1 Techniques Available to Author, Teacher, and Reader to Improve Retention of Main Ideas of a Chapter

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PREFACE

It is difficult to imagine how one could avoid feeling self-conscious when writing a chapter about techniques to improve the writing of chapters. Indeed, without discipline and willpower, one could easily become so inhibited that the chapter would never be written. An easy escape from such an embarrassment would be an early disclaimer stating that all ideas on the improvement of chapter writing are tentative: that because the ideas are in the formative stage no attempt will be made to practice what is preached. In that way, immediate evaluation of the effectiveness of the suggestions is precluded.

I will not take the coward's way out. This chapter is an experiment in the usefulness of some of the notions presented, viz., the instructions to authors on how to make main points more memorable. For this reason, the structure of this chapter seems unusual, e.g., the same headings are repeated throughout the chapter, as ideas are restated with more elaboration. However, even if this endeavor fails, it is possible that there is some worth in the ideas; I simply may not be very good at executing my own suggestions. At the end of the chapter, a summary version of the chapter is included like those used in experiments described in this chapter. The summary and text forms of this material allow for experimental comparison of which form produces better learning and retention.

ABSTRACT

This chapter is concerned with possible devices to improve the communication of ideas of the author to the prospective reader. Most of the proposed ideas are intended for the author to incorporate into plans for writing a chapter; however, some points suggest techniques the reader could employ when reading a text, and there are also suggestions that a teacher could use to improve a student's learning from the available material.

A brief review is given of some of the past work on how to improve retention of the important ideas from a text. This research is largely concerned with the effects of advance organizers as well as questions posed before and after reading. Two theoretical explanations are offered for the effectiveness of the various manipulations—the Focus Hypothesis and the Elaboration Hypothesis. Arguments along with empirical data are offered to bolster each position.

A series of experiments is described that indicates that people learn the central ideas of a chapter more effectively when they read a summary version than when they read the original, embellished text. These data argue for the focus interpretation. Other data suggest that elaborations aid retention. An attempt is made to reconcile these somewhat contradictory findings.

It is suggested that the elaborations provided by the reader are often more effective than those provided by the author. This is due to the inherent value of integrative processing (i.e., being forced to generate one's own embellishments) and due to the poor quality of many author-provided elaborations. An implication of this notion is that authors should provide better embellishments of the central ideas or skip writing embellishments at all. It is also suggested that authors present their ideas in a top-down fashion, repeating them more than once, each time giving more detail. The ideas in this chapter are presented several times, each time with more detail.

RESEARCH ON HOW TO IMPROVE RETENTION OF PROSE

For several decades, much of the research on improving reading comprehension has looked at the effects of adjunct aids, especially adjunct questions, that is, aids that are not part of the text itself. Ausubel, in the early 1960s, studied how *advance organizers* stimulate cognitive structures to improve retention of a passage. This work was extended by other investigators to look at other aids to comprehension, especially the use of pre and postquestions, also known as *priming questions*.

Experiments using priming questions manipulate when the questions are asked relative to the passage being read and vary the overlap between these questions

and the criterion test questions. Readers do better on test questions if they are given priming questions first, so long as these questions are not totally irrelevant to the criterion questions. If the two sets of questions are exactly the same, subjects do better when given the priming questions before reading the passage. Otherwise, they are better off when the priming questions come after reading the passage.

Theoretical Explanations for the Effectiveness of Adjunct Aids

The two most obvious hypotheses to account for the effectiveness of adjunct aids are the Elaboration Hypothesis and the Focus Hypothesis. The former states that priming questions stimulate the reader to *elaborate* relevant parts of the passage and this causes redundant propositions to be stored in memory. Redundancy will be useful if the original statements are forgotten because they can be reconstructed from the redundant embellishments stored. The second hypothesis states that priming questions cause a person to *focus* attention on the important, central ideas. This facilitates rehearsal of the important information, which is thereby strengthened for better retention.

Support for the Elaboration Hypothesis. This hypothesis is supported by biases observed in memory: distortions of recall and selective recall of certain portions of a passage, as well as uneven susceptibility to intrusions and incorrect recognition (false alarms). These biases are affected by factors that affect elaboration, such as prior knowledge, orienting instructions, topic sentences, or special information about a passage.

Support for the Focus Hypothesis. The predominant analyses of text structure represent the information hierarchically and stipulate that the important ideas of a passage are represented higher in the hierarchy with details below them. Access to the information in a hierarchy is top-down. Because search starts at the top in this model, retrieval of a main idea could not be helped by knowing details. The reader must divide study time between the important ideas and details that do not help memory for the main points. Details also hurt memory for main points by distracting the reader from focusing on the main points and by making it more difficult to identify the main points.

A large number of experiments were conducted (Reder & Anderson, 1980) that indicated that people learn better by reading summaries of textbook chapters than by reading the original. Subjects read some topics in the original form, others in a summary form that was roughly one-fifth the original length. With retention intervals of 20 minutes, 30 minutes, 1 week, and 6 to 12 months,

summaries were consistently at an advantage on true-false tests and on short-answer tests. Summaries were superior both for questions directly taken from the text and for inference questions that required the subject to combine facts that had been studied. Subjects learned new, related material better in a transfer task if the original material had been learned in summary form. Reaction time differences showed the same pattern as percentage of questions answered correctly. Summaries maintained their superiority even when the main points in the text were underlined.

Resolution of Apparent Inconsistencies—or What Does All This Mean?

There is a great deal of literature that supports the elaboration hypothesis. The experiments mentioned previously appear to favor the Focus Hypothesis in that embellished main points found in texts are not as well remembered as summaries that focus attention on just the central ideas. However, these results are not necessarily inconsistent.

Texts are not simply elaborated collections of main points. Some of the details in texts are irrelevant to the central ideas and interfere with them. They compete for study time, distract the reader from the important points, etc. There is evidence from other experiments that author-provided elaborations are not as effective at promoting memory as subject- or reader-provided elaborations.

This does not necessarily mean that a chapter could not be written that promotes better retention of the central ideas than a summary. An author should be better able to provide accurate, diverse, and interesting elaborations to the reader. The usefulness of elaborations has been shown to depend primarily on whether or not they help *constrain* the interpretation of the main point. Author-provided, constrained elaborations should be at least as good as subject-provided elaborations.

