

Reconstructive and Reproductive Processes in Memory

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Current views of prose memory argue that memory inaccuracies in the retelling of a complex event occur in part as the result of a storage deficit induced by the abstractive and assimilative aspects of prose processing. This view appears to contradict a large portion of the memory literature that shows, over long intervals, remarkably accurate recall. A perspective, based on an elaboration of Underwood's attributes model of memory, is advanced which proposes that for all types of information both detailed and thematic attributes are stored. Consequently, the type of recall one sees, whether reconstructive or reproductive in nature, depends in part upon events that occur at the time of the request for recall. Two experiments using prose passages as stimulus materials with retention tested by free recall support this perspective. Subjects were treated identically until the test of recall, when two sets of procedures were introduced, one that led subjects to reconstruct the story and one that led subjects to reproduce the story.

Probably the most widely held views about the processes involved in memory for linguistic materials are lineal descendants of Bartlett's (1932) original proposal of a reconstructive memory process. Bartlett argued that memory for complex materials, such as a folktale, consists of a general impression (schema) together with a few abstracted details which can be used to reconstruct the original message. Recall from such a memory base is of course likely to contain little in the way of verbatim productions—and quite a lot in the way of paraphrase, of integration of originally separate concepts, of inferences consistent with

those story concepts, and also of elaborations upon story material made by confusing one's general knowledge on the topic with one's specific knowledge of the target situation (Bransford, Barclay, & Franks, 1972; Pompi & Lachman, 1967; Sulin & Dooling, 1974).

From a constructivist perspective, memory inaccuracies originate largely as a storage deficit: the result of the abstractive and assimilative processes that occur as complex information is being presented. Thus details such as syntax and simple sentences are not remembered because shortly after they are comprehended, they are assimilated into summary structures which integrate separate concepts within the story and also integrate these with one's knowledge of the issue at hand (Bransford & Franks, 1971; Sachs, 1967). Indeed, extremely poor recall may be seen in situations in which the subject lacks sufficient general information with which to integrate the new information (Bransford & Johnson, 1972, 1973) and the deficit appears to be irreversible; information that could have facilitated assimilation of the passage when presented

This research was supported by National Institute of Mental Health Grant MH 27755. We wish to thank Norman Spear, James Larimer, Karen Krog, Joyce Iavecchia, and Marlane Edelman for their assistance at various stages of this project. The preparation of this article benefited from comments on an earlier draft that were made by Rose Zacks, Ruth Maki, Bonnie Strand, and Benton Underwood, and by an anonymous reviewer.

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prior to it does not when presented after the passage (Bransford & Johnson, 1972).

Although the constructivist position has attained center stage in our conceptualization of the processing of complex materials, it does not, as Cofer, Chmielewski, and Brockway (1976) have suggested, form an easy amalgam with another body of the memory literature which appears to demonstrate recall that can be remarkably accurate—or reproductive. Extremely low intrusion rates are found in a set of tasks (e.g., free recall, paired-associate learning) when relatively simple materials are used. This is the case even when there is an interval as long as 2 weeks between presentation and recall. The operation of a *selector mechanism* (Underwood & Schulz, 1960) has been postulated to account for this phenomenon. Further, in situations characterized by extensive forgetting (e.g., retroactive interference), there are some circumstances in which those memory losses can be minimized. These include cuing at recall (Tulving & Psotka, 1971) and successive attempts at recalling the same material (e.g., Richardson & Gropper, 1964).

Such studies suggest that memory can hold a wealth of details and that memory losses are often the product of circumstances prevailing at retrieval, rather than at storage. It might be tempting to dismiss the relevance of these findings for prose memory by arguing that reproductive processes operate only for simple material while reconstructive processes operate for prose. Such an argument would be undermined, however, by evidence which suggests the existence, on the one hand, of *reproductive* recalls of prose materials, and on the other, of *reconstructive* recalls of simple materials.

With regard to prose it is clear that actors do not reconstruct their lines, nor apparently did John Dean who, at the United States Senate hearings on the Watergate break-in, showed accurate memory for conversation, as later confirmed by tape recordings. Indeed, as Tzeng (1975) and Cofer et al. (1976) have pointed out, there is evidence even within the constructivist tradition of verbatim memory for sentences

(Bransford & Franks, 1971; Sachs, 1967), and of accurate, if abbreviated, recall of prose (Brockway, Chmielewski, & Cofer, 1974; Cofer et al., 1976; Gomulicki, 1956; Zangwill, 1972; also see Rubin, 1977).

