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## Schema Activation and Schema Acquisition: Comments on Richard C. Anderson's Remarks

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Professor Anderson has done an excellent job of presenting the essentials of schema theory and of highlighting a number of its implications. My comments on his paper are divided into two points. First, I want to reemphasize some of Anderson's major arguments and elaborate on several of their implications. I shall then discuss some potential shortcomings of many versions of schema theory and suggest some modifications that seem relevant to the issue of understanding how people learn from texts.

Several of Anderson's points about schema theory can be reviewed by considering the processes involved in understanding, and later remembering, a simple statement such as the following: "Jane decided not to wear her matching silver necklace, earrings, and belt because she was going to the airport." In order to comprehend this statement, one must go beyond the information that was given and postulate a reason for the connection between airports and Jane's style of dress. People who are familiar with airports—who have a well-developed "airport schema"—might assume that Jane decided not to wear her silver jewelry because of the metal detectors in airports. In Anderson's terminology, their schemata provide a basis for interpreting and elaborating on the information they heard.

Anderson also argued that schemata affect processes at the time of output as well as at input. For example, adults who attempt to recall the original "airport" statement three days later may rely on their knowledge of airports for a selective search of memory and then state that "Jane decided not to wear some metal jewelry because it could cause unnecessary delays at the airport." Note that this type of response reveals the comprehender's assumptions about important elements. It is the fact that the jewelry was metal that was most important and not, for example, that it was expensive or pretty. Anderson also emphasized this

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function of schemata: They provide a basis for determining the important elements in a message or text.

Overall, Anderson discussed six functions of schemata. They provide a basis for (1) assimilating text information, (2) making inferential elaborations that fill in the gaps in messages, (3) allocating attention to important text elements, (4) searching memory in an orderly fashion, (5) formulating a summary of information, and (6) making inferences that can enable one to reconstruct an original message despite having forgotten some of the details. It may be possible to add to Professor Anderson's list of "schema functions," but the six functions he cited are sufficient to illustrate why the knowledge possessed by the learner has pervasive effects on performance. I might add that Anderson was not simply arguing that the activation of appropriate knowledge is a useful thing to do; he was asserting that it is a fundamental aspect of the act of comprehending and remembering. One clear implication of this position is that some children may appear to have poor comprehension and memory skills *not* because they have some inherent comprehension or memory "deficits," but because they lack, or fail to activate, the background knowledge that was presupposed by a message or a text.

It is instructive to note that there are many levels at which a child may lack the background knowledge necessary to understand a text. At one extreme, the child may have no information about a concept; he or she may know nothing about airports, for example. At another level, a child may know something about a concept (for example, airports) yet still fail to understand many statements that involve this concept. As an illustration, consider once again the simple statement about Jane's trip to the airport and her decision about her silver jewelry. A child may know that airports are "places where planes take off and land" yet have no knowledge that airports contain metal detectors. The child therefore knows something about airports, but his or her "airport schema" is still less articulated than that of most adults. The child's knowledge may be sufficient for understanding some types of statements about airports (e.g., John went to the airport because his aunt was coming to visit) yet insufficient for others (e.g., the earlier statement about Jane.) The question of what it means for children to be "familiar" with the words used in a story is therefore more complicated than might be apparent at first glance.

Imagine another child who knows that airports are places where planes land and take off, and also knows that airports are often crowded and may be havens for thieves. This child may form the following interpretation of the statement about Jane and the airport: "Jane did not wear her expensive jewelry because she was afraid that someone might take it." This interpretation is quite different from one that focuses on the fact that airports have metal detectors. According to the "crowded airport" interpretation, the important elements are that the jewelry is valuable, visible, and easily accessible, rather than the fact that the jewelry is metal and hence may trigger a security alarm. Relatively subtle

differences in people's schemata (in this case their "airport schemata") can therefore have important effects on the interpretations they make.