A text should also allow for distributed practice of each main point, by repeating the main ideas at spaced intervals. An optimal organization might be a top-down structure where the reader first gets an overview of the important ideas and then successively is presented with the ideas in more detail. This can partly replace the PQ4R method that students should use for normal texts. This method advocates six phases for studying a chapter: *Preview* the material, make up *Questions* about each section, *Read* each section carefully, *Reflect* on the text as it is being read, *Recite* back the information contained in a section, and *Review* the entire chapter, recalling the main points after completing it. This chapter provides the preview (abstract and first pass summary) for the reader. It does not provide the questions, although a potentially better version of this chapter might include questions for thought too. The reader, however, must still reflect for him or herself. In the following sections, the ideas discussed so far are given in more detail.

RESEARCH ON FACTORS AFFECTING COMPREHENSION OF PROSE

There has been a great deal of work describing those aspects of prose or texts that are best remembered (e.g., Crothers, 1972; Kintsch, 1974,1977; Mandler & Johnson, 1977; Meyer, 1975; Schank, 1975; Thorndyke, 1977). Much of this work has focused on specifying grammars for stories or texts. This research predicts what aspects of stories or paragraphs are considered important and are best remembered. Investigations have continued to try to determine why certain parts of a text are better remembered than others. For example, Meyer (1975) had found that *height* of a paragraph within a passage, as she defines it, is correlated with probability of recall; recently, she and others have attempted to understand why this is so. Britton, Meyer, Simpson, Holdredge, and Curry (1979) found that height of a paragraph within the hierarchical description of a passage was not correlated with reading time nor with ability to perform a secondary task. Therefore, they argue that the effect of paragraph height is in the ability to retrieve the input, not in selective attention during acquisition. On the other hand, Walker and Meyer (1980) found that the probability of a reader integrating various assertions in a text (i.e., drawing inferences) is partly a function of the height of the paragraph that contains the assertions. This indicates that height predicts different processing during reading.

Related research has tried to predict what aspects of natural reading matter take longest to read and what parts are best remembered. (e.g., Carpenter & Just, 1980; Miller & Kintsch, 1980). Both groups of researchers would claim that readability is an interaction of the reader's processing strategies and the text. Other research has been concerned with determining those factors necessary to achieve normal comprehension and retention of prose, (e.g., Adams & Bruce, 1980; Bransford & Johnson, 1973; Britton, Holdredge, Curry, & Westbrook, 1979; Collins, Brown, & Larkin, 1977; Dooling & Lachman, 1971; Morris, Stein, & Bransford, 1979). Some of the notions put forth include the importance of prior knowledge to comprehension and the ability to identify the referents of the passage. For example, abstract passages are much better recalled when an elaboration such as a descriptive title or picture is presented just before reading the passage. However, elaborations help only when they are precise, that is, to better remember the sentence, "The group felt sorry for the fat man but could not help chuckling about the incident," one should also study the precise elaboration, "The fat man had gotten stuck in the cave," rather than the imprecise elaboration, "The fat man had made a fur hat." The reader must be able to elaborate the input using concepts already available in memory. There must be a good correspondence between the knowledge the author assumes of the reader and what the reader actually knows before reading the passage.

RESEARCH ON HOW TO IMPROVE RETENTION OF PROSE

The concern of this chapter, however, is not on determining those aspects of texts that are normally remembered best, nor on isolating those aspects of text that are critical to normal processing. Rather, the goal of this chapter is to develop ways to actually *improve* retention of those aspects of a document that are deemed important by author, teacher, or student. There is evidence that students have a great deal of difficulty determining what aspects of a passage are important and retaining those aspects the speaker/writer wants the student to remember. Kintsch and Bates (1977) found that students' memory was equally good (or poor) for details and main points of a lecture.

There has been a considerable amount of research on the goal of improving the reader's ability to comprehend a passage. Most of this work has been concerned with adjunct aids, especially adjunct questions. Perhaps the most influential work concerned with improving the retention of a passage was that of Ausubel. Ausubel (1960) claimed that *advance organizers* stimulate available *cognitive structures* (i.e., meaningfully organized information in memory) or help build new structures to facilitate the anchoring of new, incoming ideas. He wanted to show that giving the reader a preview of the content leads to better comprehension and retention. An example of his task is to give subjects a passage before the critical passage. The passage either contains subsuming concepts of the critical passage or is essentially irrelevant to it. He predicted that prior exposure to subsuming concepts or *anchors* would facilitate retention. Ausubel found data to be consistent with these notions to some extent (e.g., Ausubel & Fitzgerald, 1962); however, it was noted that an advance organizer's usefulness interacts with many other variables such as previous knowledge and verbal ability.

Although many researchers agree that Ausubel's work provided interesting speculations that stimulated others to pursue similar questions, he has been criticized for lack of appropriate experimental controls and lack of objective measures of his stimulus variables (see Frase, 1975). It is difficult to test the notion that previous exposure to high-level concepts of a passage will improve retention of lower level concepts when no procedure for evaluating the structure of a passage has been proposed. Gagné and Wiegand (1970) are an example of investigators who put Ausubel's conclusions into doubt. They found that improvement in retention due to Ausubel's advance organizers may have involved facilitation in retrieval, not in encoding or acquisition. This possibility was suggested by the finding that recall was improved even when the related topic sentence was not given until just before the test. Britton, Meyer, Hodge, and Glynn (1980) also argue that the effect of textual importance on recall may be in retrieval rather than in acquisition. This is inconsistent with Ausubel's argument that improvement results from the ability to embed the information in preexisting structures.

The investigation of the use of adjunct aids in the comprehension of prose has been continued by a number of investigators. The major thrust of this research has been on the effect of adjunct or priming questions on text comprehension (see R. C. Anderson & Biddle, 1975 and Rickards, 1979 for extensive reviews). The paradigm that is used involves subjects receiving priming questions about the passage either before, during, or after reading the text. Their performance is compared with subjects who do not receive priming questions. A test is used to measure comprehension of a passage. Experiments also vary the extent of overlap between the priming questions and the criterion test questions. Some experiments involve giving subjects orienting directions other than questions, such as, "Pay attention to the following aspects of the passage" or "Underline all instances of the following."

