Effective elaboration and inferential reasoning

C. DONALD MORRIS and JOHN D. BRANSFORD
Vanderbilt University, Nashville, Tennessee 37203

The present study investigated the effects of several variables on subjects' abilities to draw inferences from two related premises. Contiguous presentation of the related sentences led to significantly higher inference scores than did noncontiguous presentation. The nature of the initial premise was also manipulated. For some subjects, the initial premise was relatively consistent with subjects' semantic knowledge, whereas other subjects received initial premises that were somewhat arbitrary with respect to semantic knowledge. Inference scores were significantly higher for subjects who received the more consistent initial premises. This effect persists even when differential memory for the initial premises has been accounted for. The results suggest certain constraints on the nature of the knowledge one must possess in order to make appropriate inferences from material.

The present paper investigates a number of factors that affect people's abilities to successfully combine or integrate information from multiple sources. Theorists in several areas of research have argued that people combine information from two or more distinct sources (e.g., sentences) in order to form more holistic representations. Data supporting this view have been reported in studies of remembering (Barclay, 1973; Bransford & Franks, 1971, 1972; Kintsch, 1976) and in studies of inferential reasoning (Moeser, 1976; Potts, 1972, 1974; Riley, 1976). Other studies also suggest that subjects can use information from one source to help comprehend new sources of information (Bransford & Johnson, 1973; Haviland & Clark, 1974; Morris, Stein, & Bransford, 1979).

One variable that affects the degree to which people can integrate information from distinct sources is whether or not those sources of information are presented contiguously. For example, consider a series of experiments by Moeser (1976). Moeser's subjects were asked to learn sets of propositions presented under one of three conditions. One group of subjects heard each set of propositions included in a single "holistic" sentence (e.g., "The ants ate the jelly on the table in the kitchen"). A second group heard each set of propositions as individual sentences presented in logical order (e.g., "The ants ate the jelly. The jelly was on the table. The table was in the kitchen"). The third group also heard each set of propositions as individual sentences, except that these sentences were presented in a random order with no two sentences from the same set ever presented contiguously. Following acquisition, all subjects received an inference test. Inference scores

were highest for the holistic sentence group, intermediate for the ordered-propositions group, and lowest for the random-propositions group. These results may be interpreted to indicate that the informational contents of individual premises are more likely to be integrated successfully when those premises are presented contiguously rather than separately. Data from several other studies (Foos, Smith, Sabol, & Mynatt, 1976; Moeser & Tarrant, 1977; Smith & Foos, 1975) are in agreement with this interpretation.

In the Moeser (1976) study, contiguously presented premises led to better inferential reasoning than did noncontiguously presented premises. There are, however, several demonstrations that noncontiguously presented inputs can be effectively integrated. For example, Moeser, in one of her conditions, provided a semantic framework that permitted subjects to incorporate new information into an already existing cognitive structure. These subjects were given a story context that could be used as a conceptual basis for interrelating the individual premises. Moeser found that subjects given this story context were generally able to make the appropriate inferences.

Moeser (1976) argues that when people receive a new unit of information, they attempt to encode this information by incorporating it into an activated semantic memory structure. The extent to which the new information is successfully related to other pieces of information is largely determined by the nature of the semantic memory structure. For example, depending on how much an individual knows about a certain person, a new fact about this person may be "encoded into a relatively rich cognitive structure, or it might be encoded as a discrete segment of information bearing no relation to the rest of his cognitive system. If encoded as a discrete segment, the fact could not be used to generate new information; if encoded into a complex structure, it would be interrelated with other concepts and could be used to generate inferences" (Moeser, 1976, p. 212).

This research was supported in part by National Science Foundation Grant BNS77-077248 awarded to J. D. Bransford and J. J. Franks. Reprints may be obtained from Donald Morris, Department of Psychology, St. Lawrence University, Canton, New York 13617.