Consider some of the problems that can arise when two people form different interpretations of the same message. For example, imagine that a teacher forms a "metal detector" interpretation of the statement about Jane and that a child forms a "thief" interpretation. In a one-to-one conversation, these two individuals might well discover their differences in interpretation and agree that both are reasonable. However, extended one-to-one conversations are often impossible in an educational setting. Teachers are frequently forced to use assessment questions in order to evaluate students' comprehension. These questions may be supplied either by the author of a text or by the teacher. In either case, the phrasing of the question may reflect the question asker's initial interpretations of a message. For example, a question such as "Why didn't Jane wear something metal?" may stem from a "metal detector" interpretation, whereas the question "Why didn't Jane wear her expensive jewelry?" tends to reflect a "thief" interpretation. My colleagues and I have found that even relatively subtle mismatches between a learner's initial interpretations and a teacher's or a tester's way of phrasing questions can cause considerable decrements in memory performance (Barclay, Bransford, Franks, McCarrell, & Nitsch, 1974). If my phrasing of a question is not congruent with a child's initial interpretation of an event, I may erroneously conclude that the child did not learn.

Mismatches between the phrasing of questions and a child's initial interpretations affect not only teachers' assessments of children's learning abilities; I am convinced that they also affect children's assumptions about their own abilities. Several years ago, Marcia Johnson and I conducted a study with college students that is relevant to this point (Bransford & Johnson, 1973). We created a passage about a man walking through the woods; nearly all our students interpreted the story as describing a hunter. They did not realize that the passage could also be interpreted from the perspective of an escaping convict. As Anderson noted, the perspective one takes on a story affects one's interpretation of the significance of information. For example, the story included information about it being muddy, hence the man's boots sank in deeply. He then came to a little stream and walked in it for a while. From the perspective of a hunter, this information suggests that the boots may have become caked with mud and that the man tried to clean them by walking in the stream. From the perspective of an escaping convict, however, the same information suggests that the man was leaving footprints and must take precautions in order to avoid being tracked.

We asked one group of college students to read the story I have described but said nothing about the possibility of interpreting it as an escaping convict. They therefore assumed that it was about a hunter, and the story made sense from this point of view. After reading the story, we supplied students with questions and explained that these should help them retrieve the information they had

studied. However, the questions were written from the perspective of the escaping convict interpretation. For example, one question was "What was the concern with the trail and what was done to eliminate it?" Not surprisingly, these questions did not help students remember relevant aspects of the story; instead they caused confusion. Many of the students thought about the questions for a considerable amount of time and eventually concluded that they had completely misinterpreted the story. Several apologized for having made such an error. In reality, however, they had not "misinterpreted" the story; their original interpretations had been perfectly reasonable. We eventually told the students this, of course, because it would have been unfair to let them think that they had been in error. The point I want to stress, however, is that these mismatches between initial interpretations and the phrasing of questions can occur inadvertently in almost any situation. Furthermore, learners who do not realize why their performance suffered may mistakenly attribute their difficulties to their own inability to learn.

The preceding examples illustrate only a few of many important implications of schema theory, but I now want to consider some possible shortcomings of many versions of this theory. I refer to these as *possible* shortcomings because I am uncertain whether they are shortcomings of the actual theory or shortcomings that stem from my personal interpretation of schema theory (i.e., my "schema theory schema" may be only partially developed). At any rate, I believe that there are some issues concerning schema theory that need to be explored, especially when one begins to ask how teachers and authors might use this theory to help themselves avoid some of the text-student mismatches and question-student mismatches that have been discussed.

One possible approach to the problem of mismatches is to analyze carefully the materials presented to children and then to simplify them so that mismatches are much less likely to occur. There are some obvious merits to this approach, but it involves some potential problems as well. These problems revolve around the issue of what it means to "simplify" texts.

Several years ago, I participated in a conference where the topic of simplifying texts arose during one of the discussion periods. One of the participants at the conference expressed some concerns about the reading materials that his children had received in the elementary grades (see Kavanaugh & Strange, 1978, pp. 329-330). He felt that the content of the stories (e.g., about a milkman, mailman, etc.) was extremely dull. When he asked the teachers why the children received such uninteresting materials, he was told that the children were familiar with the "community helpers." The teachers had not read about schema theory, so they did not say, "These stories are written to be congruent with the children's preexisting schemata." Nevertheless, the teachers were emphasizing the importance of providing children with materials that were congruent with the knowledge they already possessed.

The conference participant went on to say that his children did not like to read stories about topics that were extremely familiar; they were much more interested in reading about novel situations. In addition, he asked how theories that emphasize the importance of assimilating information to preexisting knowledge can account for the fact that it is possible to understand stories about novel situations. I think that this is a crucial question to ask schema theorists. It is especially crucial for those schema theorists who argue that comprehension involves the activation of a preexisting schema that provides a coherent account of the givens in a message. Many schema theorists have very little to say about the processes by which novel events are comprehended and new schemata are acquired.