From this research, a number of conclusions can be drawn that are summarized here. First, people perform better on criterion tests if previously given orienting instructions or priming questions regarding the text. The benefit of priming questions is comparable for groups asked priming questions prior to the relevant material and for groups asked priming questions after the relevant material in the text, so long as the criterion question taps the same information as the priming question. However, if the criterion question is different than the priming question, then the postquestion group (those asked a priming question *after* the relevant information) perform better. Presumably, when readers are given the questions before the passage, they search out the answers in the text and ignore all other information; if questions are given afterwards, only the review and rehearsal processes are affected.

Second, the extent of benefit depends in part on the overlap between the orienting directions and the criterion test. For example, Frase (1975) gave subjects learning directions such as, "Pay attention to the number of rotations of Mars around the sun that occur in one year." Control subjects were given no directions. Experimental subjects did slightly worse than control subjects on questions irrelevant to the directions (52% correct vs. 57% correct). However, the experimental subjects did much better than controls on questions relevant to the orienting instructions (76% vs. 57%). So, *overall*, there is a clear advantage for asking relevant priming questions.

Priming questions do more than indicate what is important; they force readers to process the text in a certain way. This is clear from results of experiments where critical aspects of the text were directly highlighted (in a box) at study. Bruning's (1968) study found that this method of highlighting was not nearly as effective as forcing subjects to *review* material by asking them to answer a particular question. The conclusion that providing information may not be as effective as forcing subjects to retrieve it themselves has been encountered before. Bobrow and Bower (1969) found that providing the mnemonic to relate a pair of words was not nearly as effective as asking subjects to provide one themselves.

Frase (1967) suggested that priming questions cause subjects to review the relevant aspects of the passage. This review process probably involves more than merely stating the critical information in the question or answer because highlighting the critical information was so much less effective. Indeed, McGaw and Grotelueschen (1972) found that the information does not need to be directly tested. In their study, when a question *reminded* subjects of information present in the text, without either stating the information in the question or demanding it as an answer, subjects later recalled that fact better than a comparable fact unrelated to the priming question. For example, the question, "The surveying ship which recovered starfish . . . was exploring a route for a cable from Faroe to ____," aids recall of "The surveying ship ____, which recovered . . . ". Just mentioning the ship caused subjects to review the relevant information.

The reason that priming questions in studies mentioned earlier only helped some questions and not always new test questions is probably due to the nature of the overlap between questions. In fact, Reder (1979) and Watts and Anderson (1971) both conducted experiments in which priming questions helped some new questions and not others, depending on the type of question or the type of relation between priming and test questions.

It seems clear that merely asking a question will not produce improved performance. The question must force the subject to process relevant aspects of the text in useful ways. Watts and Anderson (1971), for example, found that subjects do better on a posttest about passages they read if they had been asked immediately after reading each passage a question that forced them to "integrate" the material (i.e., apply a principle in the passage to a new example). On the other hand, subjects do even worse on the posttest if asked a low-level question (name the scientist associated with the principle) than if asked no question at all.

Britton, Piha, Davis, and Wehausen (1978) also investigated why readers perform better when priming questions are asked after the relevant information. They found that on the pages immediately following a priming question, subjects' *cognitive capacity* is more efficiently used. They claim that efficient use of cognitive capacity maps onto the slower response times obtained in a secondary and simultaneous task of detecting clicks while reading. In other words, immediately after a priming question that asks about prior information, subjects are slower to detect clicks while continuing to read than they are to detect clicks when asked irrelevant questions or no questions. They argue that the allocation of the increased use of cognitive capacity is for more elaborative processing rather than for "literal comprehension."[1]

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[1]This, they claim, is because word recognition and grammatical calculation do not require cognitive capacity. However, Britton, Westbrook, and Holdredge (1978) found that cognitive capacity usage was greater with easy texts than with difficult ones. This result is the opposite of what one would have originally expected. They suggested that with very difficult texts readers simply give up careful processing and are more easily distracted.

Mayer (1975) compared pre, post, irrelevant, and no questions on level of surprise and ability to answer critical test questions. He concluded that post-questions create a "set concerning the goals of instruction" (p. 168), because subjects in the postquestion condition were much less surprised by the critical test questions. Gagné and Rothkopf (1975) also found that providing subjects with goal-descriptive directions improved performance on goal-relevant test elements so long as the goal directions were given all at once rather than dispersed throughout the text.

THEORETICAL EXPLANATIONS FOR EFFECTIVENESS OF ADJUNCT AIDS

There are two alternative notions that can explain the results discussed previously. The first is that advance organizers, priming questions, etc. *stimulate elaboration* of relevant parts of the passage. The second is that orienting directions cause a person to *focus attention* on the important central ideas. Allowing the subject to know what to focus attention on facilitates *rehearsal* of the important information, which is thereby strengthened for better memory. The first explanation I call the Elaboration Hypothesis and the second the Focus Hypothesis. Before describing research that attempts to determine which view is more accurate, I expand upon the differences between these two views.

THE ELABORATION HYPOTHESIS

The Elaboration Hypothesis should be distinguished from the Focus Hypothesis in that rather than assuming that the subject rehearses and strengthens the exact facts in a text, it assumes that the advance organizers cause subjects to create redundant interconnection and continuations. In this way, if one fact is lost, it can be reconstructed from other embellishments in memory.

The idea that elaborations are critical to memory has been proposed elsewhere (e.g., J. R. Anderson, 1976; J. R. Anderson & Reder, 1979, Reder, 1976, 1979). We have proposed that experimental manipulations intended to affect what has been called *depth of processing* have their powerful effects upon memory performance by changing the *number* and *type* of elaborations stored. Similarly, adjunct aids such as orienting questions and directions have their effect by causing the reader to create more relevant elaborations concerning the material of interest.