With regard to the processing of simple verbal units, there is evidence for the occurrence of abstraction, integration, and assimilation, the most frequently discussed phenomena in prose processing. For example, subjects abstract a functional stimulus from a nominal one in a variety of learning tasks (e.g., Richardson, 1972; Underwood, 1963), and of course, abstract some items from a supraspan list to learn before others. Subjects actively rearrange single words into clusters either based upon widely shared preexisting knowledge (e.g., Bousfield, 1953) or upon some subtle subject-detected structure (Earhard, 1967; Tulving, 1962). There is also a set of circumstances in which subjects assimilate explicitly presented events with implicitly occurring responses (thoughts) and subsequently confuse the two (e.g., Anisfeld & Knapp, 1968; Johnson, Taylor, & Raye, 1977; Underwood, 1965).

Thus the solution of differential mechanisms underlying the memorial processes for simple verbal units as compared to complex units may be unwarranted. A perspective is needed that can account for both reconstructive and reproductive memory operations occurring for both simple and complex materials (see Dooling and Christiaansen, 1977, for a similar argument). This perspective should specify the same operations underlying all manner of verbal stimuli. Such a perspective is here proposed and tested.

Underwood (1969) suggested that memory for an event consists of a set of *attributes* or aspects of that event. Certain of these attributes are thought to play a major role in recall, while others have their major influence in recognition. As conceptualized by the model, the process of recall consists of gaining access to the cluster of attributes that represent that event. The *discriminative* attributes may be used to distinguish between attributes that represent the actual

event and others which represent reflections (thoughts, implicit associations) on those events. The occurrence of errors of commission, which in the literature have been variously termed assimilation, integration, or the failure to discriminate between fact and fantasy, is produced by the failure to discriminate between attributes representing the event itself and attributes representing reflections on the event.

With a slight elaboration, this model can be extended to account for the constructive aspects in the recall of prose materials. While it is possible that an analysis of prose from this perspective will reveal a number of attributes not yet specified, the present analysis is limited in its concern to thematic or topical codes. The concept of a *theme* has been used widely in the literature on prose memory (e.g., Sulin & Dooling, 1974). Most recently, it has been used in an attempt to write a grammar for narrative discourse (Thorndyke, 1977). In this grammar, a theme is considered to be one of the four elemental components of all stories and is defined as the "general focus to which the subsequent plot adheres" (Thorndyke, 1977, p. 80). This may be analogous to a category name or superordinate that serves to tie a particular event or episode to related and preexisting knowledge, presumably stored in semantic memory (Tulving, 1972). This thematic code is the keystone to the recall process as explained below.

A second assumption must be made in order to account for reconstructive recall: Attributes differ in their accessibility. Over time, they differ either in the rate at which they are forgotten (e.g., Bregman, 1968) or else in the ease with which they are retrieved. Such an assumption is not terribly radical in light of a recent demonstration of the independence of at least some attributes (Galbraith, 1975). In particular, it is likely that the thematic attribute is highly retrievable—probably because it benefits from both frequent and distributed occurrences (thoughts or rehearsals) during the presentation of any cohesive message. Other attributes (e.g., the beginning of the

passage and salient details) that receive similar processing will also be accessible.

When a subject is instructed to recall, the most easily accessible attributes occur to him relatively rapidly. It is the deployment of these attributes that determines whether recall is reconstructive or reproductive in nature.

In reconstructive recall, the event's thematic code makes contact with one's general knowledge concerning that topic and is used together with whatever other event and reflection attributes are easily available (e.g., the context, the beginning of the story) to construct the original event. Under these circumstances, no special effort is expended in an attempt to retrieve the weaker detailed attributes. As a result, what looks like substantial amounts of forgetting of details will be seen along with generations tied to the theme. Such constructions are likely to occur whenever the conditions of testing do not specify the importance of accuracy (Brockway et al., 1974; Gauld & Stephenson, 1967). This of course is the most common situation in which we remember prose materials.

In reproductive recall, the event's thematic code makes contact with the detailed attributes that typically guide immediate recall but that are less accessible, if only by virtue of their lesser relative strength after a time interval. Special circumstances are required for their elicitation. Two such circumstances might be the provision of additional retrieval cues and effort on the part of the rememberer. The retrieval cues may be provided by the environment (context, sensory cues), or they may be provided by the recaller (perhaps as a result of successively probing his memory).

