DOCUMENT RESUME

ED 226 341 CS 007 018

AUTHOR Ehri, Linnea C.

TITLE State of the Art Address: Learning to Read and Spell.

PUB DATE Aug 82

NOTE 28p.; Paper presented at the Annual Meeting of the American Psychological Association (Washington, DC, August 23-27, 1982).

PUB TYPE Information Analyses (070) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.

DESCRIPTORS *Beginning Reading; Cognitive Processes; Early Childhood Education; *Learning Theories; Miscue Analysis; Oral Reading; Reading Difficulties; *Reading Instruction; *Reading Processes; Reading Rate; Reading Readiness; *Reading Research; Reading Skills; *Spelling; Spelling Instruction

ABSTRACT

Research on children's oral reading errors provides evidence that both top down and bottom up processes interactively contribute to reading. Syntactic and semantic expectations are sources of information for top down processing, while knowledge of letter-sound relations provides information for bottom up processing. As children learn to read, interaction between top down and bottom up processing becomes more frequent. Since word recognition becomes automatic as readers progress, how rapidly children can read familiar words is an important factor in text reading, distinguishing between skilled and poor readers. Different explanations have been proposed for how children store spellings in memory; most likely spelling is a symbol linking visual representation to a word's pronunciation. Both flashcards and meaningful text help children with some aspects of word learning, but neither method is adequate for acquiring complete word knowledge. Although these ideas on reading have experimental support, many questions about reading comprehension, reading readiness, and the actual classroom practice of the teaching of reading remain to be answered. (JL)

American Psychological Association Annual Meeting

Washington, D.C., August, 1982

State of the Art Address:

Learning to Read and Spell

Linnea C. Ehri

University of California, Davis

One of the most important tasks facing children when they enter school is learning to read and spell. Since around 1974, I have been studying psychological processes involved in the acquisition of reading and spelling skill. The focus of my talk today is upon the current status of some of the research on this topic, some of the issues which have erupted, and where I think future research ought to head. In order to limit my remarks to 30 minutes, I have had to omit the names of many of the researchers responsible for the studies cited. Also I have not been able to cover as much ground as I had originally planned. So be advised that everything important to say about the subject will not be said, particularly about the development of spelling skill.

First, a bit of history. In their 1975 text on the Psychology of Reading, Gibson & Levin distinguish two types of research on reading and three periods when one or the other type was popular. Between 1880 and 1925, experimental and educational psychologists sought to understand the process of reading by performing carefully conceived experiments to test theoretical positions. This group included such notables as Cattell, Thorndike, Woodworth, Huey, and Buswell among others. Then around 1920 the focus of research changed dramatically. It became oriented toward curricula and toward

determining whether one method of teaching reading might be superior to another. This was the beginning of the "phonics" versus "whole word" debate which dominated the scene for 40 years and which yielded numerous studies with conflicting results. Jeanne Chall reviewed this work in her 1967 book, The Great Debate. In the 60s, things changed again. Interest in theory-based research began to grow. Reading was regarded not narrowly as a unique process to explain but more broadly as a process involving perceptual learning, or psycholinguistic activity, or information processing, and psychologists applied one or another of these theoretical perspectives to their investigations of reading. Initially, researchers tended to focus on a single process and regard it as the core of reading skill. However, more recent work has made it clear that multiple components are involved and that reading must be viewed as a complex interactive process.

To talk about processes and their interaction, two terms have become popular. The two terms, top-down processing and bottom-up processing, are derived from computer usage and refer to the way that readers arrive at an interpretation of what they read. Bottom-up analyses begin by analyzing features of the graphic stimulus to arrive at higher levels. Top-down analyses start with expectations about sentence structure and meanings expressed in the text and then move down to lower levels by checking properties of the graphic stimulus to verify contextual expectations. A few years ago, the controversy over whether text reading is a top-down or a bottom-up process reached its peak. Following much argument, most researchers came to agree that reading involves both processes interacting with each other.

What I want to do in my talk is present an interactive model of the reading process as it is thought to be executed by beginning readers once they know enough about the orthographic speech-mapping system to be able to read simple text. This will allow me to consider how the various components

develop and contribute to the text reading process and in turn how text reading contributes to the development of component skills. One reason for approaching the topic in this way is that text reading begins very early during acquisition, so component skills are acquired mainly by practicing the act of reading.