One might ask why extra elaborations are important to retention of the ideas in a passage. One might also wonder why orienting directions should affect the number of elaborations generated. To answer these questions, it is necessary to articulate my view of the nature of the representation of information in memory. I assume that long-term memory is a network of interconnected propositions and

that when a person reads a passage new propositions are added to this memory network. Any particular encoded proposition is fragile. There is a significant chance that the reader will not be able to activate the presented proposition at test. So, if a person's memory for the tested idea rested only upon the minimal, original set of propositions, poor memory would be the result. However, if the person encoded multiple propositions that were partially redundant with the to-be-remembered information, he or she would have a much better chance of recalling it at time of test.

Experimental Support for the Elaboration Hypothesis

The provision of strong empirical support for the Elaboration Theory is difficult because the theory implies that an experimenter has poor ability to manipulate the amount and direction of elaboration. Nonetheless, there are a number of experiments concerning selectivity in memory for prose that are consistent with an elaboration-plus-reconstruction viewpoint. If subjects have more ability to make certain types of elaboration than others, or if subjects are directed to make certain elaborations rather than others, one should see better memory for material consistent with the preferred elaboration, and more distortion of material in the direction of preferred elaboration. In the classic study conducted by F. C. Bartlett (1932), subjects from pre-World War I England studied an Indian story, "The War of the Ghosts." Bartlett obtained what he interpreted as systematic distortion of the material in the direction of the knowledge of his subjects. This distortion took the form of additions to the material that made the story more consistent with the world view of his subjects, deletion of inconsistent information, and transformations of inconsistent information to make it more consistent with prevailing beliefs.

There has been a long history of debates (e.g., J. R. Anderson & Bower, 1973; Gould & Stephenson, 1967; Spiro, 1975) over the extent to which Bartlett's subjects were really misremembering and the degree to which they were knowingly confabulating in response to perceived task demands. It seems that, at least to some degree, subjects are aware of their distortions and are able to assign lower confidence to these than to veridical recalls. However, this debate misses an important point: The behavior of subjects in Bartlett's task is typical of prose processing. Normally, the reader does not make distinctions between what was actually read in a passage and what is a plausible inference. With most stories, the inferences made are plausible extensions of the story and are not distortions. It was Bartlett's clever story selection that served to highlight the elaborative behavior of subjects.

Sulin and Dooling (1974) and Dooling and Christiaansen (1977) showed that subjects are more likely to falsely recognize statements that are consistent with a famous person as having been presented when the passage is described as being about that person than when the same passage is said to be about a fictitious person. These distortions can occur as a reconstructive process or as an encoding

process. Subjects make more thematic false recognitions if they are told the famous name prior to reading the passage, but they still make them if told this information immediately after reading the passage. When told the name just prior to the test, they make still fewer errors, but more than if not given this bias. The difference in errors among the three conditions is probably due to differential elaboration.

Bower (1976) reports an interesting experiment looking at the effect of prior information on subjects' memory for a passage. Subjects were given a story that consisted of episodes. Half the subjects were given prior information that would suggest an unusual interpretation of some of the subpassages, such as that the main character (a college co-ed) had just found out that she was pregnant. The story follows the heroine through five episodes: making a cup of coffee in the morning, visiting a doctor, attending a lecture, going shopping in a grocery store, and attending a cocktail party. The meaning of these episodes can be very different depending on whether or not we view the heroine as pregnant. Subjects given the interesting interpretation intruded many more inferences appropriate to the pregnancy theme. However, they also recalled more facts from the story. This result is what would be expected if subjects had used the information about pregnancy to elaborate. These elaborations should make the text information more redundant and introduce additional inferences.

Hayes (1977) has found a similar correlation between number of intruded inferences and overall memory for text. Hayes and his colleagues tried to find out what mechanisms allow some people to remember more than others. They pretested subjects on their memory for various historical facts and then classified them as those who remember a lot of history and those who do not. The subjects were then given a fictitious historical passage to read. The same subjects who knew more veridical history performed better on a test of the fantasy history passage. Subjects were also asked to free recall the passage that they had read. Not only did the subjects with better history-memory recall more; they also recalled many elaborations that were not asserted. These elaborations were not simply paraphrases of the passage nor were they simple inferences. The subjects classified as having poor memory for history offered almost no elaborations. From this finding, Hayes conjectured that embellishing the input with elaborations promotes better retention.

Schallert (1976) indirectly provided evidence consistent with the notion that elaborations help retention and that the amount of elaboration generated can be influenced by instruction. Subjects were given ambiguous passages that were either biased by prior information or were not biased. She found that subjects in the biased group remembered more information consistent with the bias than those who did not receive prior information. She also introduced a depth-of-processing manipulation in which subjects either processed the sentences at a *shallow* level (counting four-letter words in the passage) or at a *deep* level (rating for ambiguity). Biased subjects were more likely to remember consistent information when they were processing the material at the semantic level. It is

reasonable to assume that subjects would be generating more elaborations under semantic-orienting instructions (see J. R. Anderson & Reder, 1979), and that elaborations are responsible for the bias found in recall. Therefore, one would expect to find a greater bias in recall for the deep-processing group. In other words, Schallert's data support the notion of elaborative processing in comprehension because of the interaction of mode of processing and bias.

Brown, Smiley, Day, Townsend, and Lawton (1977) conducted a study with children that supports the elaboration theory by showing that the types of elaborations generated can be manipulated and that generating more elaborations improves recall. The study indicates that if teachers provide students with background knowledge, students are likely to remember more of the material presented to them. In the Brown et al. study, children in various grades were presented with information about either a fictitious tribe called the Targa or people from Spain. Those who learned about the Targa were told either that the tribe consisted of Eskimos or desert Indians. A week later all groups read a story about a young boy from the Targa tribe, and no mention was made about what they had studied the preceding week. Of those receiving relevant background information, intrusions and biases in interpretations of ambiguous sentences were consistent with the orientation given earlier. More important, those subjects in the Spanish control recalled significantly less of the veridical material. The usefulness of the background material was evident at all age levels. However, not only did older children recall significantly more veridical information; they recalled significantly more elaborations (had more intrusions) consistent with the background material. In other words, both recall and number of elaborations increased with age.