A summary of the proposed perspective follows: In the course of learning any verbal event, a subject acquires a great deal of information. For complex materials, this includes the theme, a verbal representation of the general topic. It is the theme which is the attribute with the greatest memory strength and which thus has the highest probability of being remembered after some time interval. If this attribute, together

with others including those representing salient details, constitute the majority of elements in the retrieval pool, then recall will be reconstructive in nature: Details will be few, and inventive constructions, based on general knowledge about the theme, will be many. If, however, additional attributes are included in the retrieval pool, because of special instructions or motivation, recall will be reproductive in nature. Relative to the reconstructive production, more of the original information will be present, and thematic constructions will be minimal.

Since, according to this perspective, memory for prose includes both thematic and detailed attributes, the conditions prevailing at the time of recall will be critical determinants of the type of recall protocol one observes. If this perspective is correct, one should be able to produce evidence of either reproductive or reconstructive recall after a retention interval for subjects who have had identical learning experiences. The present experiment reports such a finding.

Experiment 1

In this experiment a subject read one of two prose passages and then recalled it after a 5-min, 2-day, or 1-week interval. The passages were written in such a way that each sentence and the sequence of actions specified by the sentences were an appropriate and ambiguous description of two different events. One passage described a man in the woods who was either on a hunting trip or escaping from prison. The other described a long voyage, either that of Columbus or else of an early manned trip into space. A subject was presented with one of the two appropriate titles at the time he read the passage. It was our assumption that the title would guide the subject to derive a theme code close in meaning to that title.

The critical manipulations involved instructions introduced after the story was read. These were designed to influence whether or not the subject relied extensively upon the thematic code to guide his recall. We expected *reconstructed* recalls when subjects used the thematic attribute.

To induce reliance upon the theme code, subjects were provided at the time of recall with the original title of the story (*same-theme* conditions). According to the model, and consistent with other findings (e.g., Bartlett, 1932; Sulin & Dooling, 1974), we expected these subjects to show a decrease in accurate recall over the retention interval and an increase in the proportion of thematic intrusions, evidence for the process of reconstruction.

We expected reproductive recall under circumstances that would reduce reliance upon the thematic code. The procedure adopted was to tell subjects sometime after reading the story that a procedural error had occurred when they were originally given the title of the story. The experimenter expressed dismay and was apologetic about the error. The subject was then provided with the correct title, the alternative that was also appropriate to the story (*different-theme* conditions).

We believed that such a procedure would lead the subject to discard the thematic code he had originally adopted. He would not use it to generate related information from semantic memory. Rather, he would use it to edit out responses appropriate only to that original theme. Lacking the original theme to generate recall material and so lacking in easily available information to produce at recall, the subject is more likely to retrieve the less available content attributes. Two major differences between the recall protocols of the same- and different-theme subjects would then be expected. The first is a reduction in the number of thematic intrusions made by different-theme relative to same-theme subjects. This would be the result of less generation and careful editing on the part of the different-theme subjects. The second difference represents a critical test of the perspective proposed in this article, as well as a counterintuitive prediction: different-theme subjects should recall more of the actual material in the passage than same-theme subjects. This would be the result of the retrieval of less accessible attributes by different-theme subjects.

Table 1
Titles and Initial Paragraph of Each Passage

Titles	Initial paragraph
Passage A	
Going Hunting An Escaped Convict	The man walked carefully through the forest. Several times he looked over his shoulder and scrutinized the woods behind him. He trod carefully, trying to avoid snapping the twigs and small branches that lay in his path, for he did not want to create excess noise. The gay chirping of the birds in the trees almost annoyed him, their loud calls serving to distract him. He did not want to confuse those sounds with the type he was listening for.
Passage B	
Columbus Discovers a New World First Trip to the Moon	The voyage was long and the crew was full of anticipation. No one really knew what lay beyond the new land that they were heading for. There were, of course, speculations concerning the nature of the new place, but this small group of men would be the only ones who would know the real truth. These men were participating in an event that would change the shape of history.

Method

Design. The experiment was originally conceived of as a 3 (instructional conditions) \times 3 (retention intervals) factorial design. Subjects in the same-theme condition were provided with the same title when they read the story and again when they recalled it. These subjects were expected to show reconstructive recall. Subjects in the different-theme condition were provided with one theme when they read the story and another theme (the alternative theme) when they recalled it. With this invalidation of their thematic code, these subjects were expected to show reproductive recall. Subjects in a third instructional condition, different-theme-immediate (the former will now be called different-theme-delay) were provided with one theme when they read the story and another immediately after they finished—rather than at recall as in the different-theme-delay condition. This third condition was initially included to determine whether subjects who have had one thematic code invalidated would actually adopt an alternative thematic code and use it to generate their recalls. In so doing they would show reconstructive recalls that are based on the second and presumably more valid theme. Such a finding would provide evidence of the phenomenon of retrospective reinterpretation, an after-the-fact recoding of an event originally interpreted in some other way.