The nature of the cognitive structures one uses to acquire new information has been examined in a study by Morris et al. (1979). Morris et al. manipulated the nature of prior information given to subjects who were trying to learn a passage of prose. For example, one group of subjects heard a set of prior information sentences that were meaningfully related to one's semantic knowledge of the world (e.g., "The fat man got stuck in a cave"). A second group of subjects received prior information sentences that were arbitrarily related to one's semantic knowledge (e.g., "The bald man got stuck in a cave"). Note that one's semantic knowledge of "fat" could be used to clarify the significance of getting stuck in a cave; one's semantic knowledge of "bald," on the other hand, could not. Morris et al. found that prior information sentences that were meaningfully related to semantic knowledge were better recalled than prior information sentences that were arbitrarily related to semantic knowledge (see also Rosenberg, 1969).

Of particular interest was how subjects would be able to use these different prior information sentences to help learn new material. Subjects were presented new sentences, such as "The group felt sorry for the [fat/bald] man but couldn't help chuckling about the incident." When presented in isolation, these two sentences were equally difficult to learn. But when preceded by prior information sentences, such as those discussed above, there were marked differences in subjects' abilities to learn the new material. Subjects who heard the semantically appropriate set of prior information sentences learned the new material much better than did subjects who heard the arbitrary set of prior information sentences. It thus appears that qualitative differences in the nature of the prior information affect subjects' abilities to effectively elaborate new information (see, for example, Craik & Tulving, 1975; Stein, Morris, & Bransford, 1978). Prior information that was consistent with subjects' semantic knowledge permitted relatively effective elaborations of new material, whereas prior information that was arbitrarily related to semantic knowledge permitted only imprecise elaborations of new information.

In terms of Moeser's (1976) conclusions, these results suggest that semantically consistent prior information may activate a richer, more complex cognitive structure than does arbitrary prior information. Therefore, new information may be more efficiently incorporated into this structure and would be more easily learned. If this is the case, then it is reasonable to expect that manipulating the nature of prior information given to subjects should also affect the degree to which new information may be interrelated with other pieces of information in order to generate inferences. The present study was designed to investigate this possibility. In addition, the effects of contiguous vs. noncontiguous presentation of items were also examined.

EXPERIMENT 1

Subjects were presented two lists of related sentences. Either the two lists were presented in blocked form or the related sentences were presented contiguously. The blocked form of presentation involved presenting all the sentences from the first list and then all the sentences from the second list. The contiguous form of presentation involved presenting a sentence from the first list, followed immediately by its related sentence in the second list. Sentences in the first list were designed to be either consistent with semantic knowledge or arbitrary with respect to semantic knowledge. When the first-list sentences were consistent with semantic knowledge, it was assumed that these sentences could be more effectively integrated with the related sentences in the second list. Correspondingly, it was assumed that it would be more difficult to integrate the arbitrary first-list sentences with the related sentences in the second list. Therefore, it was hypothesized that the subjects who received the consistent first list would perform better on a subsequent inference test than would subjects who received the arbitrary first list. It was also hypothesized that subjects who received the related sentences contiguously would perform better on the inference test than would subjects who received the two lists in blocked form.

Method

Subjects. Sixty students from a number of psychology classes served as subjects in this experiment in order to fulfill a course requirement. Thirty subjects were in the consistent condition and 30 were in the arbitrary condition. Within each of these conditions, 15 subjects received blocked presentations of the two lists of sentences and 15 subjects received contiguous presentations of the related sentences from each list. Subjects were randomly assigned to the four groups.

Materials. Two acquisition lists of 10 sentences each were constructed (see Table 1). One list contained 10 sentences that were consistent with respect to semantic knowledge, whereas the other list contained 10 sentences that were somewhat arbitrary with respect to semantic knowledge. These two lists were designed to vary in the degree to which the informational content of each was consistent with one's prior knowledge. For example, in the sentence "The [short/bald] man stood on the stool," one could use semantic knowledge of "short" to understand the significance of standing on a stool. One's semantic knowledge of "bald," however, would be of little value in understanding the significance of standing on a stool. It would, in effect, be arbitrary. By the same line of reasoning, this manipulation was also expected to affect the ease with which subjects could use prior information in order to effectively elaborate new information and integrate it with previously given information.

