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ABSTRACT

The movement away from a stimulus-response to a constructive view of memory and reading comprehension has had an impact on both reading research and teaching. Viewing memory as not simply the recollection of sensory data, but as the complex interaction of the sensory experience with its immediate context and the perceiver's previous knowledge, contemporary research sees reading comprehension as dependent on the reader's ability to use his or her background knowledge as well as to recognize specific letters and words. According to this theory, reading disorders derive from either lack of appropriate schemata--that is, hypothetical knowledge structures generalized from memories--or undeveloped control strategies for using schemata. Recent research, therefore, concentrates on how successful readers use schemata to reach an understanding of new material, and how inferencing processes operate and can be improved in poor readers. (MM)

Occasional Paper No. 1

READING AND REMEMBERING: A CONSTRUCTIVIST PERSPECTIVE ON READING COMPREHENSION AND ITS DISORDERS

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Introduction

The history of research and pedagogy in reading reflects growth and change in the social sciences. In the last decade, the number of models, theories and hypotheses explaining how people learn to read, read to learn, and remember from reading has rapidly expanded (Singer and Ruddell, 1976; Wolf, McQuillan and Radwin, 1980). Along with theoretical shifts, changes in reading research and pedagogy have emerged from the fertile cross-pollination of work in linguistics, psychology and pedagogy.

This paper will focus on examining ways in which theoretical changes in conceptualizing memory and language comprehension are affecting reading research as well as the teaching and assessment of reading and perspectives on disorders of reading comprehension.

Views on Memory and Models of Reading

Models of memory have always been relevant to reading educators and the study of reading, similarly, has been a crucial one for psychologists looking for another window into the mind.

Two distinct theories that have emerged from efforts of psychologists to account for the remembering process have been especially seminal for educators. The first has been called the "reappearance" or abstract trace hypothesis (Neisser, 1966). Central to this position is the notion that remembering involves reviving a memory trace which essentially is a stored copy of the sensory experience. The content of the trace can be completely described by the initial event and, thus, remembering involves locating this trace in memory and bringing its contents to consciousness.

This viewpoint is consistent with learning theories that characterize the human organism as being driven by sensory stimuli which

are said to "evoke" or even "control" responses. Seen in this light, higher order processes are amalgamations of simple, lower order processes. This logical empiricism, so typical of much of the input from the social sciences to American education, has predominated both philosophically and methodologically in the preceeding two decades.

Models of reading flowing from this influence, such as that proposed by Gough (1972), contend that processing in reading is data-driven in that all decisions about visual units, such as letters or words, must be made before the data are transformed into the kind of meaning code necessary to allow instantiation into long term semantic memory. The memorial structures never serve to direct the hypotheses about what a particular word or letter might be.

When reading is analyzed in this way, the component levels of processing appear to be organized hierarchically and the attainment of any given level presumes the execution of all subordinate levels. Further, the motion is conceived of as being unidirectional. Whereas the reading of the text depends on the reading of its sentences, words and letters, an individual letter may be perfectly legible whether or not it is embedded in a word of larger context. Similarly, readers are able to read individual words, phrases and sentences in the absence of a larger context.

The appeal of this analysis of reading is in its logical simplicity. For pedagogues it provides a rational structure for instructional programs starting with the letter, or perhaps lower with the features of letters, and working up to larger contexts. For researchers it provides a method of isolating and organizing processes.

The difficulty with this approach is in its ecological validity. When one is reading a meaningful, contextually rich passage, the normal reading activity, one does not seem to focus on letters, words and phrases in the same way as one does in an out-of-context experimental situation. Rather, processing at each level is influenced by both higher and lower order information. Thus, individual letters become more easily perceived when embedded in words (Wheeler, 1970; Kolers and Katzman, 1966), individual words are recognized more easily when embedded in meaningful sentences (Kolers, 1970; Tulving and Gold, 1963), the perception of unfamiliar words is enhanced by a familiar context (Wittrock, Marks and Doctorow, 1975) and sentences that integrate conceptual relations are more easily read even if their syntactic complexity is greater (Pearson, 1974-75; Haviland and Clark, 1974).

These sorts of facilitations from context greatly ease the task of reading but complicate the business of research. They challenge the empirical, bottom-up models of reading and bring into question instructional practices based on logical analyses of reading.

A second theory of remembering, commonly referred to as "constructive" theory (Bransford, Barclay and Franks, 1972; Anderson and Ortony, 1975) also involves the notion that remembering requires finding and bringing to consciousness stored records of past events. However, in this case, the contents of the memory trace are not definable in terms of the initial experiences that created the traces. Rather, the contents of the memory trace are jointly determined by the initial event, the present knowledge structure of the learner and the salient features of the environmental context in which the event takes place. Whereas reappearance theory would suggest that memory

of identical sensory experiences should be the same for two learners (with the exception of omissions of content), constructive theory would suggest that two learners experiencing the same event would very likely have very different contents in their memory representation.

