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**Elaborations: When do they Help  
and When do they Hurt?\***

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*Abstract*

*Theories of memory and text processing have begun to emphasize the important role of elaborative processing. The support for this role is tenuous, most of it being correlational. Few studies have been concerned with whether or not memory is better when the author (or experimenter) provides the embellishment. Most have only looked at effects of elaboration when the reader generates embellishments, possible confounding degree of effort with degree of elaboration. Experiments are described here where the elaborations are given to the reader. The paper specifies those situations where memory is improved by elaborations, and those that hurt retention.*

**1. Introduction**

It is widely recognized that the reader of a text passage does not passively store the input sentence strings. Rather, the reader is obliged to make many inferences to connect different parts of the text and to relate the text with

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prior knowledge (e.g., Graesser, 1981; Kintsch, 1974; Schank & Abelson, 1977). A term that encompasses much of this activity has been called 'elaborative processing,' which means generating embellishments during comprehension. The notion that elaborations should help retention of text is a view that I have endorsed for a long time (Anderson & Reder, 1979; Reder, 1976, 1979, 1980). However, despite my commitment to the importance of elaborations as an aid to the retention of facts, attempts to demonstrate the importance to the retention of text material have been unsuccessful (Reder & Anderson, 1980; 1982). In fact, we have conducted a large number of studies that show the detrimental effects of text embellishments.

This paper is concerned with trying to resolve this apparent inconsistency. First I will briefly explain why we need a concept such as elaborative processing, the motivation for this particular type of theoretical construct, and then the empirical evidence that contradicts the theory. Then some new results are described that support the usefulness of elaborations. An explanation is offered to reconcile the apparently inconsistent results and then other new data are presented that bolster this explanation.

## 2. Elaboration Theory

First, it would be useful to define what I mean by elaborations (see also Anderson & Reder, 1979). Elaborations are any additional facts about material to be remembered (TBR) that are thought about at the time that TBR material is studied. Elaborations can be either generated by the rememberer or presented to the rememberer along with the TBR material. The distinction between elaborations generated by the rememberer as opposed to the author is an important one. The issue of whether elaborations are more effective or only effective when generated by the reader will be discussed later in the paper.

The need for a construct such as elaborative processing has become increasingly apparent. There has been much written about the processing done during comprehension of text material (e.g., Graesser, 1981; Kintsch & van Dijk, 1978; Just & Carpenter, 1980) and there have been numerous examples of the kind of inferences that must be drawn in order to make sense of a text. However, even in memory experiments that do not use prose (e.g., those that use unrelated words), it is clear that variables other than amount of study and retention interval affect the amount remembered (e.g., Craik & Tulving, 1975;

Woodward, Bjork & Jongeward, 1973; Craik & Lockhart, 1972; Fisher & Craik, 1980).

The term 'depth of processing' (Craik & Lockhart, 1972) has often been introduced as the new variable needed to account for memory phenomena (see Cermak & Craik, 1979, for extensive discussion). Much of the research under the rubric of 'depth of processing' can be understood in terms of elaborative processing (Anderson & Reder, 1979). Although the depth of processing construct can account for much of the memory phenomena, I prefer the elaborative processing construct. Neither term is technically precise, but the latter phrase can be made more specific in meaning and implications.

The elaboration model (Anderson, 1976; Anderson & Reder, 1979; Reder, 1976) assumes that long-term memory is a network of interconnected propositions. When a person reads a passage, new propositions are added to this memory network. Any particular newly encoded proposition is weak. For this reason, it is uncertain whether a subject will be able to activate the presented proposition at test. If a person's memory for the tested ideas rested on the minimum proposition found in memory, there would be poor retention. However, if the person encoded multiple propositions that were partially redundant with the TBR information, he or she would have a much better chance of recalling it at time of test, for three reasons: One reason is that elaborations redirect activation away from interfering facts and shift it towards the TBR fact. For example, in a verification task, cued recall test, or with self-generated prompts, activation will flow from concepts in the prompt to concepts in the elaboration providing more access routes to the TBR material. Second, subjects can elaborate on the probe at test to try to generate additional concepts from which to spread activation. Third, elaborations allow for inferential reconstruction of the TBR item. (See Anderson, *in press*, for a fuller discussion of these points.)