A third list of sentences was also constructed (see Table 1). Each sentence in this list was related to one and only one of the sentences in the consistent or arbitrary list. The nature of the relationship was as follows: The subject noun of the sentence in the third list was the same as the object noun of a sentence in either the consistent or the arbitrary list. For example, imagine that subjects heard "The [short/bald] man stood on the stool" from one of the initial lists. The related sentence from the third list would be "The stool was in the kitchen."

Following acquisition, subjects were given an inference test.

Table 1
Examples of Materials Used in the Present Experiment

Initial-List Sentences*	Second-List Sentences	Inference Questions
The funny/strong man danced on the stage.	The stage was surrounded by TV cameras.	Which man was filmed by TV cameras?
The short/bald man stood on the stool.	The stool was placed in the kitchen.	Which man was doing something in the kitchen?
The old/angry man sat in the rocking chair.	The rocking chair had several soft cushions.	Which man positioned the soft cushions?
The smart/fat man read the textbook.	The textbook was left in the shopping cart.	Which man went back to the shopping cart?
The angry/sleepy man smashed the window.	The window was in a yellow bus.	Which man stood near a yellow bus?

*The first adjective represents a meaningful relationship; the second adjective represents an arbitrary relationship.

Questions on this test required subjects to integrate information from the two related sentences. For instance, subjects were asked "Which man was in the kitchen?" Note that the correct answer to this question ("short" for the consistent groups, "bald" for the arbitrary groups) could not be given if subjects retrieved information from only one of the members of the related acquisition sentences. Rather, it was necessary to encode the related sentences as an integrated unit.

Procedure. Four groups of 15 subjects each were run. Groups 1 and 2 received blocked presentations of consistent or arbitrary initial lists, respectively, followed by a 30-sec interval and, then, the blocked presentation of the set of related sentences. Groups 3 and 4 were presented a single sentence from the consistent or arbitrary lists, respectively, followed immediately by its related sentences from the third list. Subjects in these groups heard five pairs of contiguously presented sentences, followed by a 30-sec interval, and then heard the remaining five pairs of contiguously presented sentences. All sentences were read aloud by the experimenter. For Groups 1 and 2, there was a 2-sec interval between the sentences in each block. For Groups 3 and 4, there was a 2-sec interval between the successive pairs of related sentences. Note that subjects in each group received 10 sentences, a 30-sec interval, and then 10 more sentences.

Subjects in Groups 1 and 2 were instructed to pay careful attention to each sentence in the initial list and to each sentence in the related list. Subjects were informed of the nature of the relationship between sentences and were instructed that they should attempt to integrate each pair of related sentences. Subjects were told in advance the nature of the study and were given examples of the acquisition sentences and the inference questions. Subjects in Groups 3 and 4 were instructed to listen carefully to each pair of sentences they heard and to note the relationship between the members of each pair. These subjects were also told in advance the nature of the study and given examples of acquisition and test sentences.

Following acquisition, subjects in each group sat silently for 60 sec and were then given the inference test. This test consisted of 10 questions read aloud by the experimenter. A 7-sec interval was allowed after each question, during which subjects were to write down the answer.

Results and Discussion

A 2 by 2 analysis of variance (presentation mode by sentence type) was performed on the inference test scores. These scores are presented in Table 2. The main effect for presentation mode was significant [$F(1,56) = 10.52, p < .01$]. There was also a significant main effect for sentence type [$F(1,56) = 29.99, p < .001$]. The interaction between these two factors was not significant.

These data indicate strong support for the hypoth-

esis that contiguous presentation of the related sentences is better than blocked presentations. Inference scores were substantially higher for contiguously presented sentences, presumably because the contiguous presentation enhanced subjects' abilities to encode the related sentences together as a single integrated unit. Note that Moeser (1976) found a similar effect in her study.

The question of major interest involves the degree to which inference scores vary as a function of the nature of the initially presented materials. The data indicate that, regardless of presentation mode, consistent sentences resulted in higher inference scores than arbitrary sentences did. These results suggest that when sentences are more consistent with subjects' general knowledge of the world, it is easier for subjects to effectively integrate novel related information into that knowledge framework. When asked to utilize this knowledge in a subsequent transfer situation (i.e., an inference test), such knowledge is more readily available.