Emerging from this conceptualization of memory has been the proposal of an essentially top-down model (Goodman, 1976; Smith, 1978) with a conceptually driven processing model. In these models, bottom-up processing is necessary only in the most dire of contextually impoverished circumstances, such as the paired associate tasks of experimental research design.

Still other models, most notable, that of Rumelhart (1977) argue for a constant and simultaneous generation of hypotheses about both visual and meaningful information. The domination of one mode (data-driven versus conceptually driven) over another depends upon factors such as background knowledge, text difficulty and the nature of the reading task. Hypothesized is a constantly shifting interactive process depending on familiarity with the topic, the syntax, the lexicon and purpose for readings; for example, understanding versus proofreading.

Such models are particularly attractive to reading educators because they better explain collected data on reading performance. Extensive observational data collection on reading performance suggests that syntactic and semantic variables influence the reading behavior of even very young readers (Goodman, 1970; Biemiller, 1970; Weber, 1970).

It is Rumelhart's type of interactive model which is now a dominant one shaping pedagogical practices and research in reading.

Central to this model, the constructive view of memory undergirding it and the processes it engenders is the theoretical construct "schema." Though recently emphasized, it is a concept in early psychology (Bartlett, 1932; Head, 1926; Woodworth, 1938), and finds even earlier amplification in philosophy and formulation of rules of "productive imagination" (Kant, 1787). A simple discussion of the term will set the stage for understanding the emerging trends in research and practice.

What Is a Schema?

A schema is an hypothetical knowledge structure which represents an organization of a comprehender's experiences with the real world. The term hypothetical is important as a caveat against reifying a structure that we can only hypothesize on the basis of observation and experimentation. These knowledge structures are abstract in that they are not merely an accretion of experiences but rather a generalization from experiences.

The term schema applies to a wide range of objects, ideas, and phenomena. For example, one might have a schema for chair, for fidelity, for actions such as buy. Schemata have been characterized as not corresponding to one particular experience but rather to a common set of features, for example, those features of chair that make recognizing the next one possible. Alternatively, the schema may not be so much a set of abstract features as a prototype, as, in the case of chair a dining table chair (Rosch, Mervis, Gray, Johnson and Boyes-Braem, 1976). Besides objects, one can consider schemata for ideas, such as fidelity, for actions such as buy, sell, give, and for events, such as attending a conference, giving a paper, and so forth.

Rumelhart (1977) has compared schemata to plays. Just as a play has a plot, characters and actors, so schemata have corresponding parts. For example, in a buy schema, there is a buyer, a seller, an object to be purchased, a money, a place for exchange. These are the cast and setting of a play. In such a schema, there is an order to the process, much like the order of scenes in a play. Last, there are the actors, the particular buyer, seller, object, and so forth.

One important characteristic of schemata is their hierarchical organization. For example, the schema for attending a soccer game is seen as embedded in the more general framework of attending a sporting event which is, in turn, embedded in a larger schema for attending large social events (Rumelhart and Ortony, 1977). A great deal of research has been done to verify that semantic networks of relations among various concepts or schemata exist (Shoben, 1980). A hypothesized cross-referencing occurs when variables in one schema are filled by values that exist within other schemata and the explanation of this crossover is a prime consideration of work in artificial intelligence (Minsky, 1975; Winograd, 1975).

Whether conceptualized as scripts, plans (Schank and Abelson, 1975), frames (Minsky, 1975) or schemata, another essential component of this type of knowledge structure is that of variable slots which can be likened to the roles in a play. These slots are filled (instantiated) by values which can be different or changing. For example, in a buy schema, any human being is a potential for filling the slot of buyer. For a medium of exchange, fewer values exist; for example, cash, check or credit card.

Variable constraints exist in the situations which supply the boundaries for the range of things that can fill a particular slot.

For example, in a buy schema, consider the purchase of a small scarf. There, the variable constraints on payment would allow for any of the alternatives mentioned. If the object to be purchased is a house or apartment, the cash payment becomes extremely unlikely.

This facet of schema structure has been most interesting to reading educators in that it allows for enrichment of the text through elaboration and inferences. While inference on a larger scale is involved in the process of deciding which schema among many can be called into focus, it is also involved in the process of instantiating variable slots within a selected schema. This can occur in different ways. First, one may use inferential processes to decide that a particular value mentioned in a story is intended to fill a particular variable slot. For example, "I went out to buy shoes yesterday. My, was Field's crowded." In this case, one might infer that the shoes were purchased at a store called "Field's" even though that was not explicitly stated in the passage. The reader makes a text-connecting inference, recognizing the relationship between the elements of two different text segments.