## 3. Contradiction of theory with data: superiority of summaries over texts

Given the view that elaborations should help retention of important points, an obvious test would be to compare textbooks with summaries of the important ideas in those texts. Texts contain thousands of facts; no one can remember all the facts in a text, nor does anyone expect the reader to do so. Theories of text structure (e.g., Kintsch, 1974; Kintsch & van Dijk, 1978;

Rumelhart, 1975) have suggested too that certain facts have a more important status in the text than other facts.

John Anderson and I (Reder & Anderson, 1980, in press) have attempted to demonstrate that the less important facts of a text can be considered elaborations of the important points in a text and will facilitate retention of those more important points. We compared retention of the main points when presented in the original college textbooks with summaries of those textbook chapters. Unfortunately, in study after study, summaries of texts produced superior performance to the original text. Below I will briefly describe some of these experiments done in collaboration with Anderson, as well as other studies I have done.

*Original text/summary experiments.* In the first set of studies, college subjects studied introductory chapters from college texts in their original form, and others in summary form. Examples of introductory college texts used were *An Introduction to Descriptive Linguistics* by Gleason (1967), and *The Geography of Modern Africa* by Hance (1975). The texts did not require that the student have prior knowledge of the content area covered. 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 of the trues and half of the falses could be answered by retrieving a simple assertion provided in the summary. The other half 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. All subjects studied both topics, one in the original text form and the other in the summary form. Some subjects studied the text for 20 minutes and the summary for 20 minutes; others were given 30 minutes to study each type of material.

Immediately after studying each topic, subjects were tested on half of the direct retrieval questions and half of the integration questions. The other half of the true/false questions were tested one week later.

In these experiments, the summary condition is significantly better (10%) than the text study form, for both types of questions and at both delays. Subjects also responded more accurately immediately than at a delay. The

advantage of the summary condition is not affected by delay. There is an interaction of question type and study form, such that subjects answer direct questions better than indirect questions when the material is studied in summary, but answer indirect questions better than direct questions when the material is learned in the original text form. However, indirect questions are still answered better for material learned by summary, i.e., there is a clear main effect of type of study over and above the interaction. Subjects also respond faster in the summary conditions.

*Extra study time for texts.* We wondered whether the advantage for summaries would disappear if initial acquisition was equated. With this in mind, we ran an experiment giving subjects only 15 minutes to study the summaries and 45 minutes to study the text. In other respects, the procedures and material were the same as the preceding experiments. In the immediate test condition, the difference between summary and text was reduced to only 2.5%. 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 non-significant difference in retention favored summaries rather than text.

*The effect of summaries and texts on subsequent learning.* The data strongly suggest that details in a text do not help readers better retain the central points of a passage. Conceivably, there is a more subtle benefit from 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 more easily acquire *subsequent information*. This hypothesis can be tested by looking at whether there is an improvement in learning a set of facts when other related facts, previously learned, were acquired in text form as opposed to learned in summary form.

In this experiment new chapters were used that could be split in halves so that the first or second half could be learned in either form (text or 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. The primary result of interest, however, failed to show the hypothesized benefit for texts: there was no advantage to learning material in the first half in prose form on ability to acquire the material in the second

half. 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.

*A long-term advantage for texts?* 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 earlier experiments. The delays from first learning to final test varied from 6 to 12 months. The variation in delay is not serious as each subject serves as his own control. We constructed new true-false questions on the same chapters and verified with pilot subjects that these too were answered at chance levels by other undergraduates who had not studied the material.

Even at a delay of up to one 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.

*Use of different dependent measures.* All of the experiments just reported used true/false questions as the dependent measure. The results extend to other forms of testing. Recent projects using different dependent measures, such as cued recall (Reder & Anderson, 1982), and free recall (Allwood, Wikstrom, & Reder, 1982) have shown that the more difficult the dependent measure, the greater the advantage for summaries.