Owens and Bower (1977) conducted a study that indicates how perspective on a passage can affect memory for the input. Other studies discussed earlier manipulated prior knowledge about concepts in the passage or manipulated the focus of attention by the questions asked during reading. This study was more subtle in that the first few lines of the story caused the reader to identify with one character or the other, depending on which character was introduced first. Mishaps were described in the story without specifying who was to blame for them. On a subsequent recognition test, subjects were asked to judge which statements were presented in the story. Subjects were much more inclined to inaccurately recognize (i.e., false alarm to) a statement that imputed blame for the mishap to the character with whom they did not identify, and much less likely to false alarm to statements putting fault on the character with whom they did identify. Similar results have been obtained by Abelson (1976) and R. C. Anderson and Pichert (1977). These results are consistent with the notion that readers elaborate material in a fashion that is consistent with their wishes, prejudices, or perspective. And there is, of course, some tendency to confuse elaborations with presented input.

The Watts and Anderson (1971) result described earlier, that subjects do best on a posttest if asked integrating questions and worst if asked low-level questions,

is consistent with the elaboration notion. When subjects were asked no questions, they probably had more time to generate useful elaborations than when asked the low-level question, the name of the scientist, which had nothing to do with the point of the principle. Integrating questions encourage elaboration, because the answers require complicated thinking about the passage. The no-question condition produces an intermediate amount of elaboration and an intermediate recall performance.

Rothkopf (1972) conducted a study, the results of which are consistent with this view. In this study, subjects read material at their own rate and they would read slower those passages for which they were given priming questions. They probably were attending (thinking, elaborating) more to the relevant information in primed passages.

In a study of mine (Reder, 1976, 1979), I manipulated more directly the amount of elaboration given to prose material. An earlier study of mine indicated that subjects have very good memory for the sentences used in the same experimental stories. So the dependent measure chosen was the *speed* with which subjects can make judgments about a story, not the accuracy. The task demanded of subjects was to judge the plausibility of statements rather than their verbatim accuracy, which seems more representative of everyday tasks.

In these studies, the plausibility of the test sentence (with respect to the story being queried) affected plausibility judgment time even when the item had been explicitly presented. When the test sentence had been primed earlier by asking the subject to answer a related question while reading the story, there was also a plausibility effect. The decision times were faster for test items that had previously been presented or primed than for those not so treated, suggesting that the manipulations had an effect. However, because there was a large effect of statement plausibility for explicit and primed statements, it seems that people do not always first search for a specific fact in memory. Rather, they may often try to answer questions simply by computing plausibility.

Just as the number of relevant elaborations is postulated to affect *retention* of the input, it is also thought to affect the *speed* of retrieval of relevant information. This notion is based on the assumption that searching through memory for relevant information takes time and that the greater the proportion of relevant to irrelevant information, the faster a useful or relevant fact can be found; hence, faster reaction times occur with more elaborations. (See Reder, 1976, for a fuller discussion.)

FOCUS HYPOTHESIS

There are fewer theoretical arguments that can be made in support of the Focus Hypothesis as an explanation for why priming questions help. Instead, the arguments are, for the most part, made on an intuitive level. The thrust of the argument is that when trying to master the important points of a text, the more clutter that

is included in the reading, the harder it will be for the reader to attend to what is important. The adjunct aids remind the reader of what to attend to and what to ignore. Following are arguments for the Focus Hypothesis.

A number of cognitive scientists have proposed theories of the structure of text (e.g., Crothers, 1972; Frederiksen, 1975; Kintsch, 1974; Kintsch & van Dijk, 1975; Mandler & Johnson, 1977; Meyer, 1975; Rumelhart, 1975; Thorndyke, 1977), and these analyses suggest that certain facts are more likely to be retained. The predominant analysis of text has structured the propositions or idea units hierarchically where the more central or important propositions are represented higher in the hierarchy, with details subordinate to the main points in the memory representation.

Assuming that hierarchies are searched in a top-down manner, access to details depends on getting the main points, but there would be no dependence of main points on details. Therefore, details cannot help one remember the main points because access to the details is contingent on recovering the main points. Consistent with this view, investigations of these representations have found that propositions higher and more central in these hierarchies are better recalled, more accurately recognized, and more rapidly verified (e.g., Kintsch, 1974; Kintsch & van Dijk, 1975; Meyer, 1975).

Studying an unfocused text means that readers have to time-share in their concentration between the main points and the details rather than devote all their attention to the central ideas.

Because details cannot help memory for the main points, this is wasted study time. It is also more difficult to extract the important points if they are embedded in details. Both B. J. Bartlett (1978) and Kintsch and Bates (1977) obtained data consistent with this view.

Experimental Support for Focus Hypothesis

In order to determine whether the Focus Hypothesis or the Elaboration Hypothesis is a more reasonable explanation of the research on the benefits of adjunct aids, John Anderson and I performed a series of experiments comparing learning from texts with learning from summaries of texts. Following is a brief review of some of the experiments and results reported in Reder and Anderson (1980).

Experiments 1 and 2. In the first two experiments, college subjects studied one introductory chapter from a college text in its original form and studied the other in summary form. Examples of introductory college texts chosen as experimental materials were *An Introduction to Descriptive Linguistics* by Gleason (1967, pp. 1–13), and *The Geography of Modern Africa* by Hance (1975, pp. 5–20). The texts did not require that the student have prior knowledge of that content area. Summaries were written for the chapters. These summaries were roughly one-fifth the length of the originals. The questions we chose to ask the

subjects could all be answered on the basis of the summaries. In the first set of experiments, the questions were true–false and half the trues and half the falses could be answered by retrieving a simple assertion provided in the summary. The other half of the questions required that the reader combine statements presented in the summary. The former type are called *direct* questions; the latter, *indirect* questions.

The summaries were written to restate the main points in as compact a fashion as possible. The section headings of the original text were kept, but no paragraph structure or interstitial material was maintained. Each sentence started a new line. Each subject studied both the linguistics material and the Africa material, one in the original text form and the other in the summary form. Subjects in Experiment 1 studied the text for 20 minutes and the summary for 20 minutes. Some subjects complained that 20 minutes was not sufficient time to read the text; so in Experiment 2, subjects were given 30 minutes to study each type of material.

