

The Effect of Message Structure
on Inference Making in Recall

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One frustration many communicators face is the distortion of their messages by the receivers. This distortion often shows up when a receiver recalls the message and the recall includes inferences which the receiver has integrated into the message. Inferences occur when individuals add, delete, or reorganize a message in such a manner that the meaning of the original message is changed. A possible explanation of why inferences occur may be found in the interaction between the stages of encoding and decoding information. As information is encoded it seems to be integrated into and affected by the person's memory system. One way information is integrated into the existing memory structure is by schematic processing.

Schematic processing is a memory process which utilizes schema (schemata). Bartlett (1932) used the term schema to refer to the central cognitive structure in perception. In this capacity, schema acts as an intermediary between the encoded message and recall. As such, schema provide a plan or map for perceiving incoming information (Miller, Galanter, and Pribram, 1960). Thus, schema are large units of knowledge that organize much of what individuals know about the world around them. As these large units of knowledge, schema establish sets of expectations for incoming information. These expectations are formed as a person learns about the surrounding world. As a person observes a particular event occurring in the same way over and

over, the individual develops a set of expectations or schemata for that particular event. One schemata which is discussed further in this paper causes people to expect information to be presented in a particular sequence. This expectation is especially applicable to information in story form.

During schematic processing, the incoming information is perceived and categorized according to the appropriate schema or schemata. However, the system can only work with the message as it is presented. Unfortunately, the message which is recalled is not the same as the original message, thus indicating that something happens to the message between encoding and recall. One possible explanation is that an interaction occurs between the original message and the receiver's schemata for that type of information. As the system perceives and integrates the messages into memory, the schema probably determines what is stored and recalled by making the encoded information fit the expectations of the appropriate schemata. Research suggests that this type of schematic processing does indeed occur.

The evidence indicates that during schematic processing, some inferences are created as messages are first comprehended (Glaesser, Robertson, and Anderson, 1981). Other researchers feel that a foundation exists in memory for constructing conceptual representations which include both information that was truly in the message as well as inferences about the message (Schank 1973 and 1975; and Schank and Abelson, 1977). This evidence strongly suggests that the message and the receivers schema do interact and that the interaction, itself, determines

what is remembered.

This study examines the interaction of a particular type of message, story, and schematic processing in an attempt to find if the interaction between the two can explain how information distortion in the form of inferences occur in some messages.

Before the problem can be addressed, each segment of the problem needs to be explored. The discussion of the first segment inferences, attempts to explain why and when inferences occur. The second segment discusses the encoded message or story structure in order to find if some relationship exists between the encoded message and recall.

Inferences

Inference can be defined as the process by which an individual tries to represent incoming information in a well-defined structure. (Schank, 1975). During this process inferences fill gaps in the structure of incoming information (slot-filling) and connect events in the structure with other events in order to provide a higher level of organization (text connection).

Researchers feel that the slot filling, connecting and predicting functions of inferences are made with various types of inferences which occur with such regularity that they can be placed into two general categories (Warren, Nicholas, and Trabasso, 1979). The first category is logical inferences. Inferences in this category predict forward or connect things from the past. Logical inferences answer the questions "why" and

"how." Value inferences are the second category. These inferences are evaluative judgments on the actions of characters, intentions of the sources, or the validity of the events. Regardless of the function of the inferences, they seem to occur in certain points of a message.

One place inferences occur is in the listener's integration of pieces of information. To test this notion, Bransford and Franks (1972) presented a group of sentences to some subjects. The stimulus sentences were all related and were presented in groups of either 4 simple sentences or combinations of 2 or 3 simple sentences:

- a. The ants are in the kitchen.
- b. The ant ate the jelly.
- c. The jelly was sweet.
- d. The jelly was on the table.
- e. The ants in the kitchen ate the jelly.
- f. The ants in the kitchen ate the sweet jelly.

After hearing the sentences, the subjects were asked to identify sentences which they had heard and sentences which they had not heard. In many cases subjects claimed that they had heard sentences which combined four simple sentences when, in actuality, none of these were present in the stimulus. Other research has confirmed Bransford and Franks' findings (Paris, 1965; Paris and Carter, 1973; Paris and Lindauer, 1976). These findings suggest that information is integrated during memory. As the information is integrated, inferences are made and become a spontaneous part of the reconstruction of information in memory.

Still another reason inferences occur may be the presence of an incongruity in a message. Research shows that the presence of a mild inconsistency in a message will cause a receiver to make an inference in order to attain consistency (Taylor and Crocker, 1979; Kintsch and Van Dijk, 1979).

All of the inference research discussed in this paper suggests that some relationship exists between the structure of the original message and the production of inferences in recall. To further explore this notion the effect of the original message on recall will be explored.