Research on children's oral reading errors provides evidence that both top-down and bottom-up processes contribute to reading and that they participate interactively. The procedure in these studies is to have the child read a text aloud and to record all instances where what is said deviates from what is printed. The kinds of oral reading errors produced indicate that several sources of information influence the text reading process.

Two of these sources involve top-down processing. When children make errors, these errors tend to preserve the meaning and syntax of the sentence up to the point where the error was made. For example, Weber (1970) observed that 91% of the errors made by first graders were syntactically acceptable. In fact, most word substitutions were the same part of speech as the printed word. Of these errors, 93% also fit the meaning of the sentence and 68% fit the meaning of the whole passage. Another general finding is that when children spontaneously correct their errors, they are more apt to do this when the error disrupts the syntax or meaning of the sentence. They are less likely to self correct if the error makes sense. These facts point to two components involved in text reading. One is the reader's expectations about the syntactic structure of the sentence being read and how upcoming words fit into this structure of noun phrases and verb phrases. Another is the readers' memory for meanings already read and how upcoming print will add to this meaning. These two components are depicted in Figure 1 of your handout. Of the two sources, syntactic expectations appear to be more dominant than

semantic expectations, since errors are more often syntactically acceptable than semantically acceptable.

Another set of findings about oral reading errors points to the operation of bottom-up processing. One finding is that the majority of children's errors are cases where a different word is substituted for the printed word. Weber (1970) observed that 80% of the errors made by her first graders were word substitutions. Relatively few errors were word omissions, insertions or scramblings. This suggests that during text-reading, children notice letter clusters flanked by empty spaces and are compelled to produce a word for each cluster. Another finding suggesting bottom-up processing is that very often, the errors produced are graphically similar to the words in print. Weber (1970) observed that over half of the substitutions produced by her first graders had the same first letter as the printed word. Biemiller (19) observed that when first graders were given more difficult text to read, the proportion of graphically constrained errors rose. Two kinds of graphically constrained errors occur, errors where another real word sharing some of the same letters is produced, and errors where a graphically similar nonword is produced. Nonwords are more typical of beginning readers who have learned to read with a method emphasizing letter-sound decoding rules. This error type indicates that readers are attempting unsuccessfully to sound out the printed letters. Nonword responses are less common among beginners who have learned to read with a meaning-emphasis. Their errors tend to be real word substitutions. From these findings, it is apparent that knowledge of letter-sound relations supplies a source of information used by beginners to perform bottom-up processing of text. This source is also represented in Figure 1 on the far right. Children might attempt to sound out and blend all of the letters in a spelling, or they might recode some of the letters and then guess at the rest of the word.

It is interesting to note that graphic substitution errors have been reported to occur less frequently than syntactic and semantic errors. One interpretation given this is that top-down control over the reading process is more important than bottom-up control. However, another more likely interpretation is that attention to graphic cues leads more often to a correct response than attention to syntactic and semantic expectations, and this holds down the number of graphically controlled responses which end up as reading errors.

Findings of oral reading studies also show that interaction between top-down and bottom-up processing occurs and in fact becomes more frequent as children learn to read. Both Biemiller (1970) and Cohen (1974) studied first graders longitudinally and observed increases at the end of the school year in the proportion of word substitutions which were both graphically and syntactically similar to the printed word. This suggests that children learn to coordinate their expectations about syntax with the graphic cues they see in print as they become more proficient readers.

Studies have also been conducted comparing the oral reading errors of skilled and less skilled readers. Results have indicated, not surprisingly, that poor readers make more errors than good readers. However, their errors are not all that different. In fact, some studies have found that poorer readers produce almost the same proportion of syntactically and semantically acceptable errors as good readers, indicating that contextual expectations exert as much influence over their reading. Where poorer readers tend to be deficient, according to some studies, is in the effective use of graphic cues and in self-correcting those errors which are grammatically unacceptable. This suggests weakness both in the use of contextual cues and in letter-sound recoding skill.