Immediately after studying each topic, subjects were tested with 16 statements, 4 indirect true, 4 indirect false, 4 direct true, and 4 direct false as defined earlier. Another 16 statements of the same types were tested 1 week later. Of the 32 questions, the selection of 16 for the immediate test was randomly determined for each subject. Questions were presented on a computer terminal. Using computer methodology meant that we could surreptitiously collect reaction times from the onset of the statement until the subject responded true or false. The computer also allowed us to run multiple subjects in parallel.

The pattern of results is essentially identical for the 20- and 30-minute (study time) versions of the experiment. Subjects performed less than 2% better with 10 extra minutes. Because no other differences were observed, we describe the data of these two experiments together.

Table 1.1 presents the data as a function of study form (summary vs. text), delay (immediate vs. 1 week later), and question type (direct vs. indirect). In both experiments, the summary condition was significantly better (10%) than the text study form. Subjects also responded more accurately immediately than at a delay. The advantage of summary was not affected by delay. There was an interaction of question type and study form, such that subjects answered direct

TABLE 1.1
Accuracy and Latency Performance on Questions From Experiments 1 and 2 As a Function of Type of Question, Type of Study, and Delay

	Proportion correct			
	Immediate		*Delay*	
	Summary	*Text*	*Summary*	*Text*
Direct	.839	.651	.718	.607
Indirect	.752	.707	.700	.647

questions better than indirect questions when the material was studied in summary form but answered indirect questions better than direct questions when the material was learned in the original text form. However, indirect questions were still answered better for material learned in summary, i.e., there was a clear main effect of type of study over and above the interaction. Subjects also responded faster in the summary conditions.

Experiment 3. Experiments 1 and 2 found that when summary and text material were given equal study time, there was a clear advantage for summaries. One might wonder whether memory for prose would be more resistant to forgetting if initial acquisition were equated. With this in mind, we ran a third experiment giving subjects only 15 minutes to study the summaries and 45 minutes to study the text. In other respects, the procedures and materials were identical with the first two experiments. In the immediate test condition, the difference between summary and text was reduced to only 2.5% as compared with 11.7% in Experiments 1 and 2. Although there was still a slight advantage for material studied in summary form, this effect was not significant. There was a significant effect of delay on retention; however, the expected interaction of delay with type of study was not present. Moreover, the nonsignificant difference in retention favored summaries rather than prose.

In Experiments 1 and 2 it was noted that there was an interaction between type of question asked and study form. In those experiments, the interaction seemed to diminish slightly with delay. In the current experiment, the interaction was only present in the immediate condition; the effect disappears in the delayed condition. Indirect questions were not answered as well as direct questions for material studied in text form either.

Experiment 4. The data do not support the notion that the reason details are included in a text is to enable readers to better retain the central points of a passage. Conceivably a more subtle benefit might accrue with the inclusion of details. Details provide the reader with a richer, more elaborate structure of the knowledge base and perhaps this elaborated structure helps the reader to acquire *subsequent information* better. This hypothesis can be tested by looking at whether there is an improvement in learning a set of facts when other related facts learned previously were acquired either through text form or summary form.

In this experiment, new materials were used that could easily be split in half so either half (first or second) could be learned in either form (text vs. summary). The overall performance for each half of each topic studied in summary form was superior to that studied in text form. Further, subjects did better when both halves were studied in the same form, regardless of whether it was text or summary. In answer to our major question, we found no advantage for learning material in the second half by studying the first half in prose form. If anything, there was a slight advantage here too for having learned the earlier material in

summary form. Overall then, not only does one learn information better when it is studied in summary form; there is some indication that one acquires new information better when prior related material has been studied in summary form.

Experiment 5. Having been unable to find an advantage for prose in any circumstance, we made one last attempt to see if perhaps the long-range retention of prose might not be superior to retention of summaries. We brought back as many subjects as we could from Experiments 1, 2, and 3. The original three experiments had been performed from January through May of 1977, whereas the retention tests were administered from November 1977 through May 1978. Thus, the delays varied from 6 to 12 months. We constructed new true–false questions on the same chapters and verified with pilot subjects that these too were answered at chance levels by those who had not studied the material.

Even at a delay of up to 1 year, there was still some advantage for the summary condition. There was an interaction between study form and delay such that the advantage of summaries declined over time. Also, the difference between the text condition and the summary condition was not significant at the longest delay. These last two results may be attributed to a floor effect. Both groups approached chance performance at the longest delay.

Conclusions and Theoretical Interpretations

The data from a number of experiments have been summarized, all of which argue that learning material from summaries is at least as good as reading the original text. People's ability to recognize important facts about a topic is superior when the information is learned in summary form, and acquisition of new material is better (measured by one's ability to answer questions) if information learned earlier on a related topic was learned by reading a summary.

Our initial expectation had been that the embellishments would improve retention because they provide a redundant coherent structure. Apparently, helping subjects focus attention and avoid having to share study time between main points and details is a more effective way to aid learning.

WHAT DOES ALL THIS MEAN?

Although much of the literature I reviewed argued for the Elaboration Hypothesis, the set of experiments summarized in this paper seems to point to the Focus Hypothesis. Because the two hypotheses have been described as antithetical, it would appear that the results are inconsistent. If one assumed that the original text version is an elaborated version of the summary condition, the Elaboration Hypothesis would imply that subjects would perform better with the original chapters than with the abbreviated summaries. Just the opposite result was found.

The advantage of the summary condition is not inconsistent with the Elaboration Hypothesis because it is overly simplistic to characterize the original text as just an elaborated version of the summary. Some of the extra material in the text is not really elaboration, but rather irrelevant to the main points. Also, it may be that author-provided elaborations tend not to be as effective as reader-provided elaborations. If the preceding points are correct, even if reader-generated elaborations are at some advantage, one should be able to construct an elaborated text that will be at least as memorable as a summary, and in some ways more memorable.