For all three instructional conditions, retention was tested at one of three intervals after subjects finished reading the story: 5 min, 2 days, or 1 week.

Materials. Two unique prose passages were constructed in such a way that each was an appropriate description of an event that could be sensibly labeled by two different titles. The first paragraph and the two themes of each story are

shown in Table 1. Story A was 22 sentences in length, divided into 5 paragraphs. Story B was 28 sentences in length, in 6 paragraphs. Each story was typed double-spaced on white paper. With each story having two themes, there were four unique sets of materials.

Forty pilot subjects were used to validate the requirement that each story be a compelling version of its two titles. Ten subjects then read one of the four sets of materials. In conversation with the experimenter, no subject spontaneously mentioned the alternative theme. Apparently, the two sets of materials did seem to be acceptable versions of events that could be described by two different titles.

Procedure. When subjects arrived for the first portion of the experiment, they were told that they were about to participate in a study that examined how people comprehend and remember different types of short stories. Before the subject was handed a copy of the passage he was to read, he was instructed that he could read it through at his own rate but that he should be careful and attentive during the reading because sometime later he would be asked to write down as accurately as possible everything he could remember about the story. He was then handed the story, and the experimenter told him the title appropriate to his condition. The subject was not disturbed until he finished reading.

For each subject in the different-theme-immediate condition, the alternative theme was introduced immediately after he finished reading the passage. The experimenter began to thank the subject, consulted her records, appeared surprised, then shocked, and apologized for the mistake she had made. The subject was told that the title he had been given was a mistake and was then given the correct (or alternate) title. To maximize the credibility of the accident, the experimental room

was maintained in a state of disarray. The second theme was the one subjects were reminded of just prior to recall.

For subjects in the different-theme-delay condition, the theme change was effected, using the same guise, just prior to the test of recall. Subjects in the same-theme condition were provided with their original theme also just prior to their attempt to recall the story.

Subjects tested at the 5-min interval were then engaged in conversation with the experimenter, while subjects in the 2-day and 1-week conditions were dismissed. At the test of recall, the subject was given a blank sheet of paper and was told to write down as much of the passage as he possibly could and to do it as close to the original as possible.

All subjects were tested individually. Subjects were assigned to each of the nine experimental conditions using a randomized-blocks procedure. Within each of the nine conditions, the two passages were used equally often. Within each of the six different-theme conditions—3 (retention intervals) \times 2 (times at which the change was introduced)—each of the two titles was used equally often as the first, and consequently as the second, theme assigned. Within each of the three same-theme conditions, each of the two titles for each story was used equally often. With 12 subjects in each condition, each story was used for 6 subjects, and each theme, or theme order, was used for 3 subjects.

Subjects. All subjects were undergraduate students who participated in this experiment in order to fulfill a requirement for an introductory psychology course. All subjects were given feedback about the nature of the experimental issues. In addition, they were informed about the need for and importance of the mild deception involved in switching themes. The feedback was not provided until the end of the semester in which the subject participated because we found in pilot work that students found this particular experiment a topic of interest to be shared with their colleagues. A total of 108 subjects fulfilled the requirements for the experiment. Subjects who failed to return on schedule for their second appointments were discarded from the experiment.

Results and Discussion

Scoring procedures. Because we were interested in how much of a subject's production was an accurate reflection of the original story and also how much of the production was an elaboration, either theme-based or not, we decided to use the *idea unit* (e.g., Bransford & Johnson, 1972) as our dependent measure. Thus each story was divided into idea units that corresponded to individual sentences, basic semantic proposi-

tions, or phrases, as deemed appropriate. These idea units were agreed upon by two experimenters. Passage A contained 37 idea units, and Passage B contained 42. The idea units were then used as the criteria against which to measure both accurate recall and intrusions.