It is necessary, however, to qualify any claims about how effectively the consistent information may be utilized in the present situation. It is quite likely that the higher inference scores for the consistent groups are due to subjects' superior abilities to remember the original acquisition sentences, relative to those subjects in the arbitrary groups. A similar effect was reported by Morris et al. (1979) in their study of prose recall. Thus, subjects who hear consistent initial sentences might make a greater number of appropriate inferences than subjects who hear arbitrary initial sentences merely because they have better memory for the input sentences and not because the consistent sentences enhance

Table 2
Mean Percentage Inference Scores as a Function of Presentation Mode and Sentence Type (Experiment 1)

Initial Sentence Type	Presentation Mode			
	Blocked		Contiguous	
	Mean	SD	Mean	SD
Consistent	.573	.215	.773	.243
Arbitrary	.227	.243	.433	.266

the prospect of successfully integrating novel related information. Experiment 2 was conducted in order to examine this possibility.

EXPERIMENT 2

Experiment 2 was similar to Experiment 1 with two exceptions. First, subjects received only noncontiguous presentations of related sentences. The sentences were therefore presented in block format (i.e., initial premises were presented in the first block and related premises were presented in the second block). Second, after receiving each block of sentences, subjects were asked to free recall as many of the sentences from that list as possible. It was hypothesized that subsequent performance on an inference test would still be higher for the "consistent" subjects than for the "arbitrary" subjects. More important, however, this superiority was expected even when the analyses involved inference scores, given that subjects had previously recalled the acquisition sentences. Support for the latter hypothesis would indicate that consistent sentences may be more effectively utilized for a subsequent inference test than are arbitrary sentences, even when differential memory for the two types of sentences has been accounted for.

Method

Subjects. Forty students from a number of psychology classes participated in this experiment in order to fulfill a course requirement. Twenty subjects received consistent initial sentences, and 20 received arbitrary initial sentences. Subjects were randomly assigned to the two groups.

Materials. The stimulus materials were identical to those used in the blocked presentation groups of Experiment 1.

Procedure. The procedure was similar to that of Experiment 1, with one major exception. After presentation of each of the two acquisition lists (the initial list followed by the related list), subjects were asked to free recall as many of the sentences as possible. Five minutes were allowed for each recall period, and all subjects easily finished within the allotted time. Sixty seconds after the end of the second recall period, the inference test was administered, as in Experiment 1.

Results

A number of different analyses were conducted on the data from this experiment. The first analysis involved the unconditional inference scores, as in Experiment 1. This analysis indicated that the consistent group made more correct inferences than the arbitrary group (.655 vs. .355, respectively). This difference was clearly significant [$t(38) = 3.74$, $p < .01$], and it replicates the findings of Experiment 1. This finding suggests that consistent sentences do activate a knowledge base that allows subjects to effectively elaborate and integrate new information, so that inferential ability is improved.

Further analyses were performed on the free recall scores. For the first block of sentences, the consistent group recalled .665 of the sentences vs. .420 for the arbitrary group. This difference was significant [$t(38) = 3.38$, $p < .01$]. For the second block of sentences, the consistent group recalled .640 of the sentences vs. .450 for the arbitrary group. This difference was also signifi-

cant [$t(38) = 2.73$, $p < .01$]. Thus, the use of semantically consistent information led to significantly higher recall for both the first-list sentences and the related sentences from the second list.

The primary aim of this experiment was to determine whether the ability of the "consistent" and "arbitrary" subjects to draw inferences was dependent on their ability to recall the previously presented sentences. In order to determine this, a conditional analysis was performed. This analysis involved inference scores, given that subjects had recalled both the initial sentence from Block 1 (whether consistent or arbitrary) and the related sentence from Block 2. The results of this analysis indicated that subjects exposed to the consistent initial sentences made more correct inferences than did subjects exposed to the arbitrary initial sentences, even when differential memory for the premises had been ruled out. The conditional means for the consistent and arbitrary groups were .872 and .506, respectively. The difference between these means was significant [$t(38) = 3.24$, $p < .01$]. Thus, it appears that arbitrary sentences, and the second-list sentences related to them, can be available in memory although subjects may not be able to integrate these sentences and draw inferences from them. Consistent sentences, and the second-list sentences related to them, can be available in memory and can also be effectively integrated so that subjects can draw appropriate inferences.