A second way in which inferences function is by the assignment of default variables to variable slots in the absence of any information from the text. A default value is simply the comprehender's best estimate of what is likely to fill a particular slot. This choice is constrained by the comprehender's knowledge of the variable constraints for a particular slot. For example, for "I ate all the soup. It was delicious," one will most likely infer spoon rather than knife as the instrument used to manage the deed of eating the soup. A large body of evidence suggests that we quite normally make routine inferences of objects, instruments, and spatial and logical relations when we read and listen (Bransford and McCarrell, 1974).

Current Research and Practice

Many strands of current research in reading education stretch from the seminal construct of schema. Researchers and practitioners are looking at what a well-formed text or story is and how this structure relates to the activation of schemata in young readers. Also under study are control and inferencing processes, with hope that techniques can be developed to get the reader to connect the text based on his or her knowledge base in the most productive fashion. Further, the role of vocabulary development as a tool for creation of the knowledge base is undergoing a re-examination. Schema theory also offers an excellent model within which to reconsider the issue of disorders of reading comprehension.

An historical examination of the research of reading disability will reveal many attempts to isolate the factors of memory and perception as the primary variables which distinguish good from poor readers. Many investigations suggested that disabled readers exhibit deficits on retention tasks (Alwith, 1963; Senf, 1973; Noelker and Schumsky, 1973; Samuels and Anderson, 1973).

When reviewed, however, the research on memorial processes of disabled readers has been equivocal at best. The bulk of the research normally cited utilized non-meaningful stimuli which make extrapolation to reading comprehension difficult. Indeed, the supposition of generalized poor memory processes as an explanation for reading disability is now in question (Torgesen, 1978-79, gives an excellent review; Blachowicz, 1980). Clinical researchers are looking for more specific differences in processing and are finding some insights from developmental research on schema utilization and enhancement.

Three characteristics of schematic processes which are obviously related to reading performance are schema availability, schema activation and schema maintenance.

Looking at prior knowledge, Omanson, Warren and Trabasso (1978) find it a powerful variable that has often been a confounding one in memory research. Working with five-year-old and eight-year-old subjects who had equivalent levels of veridical recall, they found that the eight-year-olds drew significantly more inferences than the younger subjects. Since inferential limits were not due to memory capacity, it was hypothesized that they were consequences of insufficient prior knowledge. In other words, their background knowledge was insufficient to extend the literal for inferential comprehension.

Working in the same area, Pearson, Hansen and Gordon (1979) focused on young readers whose abilities to answer literal questions from a read selection were equivalent. Those with greater prior knowledge on the topic, in this case knowledge about spiders, performed better on all inferential tasks, supporting the conclusions of the former study.

Spiro (1975) proposes that the problem need not only be one of schema availability, having the appropriate prior knowledge, but may also be conceptualized as a difficulty in schema activation and integration. He suggests that many readers approach reading tasks as if they were memory experiments rather than as opportunities for expanding knowledge. Subjects in several of his experiments were presented with information in a read format that was modified by later new input. He found that they appeared to compartmentalize new information gained in the reading tasks as sepa-

rate from prior "real life" knowledge. He suggests that there may be differing styles of processing relating to reading with some readers regarding the text base as separable and non-assimilatable into one's knowledge base. Spiro alternately suggests that information gained from reading is not seen as very "real" or important and, thus, is not integrated into the general knowledge base.

The process of maintaining the appropriate schema as changing to another when it is called for is a third area of processing which can cause difficulty in reading. Research suggests that poorer readers have more difficulty in recalling connections across sentences (Spiro, Boggs and Brummer, 1979) and in connecting information in sentences which are not contingent (Di Vesta, Hayward and Orlando, 1979). In general, it appears that relationships between ideas in separate sentences unlinked by cue words (such as because, since, therefore) are more difficult for disabled readers to comprehend than more explicitly linked text (Marshall and Glock, 1978-79; Irwin, 1980). In working with disabled older readers with a visualizable text, Blachowicz (1979) found that their literal comprehension performance was equivalent to their IQ-matched age mates. However, their performance differed significantly on tasks involving drawing connections between two and three sentences.

This type of difficulty with reading can also be characterized as one of metacognitive strategies. Brown and Smiley (1978) have found that young children often do not know the important units of information in discourse. Children who do spontaneously attended to the important units in the text, who underlined, took notes and

so forth, have improved comprehension. Several other studies suggest that young children often do not know the semantic structures of the text, strategies for comprehending meaning or objectives for reading a text (Meyer and Paris, 1978).