In his presentation, Professor Anderson mentioned two types of situations involving schemata. One involves the activation of preexisting schemata. The second, which he noted was more interesting, involves the construction of new schemata. Since a major goal of education is to help students develop new skills and knowledge—to help them become able to understand things that they could not understand previously—the issue of schema construction or schemata acquisition is extremely important. Nevertheless, nearly all the experiments used to support schema theory involve situations where students are prompted to activate preexisting schemata. For example, students may be prompted to activate a "washing clothes" schema, "prisoner" schema, "fancy restaurant" schema, "home buyer" schema, and so forth. We have seen that these schemata provide important support for both comprehension processes and memory processes. However, experiments involving these schemata "work" only because the students in the experiments have already acquired the necessary schemata. If a person knew nothing about washing clothes, for example, it would do no good to simply tell him or her that this is the topic of the washing clothes passage. Similarly, imagine that a child is told that "Jane did not wear her silver jewelry because she was going somewhere" and is then given the cue, "She is going to the airport." A child who knows only that airports are places where planes take off and land is still going to have difficulty understanding this statement. In situations such as this, we confront the problem of helping students develop new schemata or of helping them refine the structure of schemata that they have already acquired (e.g., Bransford & Nitsch, 1978; Bransford, Nitsch, & Franks, 1977; Brown, 1979).

Imagine that we want to help a child develop a more sophisticated "airport schema." We will assume that the child knows that airports are places where planes take off and land, yet is unaware that there are metal detectors in airports. A basic and time-honored procedure for helping the child acquire this new information is to tell him or her about it. One might therefore supply information such as "There are metal detectors in airports" either prior to the child's reading a text or in the text itself.

There are many reasons why a statement such as "There are metal detectors in airports" may not be helpful to a child. An obvious reason is that a child may

not be familiar with the concept of metal detectors. However, assume that our child is familiar with this general concept. He or she may still not benefit from the statement that "There are metal detectors in airports." The child needs to understand what the detectors are for and who uses them. Without this information, the child may assume that there are stores in airports that sell things, and hence conclude that most airports have "metal detector" stores. This is not the interpretation we want the child to make.

It seems clear that effective teachers or writers would do much more than simply state, "There are metal detectors in airports." They would elaborate by helping the child realize that pilots guide planes to particular locations, that someone could try to force a pilot to fly to a different location, that this act may involve a gun or knife, that these objects can be detected by metal detectors, that the detectors at the airport are designed to keep people from taking knives and guns aboard the plane, and so forth. The amount of explanation needed will depend on the preexisting knowledge base of the learner (e.g., a relatively knowledgeable child may need only be told that "There are metal detectors in airports in order to discourage hijacking.") The point I want to emphasize is that the goal of this instruction is to help the child develop a more sophisticated schema rather than simply to activate a schema that already exists. The teacher or author is attempting to help the child activate various preexisting "pockets" of knowledge that previously had been unrelated, and to help the child reassemble these "pockets" of knowledge into an integrated schema. This schema should then provide support for comprehending and remembering subsequent events. For example, the child's interpretation of "the metal-detector repairman received a phone call and rushed to the airport" may now be more likely to involve the assumption that he was rushing to repair a machine rather than rushing to catch a plane or to meet someone arriving by plane.

At a general level, an emphasis on the importance of helping students activate sources of preexisting knowledge that can be reassembled into new schemata is consistent with Ausubel's (1963, 1968) theory of meaningful learning. For example, he advocates the use of "advanced organizers" in order to prepare students for texts. I think it is fair to say, however, that many aspects of this theory need greater articulation: in particular, the guidelines for writing advanced organizers are relatively vague. One of the difficulties of constructing these guidelines is that advanced organizers must differ depending on whether one is dealing with a problem of schema activation or schema construction. An advanced organizer that is relatively general can be effective if learners have already acquired the schemata necessary for understanding a text; these general statements can prime concepts that learners might fail to activate spontaneously. When one is dealing with problems of schema construction or acquisition, however, advanced organizers composed of general statements will not suffice.