The notion that author-provided elaborations are not as effective as reader-generated elaborations is not new. Bobrow and Bower (1969) demonstrated that subjects learned paired associates better when they were forced to generate a mnemonic to connect them than when they were given a verbal mediator provided by the experimenter. This has also been demonstrated by Rohwer (Rohwer & Ammon, 1971; Rohwer, Lynch, Levin, & Suzuki, 1967; Rohwer, Lynch, Suzuki, & Levin, 1967). Presumably it is the constructive process itself, the generation of the connection, that is valuable, rather than the reader's mnemonics. Bobrow and Bower provided data consistent with the view that it is the search, the deep processing, that is critical, more so than the appropriateness of the connection. On the other hand, Stein and Bransford (1979) showed that the precision of the elaboration is more critical than other factors. The elaboration must *constrain* the proposition. The precision of self-generated elaborations can be affected by prompting. This in turn affects retention. Nonetheless, self-generated elaborations tend to be more precise (useful) for the reader than author generated, unless care is taken in the construction of author-generated details.

The fact that subjects are better off providing their own elaborations and that author-provided details are often interfering rather than useful does not preclude the possibility of constructing a chapter that would be at least as effective as a summary of a chapter. An author should be better able to provide useful elaborations of the main points. Those elaborations should seem as relevant as what the reader can generate and they certainly could be more accurate, diverse, and interesting. The embellishments could potentially be much more educational as well as more redundant. Stein and Bransford's (1979) results indicate that author-provided elaborations can be as effective as subject-generated ones.

Another reason the summary condition was superior to the original text version was due to the phenomenon of spaced versus massed practice. When the experimenter equates for total study time, the subject learns faster when the amount of time allocated to learn a specific fact is distributed across several trials with intervening practice on other items. Massed practice is less efficient, both in learning verbal material (see Glenberg, 1976 or Hintzman, 1969 for a review) and in learning a new physical skill such as tennis or skiing. When subjects read the original text, they had time to read through the material only once; with the much shorter summaries, subjects could go back and re-read the information

several times with spaced practice. Recently, Anderson and I (Reder & Anderson, 1982) tested the notion that the advantage of summaries was due to spaced practice on the important ideas rather than the absence of details. We found that both the absence of details and distributed practice contributed to improved knowledge acquisition. This result of better learning with spaced practice implies that an optimally written chapter would present the main ideas several times, distributed throughout the text. For example, the author might first give an overview or summary of the material to be covered, then present it again with more embellishment, and close the chapter with another long summary. These techniques have been used by many authors; however, the summaries tend to be short in that they do not cover every important point.

An optimal organization might be a top-down structure where the reader first gets an overview of the important ideas and then successively is presented with these ideas with more and more detail. Newspaper stories tend to be written in this fashion so that people can read to the level of detail that interests them. Textbooks might be more interesting to the student if they too were written in such a fashion.

A top-down organization could replace for the reader some of the work that is required by the PQ4R method of Thomas and Robinson (1972). That technique for improving retention of normal texts involves the reader *Previewing* or surveying the chapter, then making up *Questions* about each section, then *Reading* each section, trying to answer the questions, and *Reflecting* on the text in the process, *Reciting* the information in a section when finished, and finally *Reviewing* the chapter, recalling its main points when the chapter is finished. Of course, the central feature of the PQ4R method is its question-generation and question-answering property. A top-down organization does nothing to help influence the depth-of-processing as the PQ4R's question properties do. A top-down organization aids the reader by offering previews and reviews. Perhaps still better designed text could also provide questions for the reader to answer and spur the reader into generating questions of his or her own.

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APPENDIX: SUMMARY OF "TECHNIQUES AVAILABLE TO AUTHOR, TEACHER, AND READER TO IMPROVE RETENTION OF MAIN IDEAS OF A CHAPTER"

Preface

- Writing a chapter on how to write a good chapter makes the author self-conscious.

- The text form of this chapter attempts to follow my prescriptions for how a chapter should be written.

- The summary and text forms of this material allow for experimental comparison of which form produces better learning and retention.

Research on Factors Affecting Comprehension of Prose

- There has been much research trying to specify those parts of text that are best remembered.
- Much of this research has been concerned with developing text grammars.
- The *height* of an idea in a tree structure representation is the best predictor of recall.
- Other research has tried to predict how long it takes to read different parts of a text and what parts are best remembered.
- The prior knowledge of the referents of a passage has been shown to be critical to comprehension.

Research on How to Improve Retention of Prose

- This chapter is less concerned with the normal processing of prose and more concerned with how to *improve* the typical retention of text material.
- Much research has been done on how adjunct aids, especially adjunct questions, can improve retention.
- The most influential work was that of Ausubel on the effects of advance organizers.
- He believed giving the reader a preview of the contents of a passage leads to better comprehension and retention of the passage.
- Although Ausubel's ideas stimulated further research, he was criticized for lack of appropriate experimental controls.
- For example, Ausubel believed that advance organizers improve acquisition of the passage; others suggested the improvement may be in retrieval.
- Further work on adjunct aids centered on the effects of priming questions on text comprehension.
- The general paradigm involves giving subjects priming questions on the text prior to the criterion test.
- The priming questions can be asked before reading the passage, after reading each paragraph or several paragraphs, or immediately after reading the passage.

- The adjunct questions can be identical to the criterion test questions, closely related to the test questions, or irrevelant to the test questions.

- Several general conclusions can be drawn from this line of research:
  We perform better when given adjunct test questions.
  The extent of benefit depends partly on the overlap between the priming questions and criterion questions.
  Performance is slightly better on relevant questions if these questions are asked before the text than if asked after; however, overall performance, especially performance on test questions not primed by the adjunct questions, is better if the priming questions are asked *after* the passage has been read.

- Priming questions do more than indicate what ideas are important; they force the reader to review relevant aspects of the passage.

- Priming questions must force the reader to process relevant aspects of the text in useful ways; distracting questions hurt performance.

- Investigations of why people perform better when given priming questions have found that readers more "efficiently use their cognitive processing capacity" after such questions.

- Questions asked after the text create "a set concerning the goals of instruction." Questions in other positions do not.

Theoretical Explanations for the Effectiveness of Adjunct Aids

- There are two alternative explanations for the effectiveness of adjunct questions and orienting instructions.

- The Elaboration Hypothesis states that priming questions stimulate *elaboration* of relevant parts of the passage.