One fact about oral reading error data which is important to note is that the proportion of errors made by readers is usually very small, that over 80% and usually 90 to 95% of the words in the text are read accurately. Researchers differ in whether or not they regard processes controlling the production of errors to be the same as those controlling accurate reading. Goodman (1970, 1976) claims that oral reading errors serve as a "window on the reading process," that readers are doing the same thing when they make errors as when they read text accurately, namely, they are forming syntactic and semantic expectations about upcoming text and confirming these by sampling graphic cues. However, it is not clear how syntactic and semantic expectations can support such accurate word prediction. Wildman and Kling (1978-79) conclude in a recent review article that readers use semantic and syntactic context to predict the classes of upcoming words, but they do not usually use this information to predict the precise identity of successive words. In addition, it is not clear how use of graphic cues can explain the high accuracy levels exhibited by less able readers who are known to have weak letter-sound recoding skills. These facts suggest that a source of information other than those considered so far is needed to account for the high accuracy levels.

Although some researchers such as Goodman (1976) minimize the role played by word recognition skill, other researchers consider this to explain how readers can process text so accurately. Numerous studies of word recognition in beginning readers clarify how this skill develops and contributes to text reading. The generally accepted view, based on LaBerge and Samuels' (1974) theory of automatic information processing, is that acquiring familiarity with specific printed words involves passing through three successive phases. During Phase 1, an unfamiliar word is recognized with increasing accuracy as readers attend to component letter-sound relations each time they read it. In

Phase 2, as a result of more practice, a familiar word comes to be recognized automatically as a whole, without attention and without deliberate processing of component letter-sounds. In Phase 3, the word comes to be recognized with increasing speed up to a maximum as processes involved in recognition and production become consolidated in memory. It is following Phase 2 when readers can recognize words automatically that the words should be easy to recognize in text, because recognition requires little effort.

To experience what it means to recognize printed words automatically, try labeling the pictures in Figure 2 of your handout. Name the pictures as rapidly as you can. Ignore the words printed on the pictures. You will find that the distracting words are hard to resist, and they definitely slow you down. Even though you do not say them aloud, you know what words are there and what they mean.

This is an example of the picture-word interference task which has been patterned after Stroop's color-word interference task. This task has been used to study the development of automatic word recognition skill in children. Various kinds of distracting word and nonword stimuli have been printed on pictures named by subjects. Examples are given in Figure 3 of your handout. These come from a study by Guttentag and Haith (1978) who compared how long it took children and adults to name pictures in the various conditions.

First, let me tell you how their adult subjects behaved. Adults took significantly longer to name pictures in each successive condition listed in Figure 3 beginning with Condition 3, the nonpronounceable letter string. The explanation is that each of these stimuli was recognized automatically and created a certain amount of interference which delayed execution of the picture name. The fact that letter strings delayed picture naming more than visual noise is interpreted to indicate that letters were processed

automatically. The fact that pronounceable letter strings created more interference than nonpronounceable letter strings indicates that letters were recoded to sounds automatically by adults. The fact that words from the same semantic category as the picture created more interference than words from a different semantic category indicates that word meanings were recognized automatically.

Guttentag and Haith (1978) compared younger readers' reaction times to name pictures across the various conditions to determine which properties of words and nonwords could be processed automatically. They tested beginning readers during the first and final months of first grade and they tested good and poor readers at the third grade level. They found that all but the early first grade readers processed letters automatically. More importantly, they found that all but the early first graders processed word meanings automatically. This indicates that children with as little as 9 months of reading instruction can recognize the pronunciations and meanings of familiar words automatically, without expending any effort and without even pronouncing the words aloud. Also, results show that poorer readers can recognize familiar words automatically. Other studies have reported similar results. The important point to be made with this data is that if younger and poorer readers can recognize words this easily when they are wishing to ignore them, then they certainly can recognize the same words easily when they endeavor to read them in text.

I have included word recognition skill as another source of information influencing the text reading process in Figure 1. The idea represented here is that readers possess something like a printed word memory bank and that they recognize familiar words in text by matching the print to a visual representation which is stored in memory along with its pronunciation and meaning. I will say more about this source of information shortly.