Story Structure

When a group of sentences form a wholistic idea -- a story -- an underlying organization holds the sentences together. This underlying structure is called story structure and represents an idealized internal relationship between the parts of the story (Mandler and Johnson, 1977). According to Mandler and Johnson (1977) the structure of a story provides a framework for comprehending the story. In this capacity, story structure functions to

1. direct attention to certain aspects of incoming material.
2. help the listener keep track of what has gone before. In this capacity the story structure provides a summary that increases the predictability of what information will immediately follow.
3. tell the listener when some part of the story is complete and can be stored, or is incomplete and must be held until more material is encoded.

Research has verified these functions. Bartlett (1932), a pioneer in the study of story structure, felt that the original form of a message influences how a receiver stores and recalls that message. He found that his subjects recalled stories much easier when they were presented in an organized format. This same finding has been repeated by others (Rumelhart, 1975; Mandler, 1978; Mandler and Johnson, 1977).

In order for a story structure to aid the recall of a story, certain elements (nodes) of the story must be present. The most important story nodes seem to be a setting, a goal, a beginning, a simple reaction, an attempt, an outcome, and an ending (Freedle and Hale, 1979; Stein and Glenn, 1979; Mandler and Johnson, 1977). Paris and Upton (1971) found that these categories could be collapsed into more general categories with cause and consequence categories being most important. Two additional general categories derived from the above list are setting and event (Mandler and Johnson, 1977). When one or more nodes was missing the story was difficult to recall. This was especially true if the cause node was missing. Story structure, then, does indeed have a strong influence on what is recalled.

Research Questions

The discussions of both inferences and story structure, indicate that a strong relationship exists between the encoded message and recall. Based on the research cited one can postulate that inferences occur when information is missing from the structure of a story or when the story nodes are not congruent with each other. Other questions, however, arise from these two generalizations.

1. If one story node is manipulated, will the recall of other story nodes be affected?
2. Since the cause node seems to be more important than other nodes, will the manipulation of a cause node create more inferences than the manipulation of other nodes?
3. Will the presence of an incongruency in a story create inferences in story nodes other than the incongruent point?

To address these questions, the following hypotheses have been developed.

- H₁: The deletion of a story node will cause inferences to occur in the recall of the story.
- H₂: Deletion of the cause node will cause more inferences than the deletion of a consequence node.
- H₃: The presence of an incongruity will cause inferences in the recall of all story nodes.

Methodology

In order to test the three hypotheses, this study presented a set of 3 stories to a group of subjects. The stories were all communication case studies which had been carefully parsed into background, cause, event, and consequence. Background was defined as information providing the setting of the story presented in the case study. The cause was the reason for the main action in the story. The main action, itself, was labeled the event. The final node, the consequence, was the result of the event.

Subjects

The subjects used in this study were 152 students enrolled in the basic communication course taught at the University of Oklahoma.

Data Gathering

The subjects were divided into 4 groups. Each group heard three stories presented via a video monitor in the classroom. The same individual presented the three stories in each of the four experimental conditions. The four experimental conditions involved different manipulation of store structure. Group 1 heard condition 1 (CA) in which stories were missing the cause node. The consequence node was deleted in condition 2 (CQ) for Group 2. The third group heard condition 3 (IC) which contained an incongruent conclusion. The final group heard condition 4 (UA) in which the stories had no missing or manipulated nodes.

Two days after the students heard the stimulus material, a questionnaire over the stories was given to the students. The questionnaire contained 4 questions over each story. One question addressed the cause node (cause), one the consequence node (consequence), one the possible incongruency (congruency), and the fourth addressed either the background or the event (filler).

Statistical Analysis

The recall scores (number of correct responses) and the inference scores (number of inferential responses) were submitted to one-way ANOVAs, Hotelling's T Squares and selected student's

t-tests. A .05 level was required for significance in all data analysis.

Results

To test the hypothesis about the deletion of story nodes, three methods were used. First of all, the recall scores for the CA, CQ, and UA groups were computed. (The UA group is considered a baseline group for the purpose of comparison.) One-way ANOVAs were computed on the mean recall scores for the CA and CQ groups to test the main effect of the experimental manipulation. Significant ($p < .001$) F values of 26.31 (with 3 df) for the CA group and 18.88 (with 3 df) indicated that the story manipulations were indeed affecting recall.

To find if more inferences were occurring in the experimental conditions Hotelling's T Squares were computed between the means of the inference scores of the UA (baseline) group and the CA and CQ groups, respectively. Significant ($p < .001$) F values of 38.69 and 8.21 (with 3 df) showed that more inferences did indeed occur in the recall of the manipulated stories. Selected t-tests showed that these inferences occurred in certain places. In the CA condition significantly more inferences occurred on the cause question ($\underline{t} = 10.29$; $df = 56$; $p < .01$). More inferences also occurred on the congruency question ($\underline{t} = 2.03$; $df = 61$; $p < .047$). In the CQ condition significantly more inferences occurred on the consequence question ($\underline{t} = 4.76$; $df = 73$; $p < .001$) and the congruency question ($\underline{t} = 3.05$; $df = 70$; $p < .003$).