- The Focus Hypothesis states that priming questions cause a person to *focus* attention on the important, central ideas.

The Elaboration Hypothesis

- More processing of the input, caused by adjunct aids, results in additional, related, or redundant interconnections and continuations.

- By having redundant propositions, if one fact is lost, it can be reconstructed from other elaborations in memory.

- Memory is a network of interconnected propositions, and any given connection is fragile. Therefore redundancy is important.

Experimental Support for the Elaboration Hypothesis

- Although it is difficult to experimentally manipulate the amount and direction of a person's elaborations, there is data consistent with the elaboration-plus-reconstruction position.
- Some of this data is in the form of better memory and more distortions consistent with the view of the material that subjects are encouraged to adopt or the view consistent with their prior knowledge. Subjects should have poorer memory and fewer distortions for aspects of inconsistent material.
- F. C. Bartlett's (1932) classic study showed consistent distortions of an Indian story by his British subjects to make it more consistent with their world view.
- Sulin and Dooling showed that subjects are more likely to falsely recognize statements that are consistent with a famous person as having been presented when the passage is described as being about that person than when the same passage is said to be about a fictitious person.
- When subjects read about a set of events that is given an interesting interpretation (e.g., the heroine is worried about being pregnant), they recall more facts from each set of events but also have more intrusions (consistent with the interpretation) than subjects given no interpretation.
- The Elaboration Hypothesis predicts the result that, with an interesting interpretation of a passage, there will be more veridical recall, due to more redundant embellishment of the input and also more thematically consistent intrusions.
- People make more thematically consistent intrusions when they have more time for deep processing or elaboration.
- Providing children with relevant background information improves their retention of a story and increases the number of consistent elaborations recalled. Amount of veridical recall and number of elaborations intruded increases with age.
- When people are asked no questions about a passage, they later perform better than if asked a low-level question, and worse than if asked an integrating question. Low-level questions inhibit readers from making their own elaborations; integrating questions encourage the most useful elaborations.
- There is evidence that people read passages slower when given priming questions, so that they can think more deeply about the relevant information and perhaps generate more relevant elaborations.

Focus Hypothesis

- The Focus Hypothesis states that adjunct aids let a person know what to attend to. This facilitates *rehearsal* of the important information, which is thereby strengthened for better memory.
- It is more difficult to appreciate what the important ideas are if they are embedded in details. Adjunct aids help the reader to recognize the important ideas.
- The more clutter of details in a passage, the more difficult it is to devote attention to the central ideas.
- The predominant analyses of text structure stipulate that the important ideas are represented higher in a hierarchy with details below them; the hierarchies are said to be searched in a top-down manner so access to main ideas cannot be helped by knowing details.
- Consistent with this analysis, investigations of text structure have found that propositions represented higher in the hierarchy are better recalled, more accurately recognized, and more rapidly verified.
- Studying details takes time away from studying main points; because details cannot help memory for main points, they hurt learning of the important ideas.

Experimental Support for the Focus Hypothesis

- Following is a summary of a series of experiments (Reder & Anderson, 1980) comparing learning from texts with learning from summaries of texts. Texts can be thought of as main points plus embellishments, whereas the summaries only introduce (and hence focus on) the main points.

Experiments 1 and 2

- Summaries were written for two introductory college texts that were roughly one-fifth the length of the originals.
- True–false questions were constructed that could be answered from the summaries; half the questions were asked immediately after study and half were asked a week later.
- In Experiment 1, subjects had 20 minutes to read the summary of one chapter and 20 minutes to read the other chapter; in Experiment 2 they had 30 minutes.
- The data were essentially identical for 20 and 30 minutes of study.

- Subjects performed approximately 10% better in the summary than in the text condition. Although people do better immediately than at a delay, the summary advantage is not affected by delay.

Experiment 3

- An attempt was made to equate initial learning for the text and summary conditions to see if text would be remembered longer. Subjects studied the original text for 45 minutes and the summary for only 15.
- With this modification in procedure, the initial difference in test performance was reduced to 2.5% from 11.7% in the earlier experiments.
- Text material was not better remembered at delayed tests.

Experiment 4

- Because details do not help people retain the main points, perhaps they enrich the knowledge base to facilitate *subsequent* learning.
- Chapters and summaries were divided in half, so that subjects could study the first half in text or summary form and study the second half in text or summary form. They were tested on each half separately.
- There was no advantage on the second half of learning the first half in text form; if anything, there was a slight advantage of having learned the first half in summary form.

Experiment 5

- In a final attempt to find an advantage for the original text form, subjects from the first three experiments were brought back 6 months to 1 year later and further tested on what they studied earlier.
- At this long delay, there was still some advantage for the summary condition.

Conclusions and Theoretical Interpretations

- This initial expectation had been that embellishments of main points would improve retention by providing a redundant coherent structure. However, texts seem not to do this.
- Apparently, reading a summary that helps subjects focus attention and avoid having to time-share between main points and details is a more effective way to aid learning.

What Does All this Mean?

- Much of the literature reviewed previously argued for the Elaboration Hypothesis, although the set of experiments just summarized *seems* to favor the Focus Hypothesis.
- These results are not necessarily inconsistent. It is overly simplistic to characterize the original text as just an elaborated version of the summary.
- Some of the text details are irrelevant to the main points and may only interfere.
- There is evidence that author-provided elaborations tend to be less effective than reader-provided elaborations.
- Although most author-provided details may be irrelevant and interfering, and though subjects may typically be better off providing their own elaborations, one could still conceivably construct a chapter that would be at least as effective as a summary.
- The usefulness of elaborations really depends on whether they help *constrain* the interpretation of the main point. Author-provided *constrained* elaborations can be as good as subject-provided elaborations.
- The author should also be better able to provide accurate, diverse, and interesting elaborations.
- A text that allowed for spaced or distributed practice of each main point would also help.
- An optimal organization might be a top-down structure where the reader first gets an overview of the important ideas and then successively is presented with the ideas in more detail. Newspaper stories are written this way so that people can read to the level of detail that interests them.
- This can partly replace the PQ4R method that students might use to improve retention of normal texts: Preview, Question, Read, Reflect, Recite, and Review.