Earlier, I emphasized some of the specific elaboration or explanations that may be required to help a child incorporate information about metal detectors

into his or her airport schema. It seems valuable to explore this issue further by examining the processes involved in acquiring knowledge about a more complex domain. Imagine, therefore, that someone is familiar with the general terms *vein* and *artery*; yet wants to learn more about them. (This is analogous to knowing something about airports, yet needing additional information.) Assume that the person reads a passage which states that arteries are thick, are elastic, and carry blood that is rich in oxygen from the heart; veins are thinner, are less elastic, and carry blood rich in carbon dioxide back to the heart. To the biological novice, even this relatively simple set of facts can seem arbitrary and confusing. Was it veins or arteries that are thin? Was the thin one or the thick one elastic? Which one carries carbon dioxide from the heart (or was it to the heart)?

Even the biological novice who is familiar with the terms *veins* and *arteries* may have difficulty learning the information in this passage. The problem the learner faces is that the facts and relationships appear arbitrary. It is possible to create an analogous situation by using concepts that are familiar to everyone. For example, imagine reading 10 statements such as those listed below and then answering questions about them from memory:

- The tall man bought the crackers.
- The bald man read the newspaper.
- The funny man liked the ring.
- The hungry man purchased the tie.
- The short man used the broom.
- The strong man skinned the book.

College students do quite poorly when they are presented with these statements and are then asked memory questions such as "Which man bought the crackers?" (Stein & Bransford, 1979; Stein, Morris, & Bransford, 1978). The students rate each sentence as comprehensible, yet have difficulty remembering because the relationship between each type of man and the actions performed seem arbitrary. The biological novice is in a similar position because he or she sees no particular reason why an artery should be elastic or nonelastic, thick or thin. Note that to a child, a statement such as "Airports have metal detectors" can also seem arbitrary. The child may therefore have difficulty retaining the new information about airports; hence it will not be available for future use. This problem of retention becomes even more acute if we make the reasonable assumption that children are introduced to a number of new ideas during the course of a day. For example, they may receive new information about airports, fancy restaurants, dinosaurs, countries, and so forth. If these new facts seem arbitrary, it can be difficult to remember which things go with what.

In order to make the facts less arbitrary, we need to give a learner information that can clarify their significance or relevance (see Bransford, Stein,

Shelton, & Owings, 1980). For example, what's the significance of the elasticity of arteries? How does this property relate to the functions that arteries perform? Note that our imaginary passage states that arteries can carry blood from the heart—blood that is pumped in spurts. This provides one clue about the significance of elasticity—arteries may need to expand and contract to accommodate the pumping of blood. It can also be important to understand why veins do *not* need to be elastic. Since veins can carry blood back to the heart, they may have less of a need to accommodate the large changes in pressure resulting from the heart pumping blood in spurts.

The process of clarifying the significance of facts about veins and arteries can be carried further. Since arteries carry blood *from* the heart, there is a problem of directionality. Why doesn't the blood flow back into the heart? This will not be perceived as a problem if one assumes that arterial blood always flows downhill, but let's assume that our passage mentions that there are arteries in the neck and shoulder regions. Arterial blood must therefore flow uphill as well. This information might provide an additional clue about the significance of elasticity. If arteries expand from a spurt of blood and then contract, this might help the blood move in a particular direction. Arteries might therefore perform a function similar to one-way valves.

My colleagues and I have argued that there are at least two important consequences of activities that enable a learner to understand the significance or relevance of new factual content (e.g., Bransford et al., 1980). First, people who understand the significance of facts develop knowledge structures that enable them to deal with novel situations. As an illustration, imagine that a biological novice reads a passage about veins and arteries and is then given the task of designing an artificial artery. Would it have to be elastic? A person who has merely memorized the fact that "arteries are elastic" would have little basis for answering the question. In contrast, the person who understands the significance or relevance of elasticity is in a much better position to approach the problem. For example, this person might realize the possibility of using a relatively nonelastic material that is sufficient to withstand the pressure requirements of spurting blood, plus realize the possibility of equipping the artificial artery with one-way valves that direct the flow of blood. This individual may not be able to specify all the details for creating the artificial artery, of course, but he or she at least has some appreciation of various possibilities and has an idea of the types of additional information that need to be discovered or acquired.

Activities that enable people to understand the significance of new factual content also facilitate memory. Facts that initially had seemed arbitrary and confusing become meaningful; the information is therefore much easier to retain. As an illustration, consider once again the earlier statements about the different types of men. I noted that college students have a difficult time remembering which man did what because the relationship between the type of man and the actions

performed seem arbitrary. These same statements become easy to remember if students are supplied with information, or are helped to generate information, that renders these relationships less arbitrary (Stein & Bransford, 1979). For example:

The tall man purchased the crackers that had been lying on the top shelf.