As I mentioned before, learning to read words automatically is not the final achievement in the acquisition of word reading skill. Even when beginning readers and poorer readers are able to recognize words automatically, the recognition process is still executed fairly slowly. I can show you this with data from one of our studies (Ehri and Wilce, 1983). We examined how quickly first, 2nd and 4th graders could read primer-level words thought to be highly familiar, words such as "boy", "car", "ball", and "hat". We selected skilled and less skilled readers at each grade level and compared their speed to read these words with their speed to name single-digit numbers. Results are presented in Figure 4 of your handout. We also had children identify some other kinds of stimuli: object pictures, number words, and CVC nonwords. I have circled the names of the conditions of interest here, object words versus digits. Notice that skilled readers at all grade levels could identify the words as quickly as the digits. In contrast, younger less skilled readers were quite a bit slower reading the words than naming the digits. My guess is that the less skilled 2nd graders could have recognized these words automatically if we had given a picture-word interference task, since they could identify the words as fast as the pictures. What they couldn't do was read the words at their maximum speed. How rapidly children can read familiar words turns out to be an important factor in text reading, a factor influencing the interaction between semantic and syntactic expectations and word recognition.

Studies have been conducted to examine whether sentence contexts affect the process of recognizing words during text reading. Recall that results of the reading error studies showed that semantic and syntactic expectations influence the production of <u>errors</u> during text reading. However, the data did not clarify whether such expectations also influence accurate word recognition. It may be that context cues are used only to guess at unfamiliar

words, not to read familiar words. Alternatively, it may be that holding relevant semantic and syntactic expectations speeds up word recognition when this process is executed slowly on its own. This possibility has been investigated by Stanovich, West and Feeman (1981), West and Stanovich (1978), and Juel (1980) among others. The procedure has been to examine how rapidly subjects can read single words right after they have read various kinds of sentences such as ones which are semantically related to the word, or ones which are semantically neutral. Results reveal that semantically related contexts enable adults as well as children to read the words faster than semantically neutral contexts. However, the boost provided by context is much larger among younger and poorer readers than among skilled readers. These findings indicate that semantic expectations do facilitate the process of recognizing familiar words during text reading. Their contribution is to speed up the word recognition process. Thus, they are most influential among beginning readers and poorer readers who are slower to recognize familiar words.

Stanovich (1980) and others point out that this evidence conflicts with claims about text reading made by Goodman (1976). Goodman proposes that as readers gain in reading skill, they come to make greater use of semantic and syntactic expectations and progressively less use of graphic cues. However, these findings indicate that the opposite is true, that better readers make less use of contextual expectations and greater use of graphic cues than poorer readers to recognize words.

Now that I have sketched how beginning readers are thought to process text and what sources of information they use, I would like to say a bit more about how they acquire the ability to perform bottom-up processing. I regard this as the most important part of reading acquisition to explain since it is the part that beginners know very little about, how to convert alphabet

symbols into meaningful speech. Studies have been conducted to examine how printed word knowledge develops. The idea depicted in Figure 1 is that readers store specific words in a word memory bank, also called a lexicon, and this information enables them to read words through a lexical matching operation. The printed words are thought to be stored in memory along with their pronunciations and meanings so that all this information is accessed together when the word is seen.

Researchers have investigated the properties of printed words retained in memory by beginning and more advanced readers. Studies indicate that initially children notice and remember boundary letters. The first letter is especially salient. Shape becomes important only among older readers. There is some disagreement over the extent to which the visual representations of words are letter specific. However, most of the evidence suggests that they are. Non-alphabetic characteristics of words may be used when children first become able to read a few words. However, when their print lexicon begins growing, it is letters that are retained in memory. Beginning readers may not have a good memory for all of the letters. The ones in the middle may be unclear. However, they do appear to analyze and store at least partial spellings.

Researchers have addressed the question of what it is that enables beginners to store spellings in memory effectively. There is disagreement about this. One view is that when letters can be recognized automatically, then visual representations of words can be retained in memory. There is evidence indicating that letter knowledge becomes automatic before word recognition does. Furthermore, letter name knowledge measured in kindergarten turns out to be the best single predictor of reading achievement at the end of first grade, better even than IQ. Although people disagree about whether this

correlation says anything about causation, it does point to the importance of letter knowledge.