Scoring was done independently by two raters who were blind with respect to the subject's particular condition (same theme or different), the original and second theme provided, and the length of the retention interval. The scorers were not blind with respect to which story (A or B) a subject had received; this was judged an impossibility, as most subjects produced, as their first sentence, a version of the first sentence of whichever story they had read. Recall of idea units, the measure of accuracy, was done leniently: Paraphrases were allowed if they were judged to express the same meaning as the idea unit. An example of an acceptable version of the first sentence of Story A is as follows: "A man was walking through the woods, taking care as he went. . . ." This particular criterion was adopted for two reasons: (a) Accuracy of prose memory is usually considered to refer to meaning, not exact wording (e.g., Cofer, 1977; Thorndyke, 1977); (b) it biased the scoring procedure against our predictions. If paraphrases were considered as correct, (a) there would be few productions remaining to be classified into the intrusion categories and so it would be difficult to observe reconstructions; and (b) a substantial difference in idea-unit recall would be required in order to observe the hypothesized difference between the same-theme and different-theme-delay conditions.

It should be noted that if the first sentence of Passage A were recalled as "The escapee walked carefully through the woods . . .," the subject would receive credit for recalling the first idea unit as well as for making a theme-related intrusion. The alternative would have been to score this production as an intrusion. If the latter procedure had been adopted, differences in idea-unit recall and in theme-related intrusions between the same- and different-theme subjects could

Table 2
*Interrater Reliability Correlations for
Four Categories of Responses*

Pas- sage	Response category			
	Idea units	Intrusions		
		First theme	Second theme	Neu- tral
A	.92	.86	.79	.76
B	.96	.96	.86	.82

have been the result of subjects in the *same* condition using specific referents (e.g., "the explorer," "the hunter") and subjects in the *different* conditions using less particularized descriptions (e.g., "he," "they"). The alternative adopted, counting such a production as containing both an idea unit and an intrusion, precludes such a trivial change in production strategy from producing the critical and predicted results.

Anything present in the subject's production that was not on the idea-unit listing was considered an intrusion. Intrusions were classified into three categories: They were relevant to one theme, to the other theme, or else they were neutral in the sense that they were irrelevant but not inappropriate to both. There were no intrusions that were nonsensical.

Interrater reliability correlations were calculated for each scoring category based on the protocols of a random sample of 48 subjects from the experiment, 24 who read passage A and 24 who read passage B. These are presented in Table 2. These reliability measures were judged to be sufficiently high to allow the two raters to continue scoring using the existing criteria and then to allow them to resolve discrepancies by reaching a consensus. Only after this procedure was completed were the protocols separated into groups representing the major conditions of the experiment. The following dependent measures were taken from the corrected scores: the proportion of idea units recalled (proportions were used because the two stories did not have the same number of idea units); the number of in-

trusions related to the first theme (or only theme in the same-theme conditions); number of intrusions related to the second theme (presented only in the different-theme conditions); number of neutral intrusions. Subsequently, we also considered first-theme intrusions as a proportion of each subject's total production (the number of idea units plus all intrusions).

Different-theme conditions. An initial inspection of the data (see Table 3) showed a startling similarity between the two different-theme conditions, immediate and delay. A 2 (conditions) \times 2 (passages) \times 3 (retention intervals) analysis of variance on the number of idea units recalled showed no main effect of condition, nor did condition interact with other variables. Further analyses of variance on each of the three types of intrusion errors produced the same results. Consequently, for all further analyses, the two different-theme conditions were collapsed into one condition. In all remaining analyses, passage was included as a variable. Because of certain interesting effects observed, these will be discussed in a separate section.

Table 3
*Comparison of Mean Performance for
the Two Different-Theme Conditions on
each of Four Response Categories*

	Response category			
	Proportion of idea units	Number of intrusions		
		First theme	Second theme	Neutral
Recall				
Different theme immediate				
5 min	.33	.42	.00	1.42
2 day	.29	.83	.42	1.17
1 week	.26	.33	.42	1.58
<i>M</i>	.29	.53	.28	1.39
Different theme delay				
5 min	.36	.67	.17	1.25
2 day	.32	.08	.25	.92
1 week	.26	.67	.67	1.58
<i>M</i>	.31	.47	.36	1.25

Table 4

Mean Proportion of Idea Units and Mean Number of Three Types of Intrusions for Experiments 1 and 2

Scoring category	Theme condition	Experiment 1			Experiment 2 ^a
		Retention interval			
		5 min	2 days	1 week	
Idea units	Same	.34	.17	.15	.18
	Different	.35	.31	.26	.24
First theme ^b	Same	2.58	3.50	3.00	2.66
	Different	.54	.46	.50	1.19
Second theme ^c	Same	.17	.00	.25	.06
	Different	.08	.33	.54	.19
Neutral	Same	.92	.75	2.33	3.69
	Different	1.33	1.04	1.58	2.91

^a Retention interval = 1 week.