OVERALL DISCUSSION AND CONCLUSIONS

The present results highlight some important constraints that affect integration and inferential reasoning. First, the results of Experiment 1 show that physical contiguity of related sentences can improve our ability to draw inferences (see also Moeser, 1976). Inference scores for contiguously presented sentences were higher than inference scores for noncontiguously presented sentences regardless of the type of sentence in the first list. Second, it appears that physical contiguity is not the most important factor in improving inferential reasoning skills. The nature of the to-be-learned information also has powerful effects on learning. Semantically consistent first-list sentences led to higher inference scores than did semantically arbitrary first-list sentences, regardless of the manner of presentation. It is important to note that even when consistent sentences were presented in a noncontiguous fashion, the inference scores were higher than when arbitrary sentences were presented contiguously.

The present studies also examined several ways in which the memorability of the to-be-learned information can affect subjects' abilities to draw inferences. An obvious reason why arbitrary information may result in lower inference scores is that subjects may not remember this information as well as consistent information. If prior information cannot be remembered, it is unlikely that it can be effectively integrated with subsequent information so that appropriate inferences can

be drawn. However, the results of Experiment 2 show that differential memory is not the only reason why arbitrary information results in fewer inferences. Even when subjects receiving consistent and arbitrary information were equated on their ability to recall the premises (by using conditional scores), subjects receiving consistent initial information exhibited superior inferential abilities.

Note that the manipulation involving the consistency vs. the arbitrariness of the first-list information (e.g., "The short man stood on the stool" vs. "The bald man stood on the stool") was designed to affect the degree to which subjects could use previously acquired knowledge to understand the significance of each statement. It seems intuitively obvious that relationships that seem arbitrary (e.g., a bald man standing on a stool) will be more difficult to remember than relationships that seem more consistent or less arbitrary (e.g., a short man standing on a stool); our reason for using these types of sentences was not to demonstrate this obvious point. Instead, our decision to use comprehensible yet arbitrary statements stems from the assumption that people frequently confront situations in which factual relationships seem arbitrary. These usually occur when people are trying to learn about new domains and hence lack the knowledge necessary to make seemingly arbitrary relationships less arbitrary. The problem of arbitrariness that is faced by novices is discussed more fully by Bransford, Stein, Shelton, and Owings (1981).

If one assumes that the consistency vs. arbitrariness of relationships can be a function of an individual's previously acquired knowledge, the present results suggest that people's abilities to draw inferences from two different premises is strongly affected by their current knowledge base. Imagine, for example, that a novice reads or hears a message that presents some initial information and then later presents additional information that, when combined with the initial information, can enable the learner to make inferences. The present results suggest that the novice will encounter difficulties if the factual relationships seem arbitrary. First, the novice should have a more difficult time (relative to the expert) recalling the initial set of seemingly arbitrary statements. Second, the novice should have a more difficult time recalling subsequent statements that are related to the initial statements. This facilitation in recall is presumably due to the fact that "experts" can more readily integrate the second set of sentences with those that they learned earlier.

The most important result of the present studies involves the degree to which "experts" and "novices" can draw inferences from two different sources of information that were both recalled. Experiment 2 was designed to assess the degree to which subjects could make inferences, given that they were able to recall statements from the first set and to recall the corresponding statements from the second set. The conditional scores showed quite clearly that the ability to draw appropriate inferences was much higher for the semantically consistent subjects than for the semanti-

cally arbitrary subjects. By analogy, novices may be able to recall sets of propositions and yet have a difficult time relating them to make inferences.

One additional issue worth noting is the question of whether the integration of related premises occurs during the initial encoding of the premises or during the retrieval of those premises prompted by the inference questions. The present results suggest that at least some of the integration occurs during the initial encoding and that, furthermore, the semantically consistent (expert) subjects are much more likely to integrate related premises during the encoding stage than are the semantically arbitrary (novice) subjects. This claim is supported by the finding that free recall for Block 2 sentences was significantly higher for the consistent subjects than for the arbitrary subjects. Note that the Block 2 sentences were identical for each group; the only difference between the two groups was the nature of the sentences presented in Block 1. Thus, it seems that the semantically consistent sentences from Block 1 provided a knowledge base that facilitated the subjects' abilities to effectively encode new, related materials. Note that this finding is similar to that reported by Morris et al. (1979) in their study of prose recall.