The second hypothesis says that the deletion of the cause node will produce more inferences in recall than the deletion of the consequence node. A Hotelling's T Square ($F = 32.45$; $df = 3, 71$; $p < .0001$) showed a significant difference in the mean inference scores of the two groups.

The third hypothesis postulates that an incongruency will cause inferences in all story nodes. To test the hypotheses a Hotelling's T Square ($F = 6.29$; $df = 3, 71$; $p < .001$) was performed on the mean number of inferences made in the IC and the UA groups. Individual t -tests were performed on the mean inference scores of each of the three questions. Significance was found between the means of the consequence question ($t = 3.40$; $df = 70.8$; $p < .001$) and the congruency question ($t = 2.01$; $df = 68.8$; $p < .049$). No significant differences was found between the groups on the cause question ($t = .74$; $df = 72.4$; $p < .46$).

Discussion

The data analysis shows that certain manipulation of story structure lead to the production of inferences in recall, thus supporting the hypothesis presented. The data supports the proposition that subjects will infer information which is missing in the story structure of the stimulus material. This finding was true for deleting both the cause and consequence nodes. When the cause node was deleted more inferences were made in the recall of the stories than when the consequence node was deleted, thus supporting the second hypothesis. The third hypothesis said

that the presence of an incongruity in a story would lead to more overall inferences in recall. A comparison of the group mean inference scores of the IC and UA groups supported the hypothesis. Thus, finding the notion that subjects will make inferences in order to make the story nodes congruent in recall.

Seemingly all three hypotheses were verified by the data. However, an inspection of the results and the overall study reveals that the interpretation of the results must be limited and that more questions need to be addressed.

Even though the data supported the second hypothesis that more inferences occur in the CA group than the CQ group, an examination of the data reveals that the interpretation must be qualified. Individual t-tests performed between the mean number of inferential responses to each experimental question type (cause, consequence, and congruent) in both the CA and CQ groups reveals that the significance was caused by one node. Table 1 shows the mean inference scores for each group. The t-tests

TABLE 1

		Question Type		
		Cause	Consequence	Congruent
Group	CA	2.48	.57	.85
	CQ	.67	1.69	1.07

revealed that the CQ group made significantly more inferences in response to the consequence question. The CA group, on the other hand, made significantly more inferences in response to

the cause question. However, more cause inferences were made by the CA group than consequence inferences by the CQ group. This result then supports the notion presented earlier in this paper that the cause node of a story is more important to a receiver's story schema than the consequence node. However, the conclusion that the manipulation of the cause node leads to more inferences in all story nodes can not be supported at this time.

An examination of the instrument used in this study reveals that the instrument is inadequate to test the second hypothesis. The questionnaire was composed of only 4 questions. One question addressed each of the 3 nodes which were manipulated in the study. The fourth question was a filler question and addressed different story nodes. In order to truly test the second hypothesis, the questionnaire must address all story nodes in all stories, not just three nodes.

The third hypothesis was also supported since the IC group did make significantly more inferences overall than did the UA group. However, a look at the responses to each question shows that the difference in the two groups was caused by the mean number of inferential responses to the consequence question and the congruency question. Both questions, of course, address the same story node, the consequence. An examination of the cause question shows that there was no significant difference in the number of inferences made in response to that question ($p < .46$). A look at the mean number of inferences; in fact, shows that more cause inferences occurred in the UA group (means, IC = .60; UA = .73).

The last finding generated some further questions about the effect of the manipulation of story structure. If one node of a story is manipulated, will this, in fact, cause fewer inferences in other story nodes? In order to address this question, the researcher reinspected the data and found some interesting possibilities.

In the CA group the mean number of inferential responses to the consequence question was .57. The UA group made an average of .67 inferential responses to the same question. The CQ group averaged .66 inferences in response to the cause question, whereas the UA group averaged .72 inferences. In the incongruent condition, the IC group averaged .60 cause inferences compared to an average of .73 cause inferences for the UA group. Although none of the comparisons between the means reached statistical significance, they do suggest a possible story structure effect which needs to be explored in future research. The manipulation of one node may cause a listener to more accurately remember the other nodes of the story.

Implications

This study points to several areas which need further research. First of all, in order to test the effect of the manipulation of one story node on the recall of other nodes, a more sensitive instrument needs to be developed. The instrument should tap all nodes of the story, not just two as did the instrument used in this study.

The second suggestion for future research is to explore the possibility that the manipulation of one story node causes the subject to more accurately recall other story nodes.

Future research also needs to expand the scope of this study beyond stories to other forms of messages, such as regular expository presentations. Only when research can tap the effect of message structure on the recall, including the making of inferences, of all message types can it truly address how inferential information distortion occurs in recall.

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