^b This is the first of two themes for subjects in the *different* conditions and the only theme for subjects in the *same* conditions.

^c This is the second of two themes for subjects in the *different* conditions and a never presented theme for subjects in the *same* conditions.

While thematic intrusions will be discussed later in more detail, it might be noted in considering the results seen in Table 3 that the number of thematic intrusions made by these subjects was quite low; most subjects did not make a single one. In addition, subjects were slightly less likely to make an intrusion related to the second theme they were given than to the first theme. It is clear that once a theme has been invalidated, as the first one was here, an alternative theme is not invoked to guide recall.

Reconstructive recall. A set of studies (Bartlett, 1932; Sulin & Dooling, 1974) led us to expect an increase in the rate of occurrence of thematic intrusions over a retention interval. There were three categories of intrusions: those relevant to the first or else only theme presented for the different- and same-theme conditions, respectively; those relevant to the second or else never presented theme for the different- and same-theme conditions, respectively; those not particularly relevant to either—here called neutral. The mean numbers of each type of intrusion are shown in Table 4 for each condition. Separate 2 (condition) \times 2 (passage) \times 3 (retention interval) analyses of variance were performed on each measure.

As is obvious from Table 4, the two most common error types were those that were related to the first theme and those that were neutral. Intrusions related to the second theme were relatively rare. It is also obvious from the table that the pattern of intrusions differs as a function of whether the subject received one (same) or two (different) themes during the course of the experiment. Subjects in the same-theme condition produced an average of just over three intrusions related to their first and only theme, whereas subjects in the different-theme condition produced fewer than one intrusion related to their first theme, $F(1, 96) = 48.38$, $MS_e = 3.17$. Intrusions related to the alternate theme were rare and occurred at the same rate for the same- and different-theme conditions, despite the fact that subjects in the different-theme conditions had indeed been given the alternative theme ($F < 1$, $MS_e = .38$). Finally, the two groups did not differ in their production of neutral intrusions, $F(1, 96) = 2.05$, $MS_e = 1.93$.

As can be seen in Table 4, there was a slight overall tendency for errors to increase with the retention interval. This effect was significant only for the neutral intrusions,

Table 5

First-Theme and Total Intrusions as a Proportion of Total Production at Three Retention Intervals

Condition	Intrusions					
	First-theme			All		
	5 min	2 day	1 week	5 min	2 day	1 week
Same theme	.16	.32	.24	.22	.38	.46
Different theme	.03	.04	.04	.12	.14	.21

$F(2, 96) = 3.92$. In particular, the expected increase of thematic intrusions did not occur even for subjects in the same-theme condition. While these subjects did show a slight increase in theme-related intrusions between the 5-min and 2-day retention intervals, the increase was not significant.

As a further inspection of intrusion changes with time, both the number of first-theme intrusions and the total number of intrusions were expressed as a proportion of total productions (see Table 5). There is a clear increase in the extent of all intrusions as the retention interval increases, $F(2, 102) = 9.00$, $MS_e = .02$.¹ The proportion of first-theme intrusions shows the expected increase for the same- but not for the different-theme subjects, $F(2, 102) = 3.00$, $MS_e = .02$. This difference confirms those found in earlier studies (Bartlett, 1932; Sulin & Dooling, 1974).

The findings with respect to intrusions are clear: Subjects who are given two titles—and so who presumably have their initial thematic code invalidated—show a different pattern in their generations than do subjects who are presumably free to continue using the only thematic code provided. In particular there is a marked reduction in thematic intrusions for subjects with an invalidated code as compared to subjects with a validated code. The latter group are free to reconstruct, the former are not.

Reproductive recall. The measure of accuracy used in this study was the proportion of idea units present in a subject's recall protocol (see Table 4). There was a substantial difference in performance between the same- and different-theme condi-

tions, $F(1, 96) = 21.25$, $MS_e = 83.21$. For both groups there was a reduction in recall across the time period, $F(2, 96) = 16.46$. And, most important for the proposed perspective, recall declined to a greater extent in the same condition than in the different conditions, $F(2, 96) = 5.04$. It is important to note that the difference between the two conditions was introduced by instructions given after the passage had been read—in some conditions, as long as 2 or 7 days later. The differences in accuracy of recall between the same- and different-theme conditions are differences produced as a subject attempts to regenerate his memory for an event. Indeed, retrieval attempt differences can be so substantial as to result in very little forgetting over the week's retention interval.