Another explanation for how beginners become able to store word spellings is the one I favor (Ehri, 1978, 1980, 1983). The idea is that spellings function as visual symbols depicting the sound structure of words. It is by acquiring facility with this symbol system that readers become able to retain spellings in memory. When children learn how to divide pronunciations into phonetic segments and to interpret letters as symbols for these segments, and when they can process these relations automatically, they become able to retain word spellings in memory when they read the words. Younger and poorer readers may only be able to perform a partial analysis, so only some of the letters may be retained. This view is different from the other view. According to the other view, the word's visual representation is stored as a separate code from its pronunciation in memory. According to this view, the two are amalgamated in memory because the spelling functions as a visual symbol for the word's pronunciation.

To provide support for the latter view, we have performed studies which show that letters can function as a mnemonic to improve readers' memory for nonword pronunciations and that this capability is highly correlated with how many printed words first and 2nd graders can read (Ehri and Wilce, 1979). We have also performed studies to show that when children learn the spellings of words, this influences how they conceptualize the sounds in the words, particularly when some of the sounds are ambiguous. For example, the words "little" and "middle" have the same medial stop sound, /d/. Children who don't know the words' spellings think the sound in both "middle" & "little" is identical, /d/. Children who have learned the spellings think that the two sounds are different, one a voiced /d/, the other a voiceless /t/, based on

the spelling. Such studies are interpreted to indicate that spellings are remembered by being analyzed and stored as symbols for pronunciations.

Another question to be answered about word acquisition is what sorts of learning experiences help children build a lexicon of printed words. Clearly practice is required. But what sort of practice is best? Should beginners practice reading words on flash cards, or should they practice reading words in meaningful text? We have performed two experiments to answer this (Ehri and Roberts, 1979; Ehri and Wilce, 1980). We gave half of our first graders practice reading unfamiliar words in sentences. The other half practiced reading the words in isolation and then listened to the same sentences. Results revealed that both methods were good for some aspects of word learning but not others. Children who read words in sentences learned more about the meanings of the printed words whereas children who studied the words on flash cards were able to read words faster, and they remembered the words' spellings better. These results indicate that neither way of practicing printed words is fully adequate, at least for acquiring complete word knowledge.

We are just starting to understand how printed word knowledge is acquired. More of this research is needed. I would like to tell you about a study with adult readers. Results of this study indicate that when readers become skilled, they possess complete knowledge of word spellings and can apply this knowledge very rapidly in a text reading task. Zola (1979) had skilled adults read meaningful text while their eye movements were monitored with some very sensitive equipment. Included in the text were some misspelled words, for example, the word "fracture." Some misspellings were very subtle visually. A single letter in the middle was changed to a visually similar letter so the overall shape of the word was not disturbed. For example, in "fracture," an O was substituted for the letter C in the middle. Other misspellings were more obvious. The misspelled words appeared in two types of

sentence contexts, one where the word could be predicted easily by words preceding it, another where the word could not be predicted. For example, in the case of "fracture," the paragraph was about a football injury and the sentence stated that the player had sustained either a compound fracture, the predictable context, or a terrible fracture, the unpredictable context. Readers' eye movements indicated that they detected misspellings regardless of the type of letter substitution and regardless of the context. These results suggest that adults have complete spellings represented in memory and that this information can be activated very rapidly, presumably through a lexical matching operation.

Also, Zola's results have something to say about word recognition during text processing. They indicate that readers do not attend to or ignore individual words according to their semantic and syntactic expectations, as Goodman and his colleagues suggest they do. Rather readers fixate and process most of the words. This is what the idea of word automaticity would lead one to expect. Since word recognition is automatic, there is little cost or effort required to look at each word and process it. This should be much easier than the sort of processing which requires making decisions about where the eye should land next.