The bald man read the newspaper in order to look for a hat sale.

The funny man liked the ring that squirted water.

The hungry man purchased the tie so that he could get into the fancy restaurant.

The short man used the broom to operate the light switch.

The strong man skinned the book about weightlifting.

Elaborations such as these help people understand the significance or relevance of linking a particular type of man to a particular activity. They are therefore able to answer memory questions such as "Which man purchased the tie?" "Which man used the broom?" etc. In a similar manner, people who understand the significance of various properties of veins and arteries (e.g., the significance of the elasticity of arteries) are able to remember which properties go with what, and the child who understands the significance of having metal detectors in airports is better able to remember this fact.

It is important to note, however, that there are constraints on the type of additional information, or elaboration, that will enable students to understand the significance or relevance of new facts. As an example, consider the following list:

The tall man purchased the crackers from the clerk in the store.

The bald man read the newspaper while eating breakfast.

The funny man liked the ring that he received as a present.

The hungry man purchased the tie that was on sale.

The short man used the broom to sweep the porch.

The strong man skinned the book before going to sleep.

These statements include elaborations that make sense semantically, but the elaborations do not help one understand why a particular type of man performed a particular activity. College students who receive a list of 10 sentences such as those above do *worse* than students who received the first list (the list *without* any additional elaboration; Stein & Bransford, 1979). My colleagues and I refer to elaborations such as those just noted as *imprecise* elaborations. In contrast, *precise* elaborations (such as those provided earlier) clarify the significance or relevance of facts (Stein & Bransford, 1979; Stein, Morris, & Bransford, 1978). Imprecise elaborations can make sense semantically; that is, they need not be nonsense. Nevertheless, they can actually produce poorer memory than a set of arbitrary statements that receive no elaborations at all. Note that there are many potential elaborations of facts about veins and arteries, airports, etc., that would

also be imprecise. For example, a statement such as "Arteries are elastic so that they can stretch" does not help one understand why they need to be elastic, and a statement such as "There are metal detectors in airports that are used to check passengers" does not help one understand what is being checked nor why.

An emphasis on the degree of precision necessary to help people understand the significance of facts is important for analyzing the issue of what it means to "simplify" texts. A text can be composed of relatively simple words and simple syntax yet still seem quite arbitrary. My colleagues and I asked metropolitan Nashville teachers to provide us with samples of some of the passages their elementary school students are asked to read, and found a large number that seem arbitrary. For example, one passage discussed the topic of "American Indian Houses." It consisted of statements such as "The Indians of the Northwest Coast lived in slant-roofed houses made of cedar plank.... Some California Indian tribes lived in simple, earth-covered or brush shelters.... The Plains Indians lived mainly in teepees," etc. The story provided no information about why certain Indians chose certain houses. For example, it said nothing about the relationship between the type of house and the climate of the geographical area, nor about the ease of finding raw materials to build houses depending on the geographical area. Furthermore, the story said nothing about how the style of house was related to the lifestyle of the Indians (e.g., teepees are relatively portable). If students either did not know or failed to activate this extra information, the passage was essentially a list of seemingly arbitrary facts.

Other passages we examined discussed topics such as tools, animals, machines, and so forth. In each case, the passages contained a number of facts, yet frequently failed to provide the information necessary to understand the significance of the facts. For example, a passage describing two types of boomerangs—a returning versus a nonreturning boomerang—provided information about each boomerang's shape, weight, length, function, and so forth. However, it failed to systematically help the reader understand how the structure of each boomerang was related to its function (e.g., how the shape affected whether it returned to the thrower or not, how the weight was a factor in determining whether a boomerang could be used to hunt small versus large game, and so forth). The passages about animals also failed to help students focus on relationships between structure and function. For example, camels have a number of properties that help them adapt to certain aspects of desert life, including desert sandstorms. Facts such as "camels can close their nose passages" and "camels have thick hair around their ear openings" become more significant when one understands how they reduce problems caused by blowing sand. Students who are unable to make these connections on their own experience difficulty because the facts seem arbitrary. They also fail to develop a level of understanding that can provide support for learning subsequent materials. For example, a student who realizes how various properties of camels protect them during sandstorms is in a better position to

understand a subsequent story about desert travelers who wear scarves over their faces even though it is hot.