In one line of research, done in collaboration with Carl Martin Allwood and Torbjorn Wikstrom (Allwood, Wikstrom & Reder, 1982), we used free recall as the dependent measure. We found that subjects recalled more of the main points for the material they studied in summary form than for the material read in the original form. In the text condition, the important points were underlined and subjects were told at test to try to recall the underlined material but that it was 'okay' to recall anything from the text. Even when giving subjects credit for recalling anything from the text material, they still recalled less than they did in the summary condition.

*Role of format in the summary advantage.* Given these results, one can ask whether the advantage of summaries is due to the text or format. That is, is it harder to learn from prose than from a simpler format of fact after fact, each on a new line? Or, alternatively, is the advantage of summaries due to the absence of embellishments? We (Reder & Anderson, 1982), did a study to test this issue where, in all cases, subjects read one fact at a time presented on a new line, and we controlled the amount of time subjects spent studying each fact. The analog of the text condition had subjects study a main point and its embellishments for a fixed amount of time, whereas in the summary condition analog, subjects only studied the main point, one fact at a time. The results were the same whether the test was true/false or cued recall. Also, the findings did not depend on whether total study time was equated or study time for the main points was equated: With a fixed amount of time to learn, people are better off without details. When the study time on the main points was the same across conditions, and subjects received additional study time on embellishments presented after each main point, subjects were still significantly better off without the embellishments.

*'Real-World' settings.* In a more 'natural' situation, I had subjects take a summary and a textbook chapter home to study. They were told that in a few days, when they came back, they would be given a test on the materials and they would be paid according to their performance. Half the subjects were asked to monitor their study time to indicate how much time they were spending on the various passages. The other subjects were only asked after they had taken the tests how much time they thought they had spent on each passage. Both groups gave similar estimates. There was a significant effect of study time for both of these groups, such that subjects spent much more time on the prose passage than on the summaries. Despite this result, there was still a significant effect for all subjects on test scores, such that they performed better with summaries than with the original text passages.

*The nature of the elaboration interference.* Given all these data arguing that elaborations are bad, one can wonder whether they are better than irrelevant details. John Hayes and I looked at this question. We used a text that was approximately four times as long, in terms of number of facts, as its summary. In the text condition, subjects read only the one relevant passage. In the summary condition, subjects studied 4 different summaries so that the number of facts equalled the text condition. After studying either the four summaries

(different orders for different subjects), or the one text passage, subjects were tested on just the facts contained in the relevant passage and its summary. That is, the facts from three of the summaries studied were not tested. In this experiment there was essentially no difference in performance between the two groups. So it seems that text embellishments are no worse than irrelevant facts, but they are also no better.

#### 4. Possible explanations for elaborations hurting

Given my belief in the theory that argues for the importance of elaborations, there are only two explanations that seem reasonable to account for these data: One is that elaborations must be generated by the comprehender rather than provided by the author, contrary to the definition of elaborations given earlier. The second is that the elaborations included in the texts were not very good. I do not want to consider as an explanation that elaborations never help. That elaborations can help memory has ample support. For example, Schallert (1976), Brown, Smiley, Day, Townsend and Lawton (1977), Watts and Anderson (1971), to name a few, have all provided evidence consistent with the elaboration theory (see Reder, 1980, for a discussion of these studies). However, in all these cases, the manipulation required that the subject make the elaborations, i.e., manipulations were intended to affect amounts of self-generated elaborations. These experiments did not provide the subject with varying amounts of detail, and therefore they do not predict an outcome with experimenter-generated details.

There is evidence for the position that elaborations are more effective when generated by the comprehender. For example, Bobrow and Bower (1969) found that subject-generated mnemonics were better than experimenter-generated mnemonics in terms of learning paired associates. McFarland, Frey and Rhodes (1980) also found that when subjects generated a word to fit a context rather than evaluated its adequacy, there was an enormous memory advantage.