It is not reasonable to assume that the negative correlation seen in several places between idea-unit recall and thematic intrusions is the result of the attempt of subjects under all conditions to generate the same total amount of output. Were this the case, one would also see a trade-off with neutral intrusions as well as with the other scoring categories. For the different-theme conditions, there was no increase in neutral intrusions to make up for the decrement in thematic intrusions (see Table 4). Also note that this correlation does not hold at the 5-min retention interval where the same- and different-theme conditions recall the same proportion of idea units, but the dif-

¹ Story was not included as a factor in these analyses because the two differed in number of idea units.

ferent conditions show fewer first-theme intrusions.

Passage differences. In fact, we did find passage differences present for both the accuracy measure and the intrusion measures. The passage effects are presented (Table 6) and discussed separately because they help to reinforce the primary argument we wish to make here: What one sees in the way of recall, whether constructive or productive, will vary with demands placed on the recaller by himself, by the target event, and by the recall situation.

Subjects in all conditions recalled more of the idea units of Passage A (hunter/convict) than of Passage B (Columbus/space voyage), $F(1, 96) = 16.07$, $MS_e = 83.20$. The hunter/convict passage, which received a higher accuracy score, also had fewer first-theme related intrusions than the Columbus/space voyage passage, $F(1, 96) = 6.45$. In addition, the hunter/convict story produced more second-theme intrusions than the other story, $F(1, 96) = 11.79$, although the rate of these was extremely low.

These differences in passage recall resemble the differences seen in our instructional conditions: In each case there was one condition that recalled less of the actual story and also produced more thematic intrusions than the other condition. Thus, passages, too, differ in the likelihood of

eliciting reconstructive versus reproductive recalls. While the factors that determine reconstructive pull remain to be specified, there is the suggestion in the literature (e.g., Dooling & Christiaansen, 1977) that the greater the person's prior knowledge on a topic, the greater the likelihood of thematic intrusions, or of reconstruction.

Experiment 2

Because the results of the first experiment were dramatic and the procedures new, a replication was undertaken. In this second study, the same- and different-theme manipulations were repeated at the 1-week retention interval using a larger number of subjects.

Method

The materials and procedures were identical to those used in the initial study. In this case, however, there were 16 subjects in each of the four conditions produced by the crossing of the theme manipulations (same and different) with the two passages (A and B). Scoring was again performed by two independent raters who used the criteria established for the first experiment. Interrater reliability measures were comparable to those reported for that experiment.

Results

For the sake of comparison, the results of this study are shown in Table 4 along with those from the first study. Again, the same patterns of recall prevailed. Different-theme subjects recalled more of the original passage than did same-theme subjects, $F(1, 60) = 7.00$, $MS_e = .01$. Intrusion patterns were different for the two groups of subjects: Different-theme subjects made relatively few thematic intrusions, same-theme subjects made more, $F(1, 60) = 8.44$, $MS_e = 4.09$. On this occasion, different-theme subjects made more alternative theme intrusions than did same-theme subjects, $F(1, 60) = 5.56$, $MS_e = .19$. Nonetheless, these intrusions were very rare in both conditions.

These results cannot then be dismissed; different subjects, different experimenters, and different scores all resulted in the same

Table 6
*Mean Proportion of Idea Units and
Mean Number of Types of Intrusions*

Theme condition	Idea units	Intrusions		
		First theme	Sec- ond theme	Neutral
Passage A				
Same	.26	2.33	.22	1.83
Different	.34	.19	.58	1.39
<i>M</i>	.30	.90	.46	1.54
Passage B				
Same	.18	3.72	.06	.83
Different	.27	.80	.06	1.25
<i>M</i>	.22	1.77	.06	1.11

unusual patterns of recall, patterns predicted by a framework for prose recall, which suggests that prose memory is comprised of both thematic codes and details of meaning.

Discussion

The procedure of changing themes was introduced to invalidate an initially assigned theme code. It is clear that whether the invalidation of the initial theme is introduced immediately after a story is comprehended or some time up to 1 week later, the results are the same: A subject with an invalidated theme code does not make use of that code to generate his recall. Neither does he make use of an alternative code to generate his recall. Instead, he does something which results in fewer thematic importations and a more accurate recall of the original passage than is the case for other subjects. The perspective we presented initially suggests that what the subject does is to make contact with the attributes of the story that are ordinarily less accessible than is the thematic attribute. That these other attributes must still be in memory is evidenced by the fact that subjects who do not receive an invalidation until 1 week after they have read the story can increase the accuracy of their recall.