In terms of pedagogical research, then, a primary thrust is to develop research-verified techniques for enhancing comprehension behavior and for developing the inferential strategies of poor readers. Comprehension can be considered a "generative" process in that the reader's active construction of verbal, imaginal and related representations of the text produces or enhances the understandings that comprise reading comprehension. It is interesting that an emerging body of research showing growth in inferential processes involves having readers act, as it were, on the text, producing an enhanced comprehension. This process of construction can take many forms. Hansen (1981) carried out a study with school age children in which the experimental treatment involved generating predictions about events in the material to be read and answering questions which involved constructing inferences between the text and prior knowledge. Both treatments resulted in significant growth in comprehension on both standardized and experimenter-constructed measures.

Doctorow, Wittrock and Marks (1975) asked young readers of high, average and low ability to summarize each paragraph they read in a sentence immediately after reading it. Some of the groups of students also received paragraph headings as aids to serve as cues for the relevant schema. The sentence generation task was hypothesized to facilitate the construction of relations between the reader's schemata and the story. As was predicted, the genera-

tion of sentences and presence of cues enhanced retention and comprehension, with the combination of the two doubling comprehension at each level of ability.

Such elaborative processes may be especially important for readers whose culture differs from that depicted in materials to be read. Au (1977) reported results of a cognitive training program used to enhance comprehension of minority Hawaiian-American students. This program emphasized the action of verbalization of their experiences and knowledge as they read stories. The teacher's questioning emphasized translation activities, recall of personal events that related to the story and the drawing of inferences. Again, the program was marked by significant gains for the experimental subjects over control groups as well as by changes in attitude toward reading.

Paris, Lindauer and Cox (1977) taught children to construct paragraphs about sentences they read which would integrate the sentences into a meaningful whole. The children were able to construct inferences relating the sentences but it was not a spontaneous process. Thus, though not deficient in the ability to produce inferences, they did not seem to have the control strategies to call up such processes on their own.

In a study with related conclusions, Bommarito and Meichenbaum (1978) taught reading disabled children in the junior high school to organize their reading habits as they read a story. They asked themselves questions about main idea, important details, sequence of events and characters, feelings and responses. The training group again showed significant gains in comprehension and suggested that this lack of spontaneous inferencing behavior is characteristic of both young readers and of poor readers.

These research-based techniques for fostering constructive reading processes are now finding their way into the programs and literature of teacher preparation (Spiegel, 1981 ; Blachowicz, in press). A project is now underway to examine the effect of schema related vocabulary development techniques of disabled readers (Blachowicz, 1982) and to analyze videotaped teaching sessions to pinpoint the differing ways in which normal and reading disabled students respond to such instruction. Two programs of vocabulary development stressing cognitive categorization have already resulted in impressive gains in comprehension development (Beck et al, 1982; Johnson, 1982).

Conclusion

Viewing the area of reading education research, one comes away with several impressions uniting what seems to be a wide ranging body of research. Most obvious is that the debt of the field to psychology, linguistics and sociology continues to be great. The river of reading education is contained within the banks of the social sciences and reflects the movement away from a conceptualization of memory and comprehension as stimulus-response activities towards one stressing constructive processes on the part of the comprehender. Conceptualization of and research in memory has had especially direct and analogical influence on work in reading.

The stuff of comprehension is clearly not viewed as the residing on the pages of text. Rather, reading comprehension occurs only when readers use their psychological processes, perception, attention, encoding and memory to transform the printed symbols into meanings reflective of their knowledge and experience.

These processes, along with the linguistic, neurological and pragmatic variables influence the meanings readers construct as they move through a text. The outcome of reading, therefore, consists of more than a reconstruction of the author's meaning. Rather, within the constraints of the lexicon and syntax, readers construct one or more messages consistent with their knowledge structures and those they perceive to reflect that of the author.

This viewpoint is of special interest to those interested in disorders of reading because it provides a new perspective from which to view breakdowns of the reading process. Lack of appropriate schemata, undeveloped control strategies for maintaining or varying schemata can all be associated with failures to comprehend.

There appear to be some developmental trends in the ability of a reader to control strategies for making inferences so necessary to higher order comprehension. These processes, even when not spontaneous, seem to be able to be induced further, challenging the generalized memory deficit view of reading disability. Individual differences in the ability to generate appropriate elaborations seem to exist and the research is emerging to indicate ways to enhance comprehension strategies. Thus, along with considerations of attention and neurological functioning, the construction of a knowledge base and ways to enhance its utilization and control should prove to be prime considerations in reading education research for years to come.

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