Let me make a case for why self-generated elaborations might be more effective, in addition to reasons concerning greater effort, deeper processing, or study time. I have argued that elaborations are generated by the process of mapping schemata (Reder, 1976; 1980) onto the input and then copying or adapting other parts of the given schema into that memory structure. Self-generated elaborations might be more effective to the extent that these sche-

mata are idiosyncratic, i.e., develop differently due to different experiences. This is because at recall it would be easier to reconstruct the TBR fact from an elaboration that mapped into one's own schema than one whose connection was less clear. Of course, some elaborations that could be generated by the author would not be especially idiosyncratic (i.e., author and reader share a common schema) and therefore could be useful to the reader.

The other reason I believe texts might be inferior to summaries is that the text elaborations are not very good, and that they really are irrelevant to what the author wishes to say. Table 1 gives an example of what I mean by poor elaboration. This is an excerpt from an elementary school text that was adopted by an entire state. It is not clear to me what details about size and style of can for packing tuna and salmon have to do with whether the seas can be farmed. With this type of passage, it is no wonder that students have a difficult time extracting the main ideas. Of course, this passage is an exaggerated example. The college texts we used were much better than this, but this gives an idea of what I mean by elaborations being digressions or irrelevant to what the author intends to convey. On the other hand, the embellishments generated by the author may be included for reasons other than redundancy. For example, the author may wish to *convince* the reader of the validity of the TBR facts. Establishing a fact's credibility may have no effect on its memorability.

*Carefully constructed, experimenter-generated elaborations.* To pull apart whether the text disadvantage is due to the quality of the elaborations or the fact that they were not generated by the subject, one should try to develop effective elaborations and see if author-generated elaborations can ever improve retention. At this point, the goal is not to create 'natural' texts, but rather any kind of material where elaborations actually facilitate retention.

If experimenter-generated elaborations do improve retention, then an obvious conclusion from the above studies is that texts are not written with good elaborations. If these elaborations also fail to show the improved retention of TBR items, one could always argue that these were not good elaborations. However, as more and more studies are performed, this argument begins to lose credibility. Therefore, if the results are negative with respect to experimenter-generated elaborations, one might tentatively conclude that elaborations must be generated by the reader (or that elaborations are not useful at all).

A recent study conducted by Bradshaw and Anderson (1982) was addressed

Table 1. Excerpt from a state-wide adopted text

*Aquaculture*

One earth zone having to do with food production we have not yet investigated. It is the seas. Can they be farmed?

The seas carry some of man's biggest manufactured items — his ships — and provide recreation for those who live along the shores. But the seas' greatest importance is in the number of things found in their depths. Many of them are useful and necessary to man.

From his beginnings, man has probably hunted and caught fish. As he developed boats, he was able to get into deeper areas of water.

Recognizing the high nutritional value of fish, man has sought them more and more. He has been attracted to those fishing areas in which he could catch many fish of one kind. Tuna are caught with hooks and sardines with nets. Mackerel are packed in different size cans than sardines. And tuna and salmon in the same style of can are packed quite differently.

to this issue. The important facts to be learned were the same across conditions. Subjects learned a given fact either in isolation, i.e., without any elaborations, or with a related fact, or with an unrelated fact. All to be remembered facts were about famous individuals, e.g., Newton. A related fact or elaboration about Newton did not share any more concept words with the central fact than did an unrelated elaboration about Newton. The elaborations were always about the same person as the center fact and were always true although little known. Examples of study materials are given in Table 2. Subjects were tested on their memory for the center facts one week after learning the material. It was a cued recall task in that subjects were given the name of the individual and asked to recall the facts. Scoring only for the center fact, they found that center facts were better recalled when they had been studied in the isolation condition than in the unrelated elaboration condition. However, the related elaborations actually produced significantly better performance than both the unrelated condition and the isolation condition.