It is important to note that passages such as the ones I have described do not necessarily seem arbitrary to someone who has already developed expertise in these areas. The expert not only already knows the facts but also understands their significance or relevance. Even new facts (e.g., camels can close their nose passages) can seem meaningful to the person whose preexisting schemata provide a basis for understanding their significance (e.g., a person may already know that camels are adapted to survive in desert sandstorms). Adults who construct or evaluate passages for children are usually in a "schema activation" mode, but children who read these passages are usually confronted with the problem of constructing new schemata or of developing more detailed schemata. This is as it should be; the goal of the educator is to help children develop new skills and knowledge. However, we need to recognize that schema activation and schema construction represent two different problems. Our attempts to simplify texts can be self-defeating if we inadvertently omit the kinds of precise elaborations necessary for understanding the significance of the information. Indeed, we may sometimes need to introduce children to relatively sophisticated concepts that can provide a basis for more precise understanding. For example, the general concept of adaptation (of structure–function relationships) provides a powerful schema that supports the comprehension of new facts in a number of domains (e.g., structure–function relationships are important for understanding biological systems such as veins and arteries, tools such as different types of boomerangs, animals and environments such as camels and their desert habitats, and so forth). The careful introduction of core concepts such as this one may facilitate learning to a considerable degree.

## Summary and Conclusions

I began by reemphasizing Professor Anderson's arguments about schema theory because they are extremely important. For example, Dr. Anderson's discussion of the six functions of schemata provided a powerful argument for the pervasive effects of students' preexisting knowledge. I elaborated on two implications of his argument. One implication was that students may have developed partial schemata that are sufficient for understanding some types of statements but not for understanding others. We therefore need a more precise analysis of what it means for students to be "familiar" with the words in a text. The second implication was that preexisting schemata affect the interpretation of teachers and authors as well as the interpretation of students, and that a person's interpretation can affect the way that he or she phrases test questions. If there is a mismatch between the phrasing of a question and a student's interpretation of a passage, decrements in performance can occur.

Most of my comments were directed at differences between schema activation and schema construction. Professor Anderson noted that these represented two different (although related) problems. Most of the experiments he discussed dealt with schema activation because this represents the current state of the experimental literature. I emphasized schema construction because a major task for the educator is to help children develop new knowledge and skills.

The concept of precision provided the framework for my discussion of schema construction. To the novice, new facts can seem arbitrary unless they are precisely elaborated in a way that clarifies their significance or relevance. New facts that are not elaborated, or that are imprecisely elaborated, are difficult to remember and hence are not available for future use. In contrast, precisely elaborated facts can be integrated into new schemata that can provide support for the comprehension of subsequent texts. I also noted that texts can be composed of simple words and syntax, yet can still seem arbitrary to the novice; the notion of what it means to "simplify" texts, therefore, warrants careful consideration. Indeed, we may need to introduce children to relatively sophisticated "core concepts" that can provide a basis for understanding the significance of a wide variety of new facts.

The final point I want to emphasize involves an issue which I have not mentioned but which I feel is extremely important. I have noted that texts which are not precisely elaborated can seem arbitrary to the novice, but I do not believe that children's materials should always be elaborated explicitly. The reason is that children must learn to identify situations where they need more information in order to understand precisely; and they must learn to supply their own elaborations. More generally, I believe that they must learn about themselves as learners. This includes an understanding of how different texts and text structures influence their abilities to comprehend new information and to remember it at later points in time.

My colleagues and I have been working with fifth graders who are proficient at decoding but who differ in their abilities to learn from texts. In contrast to the successful learners in our samples, our less-successful learners have very little insight into the factors that make things easy or difficult to comprehend and remember, and they rarely attempt to use information that is potentially available to understand the significance or relevance of new facts. Their ability to learn is therefore impaired. We have created sets of materials that enable these students to experience the effects of their own learning activities and that enable them to learn to modify their activities. We find that these exercises can improve their performance considerably. In order to do this, however, we purposely create materials that are arbitrary, help the students evaluate these materials and experience their effects on memory, and then help them learn what to do to make the same materials significant or relevant. This seems necessary in order to help the students learn to learn on their own. The learning-to-learn issue is beyond the scope of Professor Anderson's paper and mine. I simply wanted to mention the

issue at this point in order to emphasize that the procedures necessary to make texts easy to learn are not necessarily identical to those necessary to help children learn to learn on their own.

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