The central question to be considered here has to do with the behavior of the subjects in the different-theme conditions. In particular, what is it that enables the different-theme subjects to gain access to the more detailed memory attributes? There are two possibilities that can be considered, the first of which rests on the assumption that two retrieval cues are more effective than one. Such might be the case were the subject to use each cue to generate cue-appropriate ideas and then to recognize those that were actually in the passage (e.g., Bahrck, 1970). The recall evidence on this issue is contradictory (e.g., Maki & Hasher, 1975; Nelson & Hill, 1974). A recent prose recognition study (Dooling & Christiaansen, 1977) also failed to find an improvement in accuracy when two retrieval cues for a paragraph describing a well-known person were provided. It nonetheless remains a possibility

that the more retrieval cues available to a subject the greater the likelihood of retrieving a memory.

One potential problem with the multiple-cue hypothesis is that in the present case the second cue was not provided until sometime after the story had been read. However, the strong evidence that once suggested that only cues encoded at storage aid subsequent recall (Thomson & Tulving, 1970) has been moderated in light of several demonstrations that postinput cuing can facilitate recall—if the subject is aware of the relation of new cues to target materials (Miller, 1976; Santa & Lamwers, 1974). This is certainly the case in the present situation, in which the subject is told explicitly that the new theme is appropriate for the story. In the prose memory literature, too, there has been strong evidence that a theme or topic given after the comprehension of a story does not improve performance (Bransford & Johnson, 1972; Dooling & Mullet, 1973). More recent work suggests that this conclusion is limited to passages that when initially presented without a theme are obscure and ambiguous (Thorndyke, 1977). In part of the work on this project, the present passages were given without titles to subjects who, after a week's interval, were asked to recall the story and then assign a title. In almost all cases the titles assigned were thematic variations on the experimental titles (and recall was reconstructive to whatever title the subject had assigned). Thus, there is now evidence in both prose and simple-unit recall that a postinput cue can be effective. This then mitigates one of the major arguments against the dual-cue hypothesis.

Another possibility for the source of the increased recall of different-theme subjects is a heightening of intellectual effort that the unexpected and unusual event of the theme-change procedure might have induced (cf. Kahneman, 1973). A variant of this hypothesis would regard the procedure of invalidating the original theme as an example of a situation in which an expectancy or hypothesis of the subject is disconfirmed, a condition thought to heighten activity and information-seeking behaviors (Lockhart,

Craik, & Jacoby, 1976; Rescorla & Wagner, 1972). Although evidence from a short-term memory paradigm (Hasher & Greenberg, 1977) does not support such a view, it is possible that increased effort does play a role in prose recall.

Even though the evidence in favor of both the dual-cue and heightened-effort hypotheses is limited, there is little evidence that contradicts them. The present study does contradict the notion that subjects in this experiment adopted a higher or stricter criterion for deciding what is an old memory. Such a criterion shift could account for the decrement seen in intrusions but could not account for the increase seen in accuracy of recall: Indeed, one would expect such a criterion to result in a decrement in both intrusions and correct recall.

While the question of what mechanism operates to increase the retrieval of details under the different-theme conditions must remain open, a recent study that also shows that theme materials provided after input can change memory production should be considered (Dooling & Christiaansen, 1977). Subjects in that study read a passage that described a famous person (e.g., Helen Keller). Of interest here are two conditions in which the subjects were given a fictitious name for the character prior to the story. At the time of the recognition test, some subjects were told the famous person's name, others were not. Subjects in the title-change condition were more likely than others to falsely recognize as old material appropriate to the famous person. This effect was found only at the 1-week interval. Dooling and Christiaansen attributed this effect to the loss of story detail in episodic memory and the resultant reliance on theme information in semantic memory. At the same 1-week retention interval, subjects in the different-theme conditions in the present two studies showed an increase in accuracy of recall. The latter finding cannot easily fit within the semantic/episodic framework proposed by Dooling and Christiaansen—in fact, forgetting in the present study was minimal, as it may have been in Dooling and Christiaansen's study, where accurate recognition

remained at the same level throughout the retention interval.

Instead, both studies highlight the major point of this article: What one learns of what is stored in another's memory depends upon the demands imposed upon the system, some of which are affected by the nature of the target event (see Rubin, 1977) and some of which are determined by the retention situation itself. Thus, there are situations such as the present one in which one may see, given similar initial storage of information, either reconstructive or reproductive retention.

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Received December 20, 1977

Revision received February 22, 1978 ■