Stein, Morris and Bransford (1978) and Stein and Bransford (1979) have also demonstrated situations where experimenter-generated elaborations are effective at improving retention and situations where they are not. In these experiments, subjects must recall the missing word from a sentence frame that was previously read. The experimenters varied the appropriateness of the surrounding sentence context to the to-be-recalled word. Even in situations where the subject generated an elaboration to the sentence containing the TBR word, recall was not as effective as in those situations where the experimenter-generated elaboration was a 'precise' fit to the TBR word. For example, a subject might study

Table 2. Examples of materials used by Bradshaw and Anderson (in press)

CENTER FACT:	Newton became emotionally unstable and insecure as a child.
Related Facts:	Newton's mother had remarried and left him with his grandfather. Newton became irrationally paranoid when challenged by colleagues.
Unrelated Facts:	Newton was appointed Warden of the London Mint. Newton went to Trinity College in Cambridge.
No Extra Facts:	(Center fact presented in isolation)

'The fat man read the sign' and be given 'warning of thin ice' as the continuation. This elaboration was most effective at eliciting 'fat' if that word were omitted at recall. In fact, it was more effective than continuations that subjects generated on their own. Like Reder and Anderson (1980), Stein et al. found 'imprecise,' but semantically congruous elaborations actually debilitated retention. Hall and Geis (1980) obtained results consistent with those of Stein and Bransford.

### 5. Resolving the apparent inconsistencies

Given the results demonstrating superiority for experimenter-generated elaborations over no elaborations and even subject-generated elaborations, it would be useful to identify what it is about these elaborations that make them better than the unrelated facts (in Bradshaw & Anderson), or imprecise elaborations (Stein & Bransford), or no facts at all. Highly related elaborations allow the subject to reconstruct the TBR facts when the TBR facts are forgotten but the elaborations are remembered. Such reconstruction is not possible when the embellishment or extra facts are not so related. Consider the examples in Table 2. The two related facts do not directly imply the center fact; however, they make it more likely that one could reconstruct the center fact. These related facts also seem to stimulate more elaborations and connections between these facts for the subject. The irrelevant facts about Newton seem unlikely to offer connections between them and the center fact and seem not to stimulate further embellishments. This same notion can be applied to the Stein and Bransford material. Black and Bern (1981) have recently obtained similar results. In their experiments subjects were more likely to recall sentences (in a

cued recall and a free recall task) when they were part of a causally related pair.

Some recent research (Reder & Ross, 1981, in press) provides converging evidence for reconstruction from elaborations. We found that the opportunity to use inferences in a memory task can make extra facts beneficial in an experimental situation that typically produces interference with extra facts. In these experiments, 'beneficial' and 'interfering' refer to speed of responding rather than probability of recall. It has commonly been found that in a reaction time task, the more facts that are studied about a person (like Newton), the slower the subject is to recognize or retrieve any one of these facts. The typical task has subjects commit facts to memory and then requires subjects to judge whether or not a specific sentence had been studied. This judgment may require a discrimination of studied facts from plausible facts, i.e., facts inferrable from studied facts. However, in the Reder and Ross experiment, subjects were instructed to respond positively to a statement if it seemed true given what had been studied; subjects were not asked to discriminate inferences from studied facts. With this task, subjects actually performed better, i.e., faster, the more facts they had learned that were relevant to the decision. Learning more facts about an individual doing a specific task (e.g., Bill going skiing) made response times faster when inferences were encouraged; in blocks of trials (in the same experiment) that required the more standard discrimination of studied from non-studied facts, the normal interference ('fan') effects obtained, i.e., knowing more facts about Bill skiing, slowed RTs.

In conclusion, elaborations do help memory but elaborations must be redundant and afford reconstruction of the TBR material to truly be elaborations. Most textbooks do not provide this. Authors must write texts where the elaborations are causally connected to the main points and provide inferential possibilities. Further, the memory test must allow reconstruction; that is, the task cannot be a verbatim recognition task. Subjects must be allowed to infer, as in the Reder and Ross study. I think we are coming much closer to understanding the possibilities and limitations of elaborations and elaborative processing.

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