual processes and ambiguous sentences. *Memory and Cognition*, 1, 277–286.
- Bever, T., & Townsend, D. (1979). Perceptual mechanisms and formal properties of main and subordinate clauses. In W. Cooper & E. Walker (Eds.), *Sentence processing*. Hillsdale, New Jersey: Erlbaum.
- Cairns, H. S., & Kamerman, J. D. (1975). Lexical information processing during sentence comprehension. *Journal of Verbal Learning and Verbal Behavior*, 14, 140–179.
- Caplan, D. (1972). Clause boundaries and recognition latencies for words in sentences. *Perception and Psychophysics*, 12, 73–76.
- Clark, H. H. (1979). Responding to indirect speech acts. *Cognitive Psychology*, 11, 430–477.
- Clark, H., & Lucy, P. (1975). Understanding what is meant from what is said: A study in conversationally conveyed requests. *Journal of Verbal Learning and Verbal Behavior*, 12, 335–359.
- Conrad, C. (1974). Context effects in sentence comprehension. A study of the subjective lexicon. *Memory and Cognition*, 2, 130–138.
- Fodor, J., & Bever, T. (1965). The psychological reality of linguistic segments. *Journal of Verbal Learning and Verbal Behavior*, 4, 412–420.
- Foss, D. J. (1969). Decision processes during sentence comprehension: Effects of lexical item difficulty and position upon decision times. *Journal of Verbal Learning and Verbal Behavior*, 8, 457–462.
- Fraser, B. (1979). The interpretation of novel metaphors. In A. Ortony (Ed.), *Metaphor and thought*. Cambridge: Cambridge University Press.
- Gibbs, R. W. (1979). Contextual effects in understanding indirect requests. *Discourse Processes*, 2, 1–10.
- Gibbs, R. W. (1981). Your wish is my command: Convention and context in interpreting indirect requests. *Journal of Verbal Learning and Verbal Behavior*, 20, 435–444.
- Gildea, P., & Glucksberg, S. (1983). On understanding metaphor. The role of context. *Journal of Verbal Learning and Verbal Behavior*, 22, 577–590.
- Glucksberg, S., Gildea P., & Bookin, H. (1982). On understanding non-literal speech: Can people ignore metaphors? *Journal of Verbal Learning and Verbal Behavior*, 1, 85–96.
- Graf, R., & Torrey, J. (1966). Perception of phrase structure in written language. *American Psychological Association Convention Proceedings*, pp. 83–84.
- Grice, H. (1975). Logic and conversation. In P. Cole & J. L. Morgan (Eds.), *Syntax and semantics*, Vol. 3: *Speech acts*. New York: Seminar Press.
- Jarvella, R. J. (1971). Syntactic processing of connected speech. *Journal of Verbal Learning and Verbal Behavior*, 10, 409–416.
- Jensen, A. R., & Rohwer, W. D. (1966). The Stroop Color-Word Test: A review. *Acta Psychologica*, 25, 36–93.
- Just, M., & Carpenter, P. A. (1980). A theory of reading: From eye fixations to comprehension. *Psychological Review*, 87, 329–354.
- Levelt, W. (1970). Hierarchical clustering algorithms in the psychology of grammar. In G. B. D'arcais & W. Levelt (Eds.), *Advances in psycholinguistics* (pp. 101–112). New York: Elsevier.
- Miller, G. A. (1979). Images and models, similes and metaphors. In A. Ortony (Ed.), *Metaphor and thought*. Cambridge: Cambridge University Press.
- Ortony, A., Schallert, D. D., Reynolds, R., & Antos, S. Interpreting metaphors and idioms: Some effects of context on comprehension. *Journal of Verbal Learning and Verbal Behavior*, 17, 465–477.
- Pollio, M. R., & Burns, B. C. (1970). *Journal of Psycholinguistic Research*, 6, 242–260.

- Searle, J. (1979). Metaphor. In A. Ortony (Ed.), *Metaphor and thought*. Cambridge: Cambridge University Press.
- Seidenberg, M. S., Tanenhaus, M., Leiman, J., & Bienkowski, M. (1982, April). *Automatic access of the meanings of ambiguous words in context: Some limitations of knowledge-based processing*. Technical Report 240. University of Illinois, Center for the Study of Reading.