The above discussion has certain implications for studies that examine the role of inferences in discourse comprehension (e.g., Thorndyke, 1976). Discourse comprehension is facilitated when people are provided appropriate contexts or frames (Minsky, 1975) that can be used to help understand the meaning of individual sentences and to help relate these sentences. When such frames are not readily available, subjects often generate inferences from a current episode in order to establish some kind of "inferential chain" between the current episode and some earlier frame of reference. This process has been referred to as "bridging" (Clark, 1975).

Whether or not effective bridging occurs can determine how well new material may be comprehended. Data from several studies support this contention. For example, Haviland and Clark (1974) report that the speed of comprehension is increased when new information can be specifically related to previously given information. Hupet and LeBouedec (1977) have used Haviland and Clark's given-new distinction to account for their findings. Hupet and LeBouedec report that the ability of subjects to successfully integrate information from individual premises is a function of the order in which those premises were presented. Integration was enhanced whenever it was easier for subjects to locate the intended antecedent information for each newly presented sentence. Similar results have been reported in studies of discourse learning (e.g., Meyers & Boldrick, 1975). The present study suggests that the "bridging" effect is more likely to be successful when previously given information (or the knowledge structure activated by such information) is consistent with semantic knowledge. When this occurs, both semantic and episodic factors (see Tulving, 1972) can then contribute to the availability and utilization of previous knowledge.

The present emphasis on the relationship between elaborated knowledge structures and inferences also has implications for theories of the development of comprehension abilities. Certain studies suggest that young children are not able to combine pieces of information learned as discrete units (Kendler & Kendler, 1967), whereas other studies suggest that children are in fact able to combine discrete pieces of information if such information is presented sequentially (Moeser, 1976; Paris & Carter, 1973) or if additional contextual information is provided (Riley & Trabasso, 1974). Results such as these indicate that even young children can effectively bridge the gap between new and old information if supplied with sufficient support information.

One implication of this claim is that the ability to integrate discrete sources of information presupposes a certain complexity or richness of the activated knowledge structure. Thus, one would expect certain developmental trends in inferential reasoning related to the complexity of the child's knowledge structures. A study by Paris and Lindauer (1976) examined this possibility. Paris and Lindauer presented 6- to 7-year-old children and 11- to 12-year-old children with both implicit and explicit word prompts in order to assess sentence memory. The two types were equally effective for the older children, but only the explicit cues were effective for the younger children. Furthermore, this difference between the two cues was eliminated by instructing the younger subjects to "act out" the activities described in the sentences. These results suggest that young children do not spontaneously generate "implicit" information that might help them to learn. They are, however, capable of doing so if put in a situation in which additional knowledge of the world is made relevant. The present studies suggest that the richness of children's knowledge may also have strong effects on their ability to integrate separate sources of information and, hence, to perform well on inference tests.

REFERENCES

- BARCLAY, J. R. The role of comprehension in remembering sentences. *Cognitive Psychology*, 1973, 4, 229-254.
- BRANSFORD, J. D., & FRANKS, J. J. The abstraction of linguistic ideas. *Cognitive Psychology*, 1971, 2, 331-350.
- BRANSFORD, J. D., & FRANKS, J. J. The abstraction of linguistic ideas: A review. *Cognition: An International Journal of Psychology*, 1972, 1, 211-249.
- BRANSFORD, J. D., & JOHNSON, M. K. Consideration of some problems of comprehension. In W. Chase (Ed.), *Visual information processing*. New York: Academic Press, 1973.
- BRANSFORD, J. D., STEIN, B. S., SHELTON, T., & OWINGS, R. A. Cognition and adaptation: The importance of learning to learn. In J. Harvey (Ed.), *Cognition, social behavior, and the environment*. Hillsdale, N.J.: Erlbaum, 1981.
- CLARK, H. Bridging. In R. Schank & B. Nash-Webber (Eds.), *Theoretical issues in natural language processing*. Proceedings of conference at the Massachusetts Institute of Technology. Cambridge, Mass.: M.I.T. Press, 1975.
- CRAIK, F. I. M., & TULVING, E. Depth of processing and retention of words in episodic memory. *Journal of Experimental Psychology: General*, 1975, 104, 268-294.
- FOOS, P. W., SMITH, K. H., SABOL, M. A., & MYNATT, B. T. Constructive processes in simple linear-order problems. *Journal of Experimental Psychology: Human Learning and Memory*, 1976, 2, 759-766.
- HAVILAND, S. E., & CLARK, H. H. What's new? Acquiring new information as a process in comprehension. *Journal of Verbal Learning and Verbal Behavior*, 1974, 13, 512-521.
- HUPET, M., & LEBOUDEC, B. The given-new contract and the constructive aspect of memory for ideas. *Journal of Verbal Learning and Verbal Behavior*, 1977, 16, 69-75.
- KENDLER, T. S., & KENDLER, H. H. Experimental analysis of inferential behavior in children. In L. P. Lipsitt & C. C. Spiker (Eds.), *Advances in child development and behavior* (Vol. 3). New York: Academic Press, 1967.
- KINTSCH, W. Memory for prose. In C. N. Cofer (Ed.), *The structure of human memory*. San Francisco: Freeman, 1976.
- MEYERS, L. S., & BOLDRICK, D. Memory for meaningful connected discourse. *Journal of Experimental Psychology: Human Learning and Memory*, 1975, 1, 584-591.
- MINSKY, M. A framework for representing knowledge. In P. Winston (Ed.), *The psychology of computer vision*. New York: McGraw-Hill, 1975.
- MOESER, S. D. Inferential reasoning in episodic memory. *Journal of Verbal Learning and Verbal Behavior*, 1976, 15, 193-212.
- MOESER, S. D., & TARRANT, B. L. Learning a network of comparisons. *Journal of Experimental Psychology: Human Learning and Memory*, 1977, 3, 643-659.
- MORRIS, C. D., STEIN, B. S., & BRANSFORD, J. D. Prerequisites for the utilization of knowledge in the recall of prose passages. *Journal of Experimental Psychology: Human Learning and Memory*, 1979, 5, 253-261.
- PARIS, S. G., & CARTER, A. Y. Semantic and constructive aspects of sentence memory in children. *Developmental Psychology*, 1973, 9, 109-113.
- PARIS, S. G., & LINDAUER, B. K. The role of inference in children's comprehension and memory for sentences. *Cognitive Psychology*, 1976, 8, 217-227.
- POTTS, G. R. Information processing strategies used in the encoding of linear orderings. *Journal of Verbal Learning and Verbal Behavior*, 1972, 11, 727-740.
- POTTS, G. R. Storing and retrieving information about ordering relationships. *Journal of Experimental Psychology*, 1974, 103, 431-439.
- RILEY, C. A. The representation of comparative relations and the transitive inference task. *Journal of Experimental Child Psychology*, 1976, 22, 1-22.
- RILEY, C., & TRABASSO, T. Comparatives, logical structures, and encoding in a transitive inference task. *Journal of Experimental Child Psychology*, 1974, 17, 187-203.
- ROSENBERG, S. The recall of verbal material accompanying semantically well-integrated and semantically poorly-integrated sentences. *Journal of Verbal Learning and Verbal Behavior*, 1969, 8, 732-736.
- SMITH, K. H., & FOOS, P. W. Effect of presentation order on the construction of linear orders. *Memory & Cognition*, 1975, 6, 614-618.
- STEIN, B. S., MORRIS, C. D., & BRANSFORD, J. D. Constraints on effective elaboration. *Journal of Verbal Learning and Verbal Behavior*, 1978, 17, 707-714.
- THORNDYKE, P. W. The role of inferences in discourse comprehension. *Journal of Verbal Learning and Verbal Behavior*, 1976, 15, 437-446.
- TULVING, E. Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of memory*. New York: Academic Press, 1972.

(Received for publication June 5, 1981;
revision accepted December 28, 1981.)