I want to say something more about the development of letter-sound knowledge, the other bottom-up component in Figure 1. Various studies have been conducted to determine when, during development, readers become able to recode unfamiliar spellings rapidly and automatically into pronunciations. Guttentag and Haith (1978) who performed the picture word interference study I talked about earlier found that skilled third grade readers and adults could recode 4-letter nonwords into pronunciations automatically. However, poorer third grade readers and 1st graders could not. In our speed study mentioned earlier, we found that skilled readers as young as 2nd grade could pronounce

nonwords rapidly, whereas unskilled readers as old as 4th grade could not. Researchers have proposed that recoding skill may contribute to text reading in two different ways, depending upon the skill of the reader. Among younger and less able readers whose reading skill is slow and non-automatic, recoding may be used only when other cue sources fail to yield sufficient information to identify words. In contrast, among older skilled readers who can execute the skill automatically, recoding may be applied and coordinated simultaneously with other operations, including lexical matching. Although both bottom-up processes are unnecessary since they supply redundant information, it may be that they combine to maintain especially high accuracy levels during text reading. Stanovich (1980) has suggested this possibility. Also, it is conceivable that automatic recoding skill executed during text reading may help the skilled reader retain information about the spellings of words in memory. This would follow from our claim that spellings are stored in memory when readers process letters as symbols for sounds in pronunciations. This is an interesting possibility which awaits study.

In my review of research on beginning reading, there are lines of work which I have not mentioned. One reason is that conclusions are less clear. The most blatant omission is my failure to say very much about studies of reading comprehension, that is, readers' ability to recall what they have read. Researchers have investigated the relationship between word recognition skill and reading comprehension. However, results have not supported expectations. In at least two experiments, training to improve word identification speed has not enabled an experimental group of poorer readers to recall a text comprised of the words better than an untrained control group (Fleisher, Jenkins and Pany, 1979; Spring, Blunden and Gatheral, 1981). Some more promising longitudinal data has been collected on younger readers by Lesgold and his colleagues (Lesgold and Curtis, 1981). This work points to

word identification speed as a cause of improved comprehension. However, more research remains to be done before this matter is settled.

Two other topics I have failed to represent adequately in my talk are studies of the prerequisites required for learning to read, for example, phonemic segmentation skill, and also studies comparing good and poor readers to identify underlying deficiencies such as verbal encoding speed and phonological short term memory. One problem with these studies is that results are mainly correlational and hence fail to indicate whether the capability being studied is a cause, a consequence, or a correlate of the lack of reading skill. Another problem with these studies is that very often it is not clear how these alleged prerequisites or deficiencies play a role in reading acquisition or text reading. Now that we have a fairly good description of this process, I would like to see researchers be more explicit about how they conceptualize the reading acquisition process and how their findings relate to current models. Better yet, I would like to see these researchers conduct studies to determine how their component plays a role. Such reseach should yield important revisions or elaborations of the models.

Finally, I would like to see reading acquisition researchers turn their attention to how reading is actually taught in classrooms. I would like them to inspect actual texts and workbooks to become aware of what kids are being asked to do during reading and spelling instruction. I guarantee that they will find some practice which is discrepant with theory or findings on reading acquisition. Once they identify something questionable, then they need to perform an experiment to see whether they are right. We have recently performed such a study to show how one activity commonly included in elementary spelling texts actually interferes with children's memory for the correct spellings of words. Our theory of printed word learning prompted us to do this study. More of this sort of work is needed to insure that what we

learn about reading in our research actually gets applied to instruction. I do not believe that it will happen automatically. It is fantasy to suppose that someone else is going to apply our basic findings to practice. Researchers need to do it themselves.

References

Biemiller, A. The development of the use of graphic and contextual information as children learn to read. Reading Research Quarterly, 1970, 6, 75-96.

Chall, J. Learning to read: The great debate. New York: McGraw-Hill Book Co., 1967.

Cohen, A. S. Oral reading errors of first grade children taught by a code emphasis approach. Reading Research Quarterly, 1974-75, 10, 616-650.

Ehri, L. C. Beginning reading from a psycholinguistic perspective: Amalgamtion of word identities. In F. B. Murray (Ed.), The Development of the Reading Process. International Reading Association Monograph (No. 3). Newark, Del: International Reading Assoc., 1978.

Ehri, L. C. The development of orthographic images. In U. Frith (Ed.), Cognitive Processes in Spelling. London, England: Academic Press, 1980.

Ehri, L. C. Influence of orthography on phonological and lexical awareness in beginning readers. In J. Downing and R. Valtin (Eds.), Language Awareness and Learning to Read. New York: Springer Verlag, 1983, in preparation.

Ehri, L. C. and Roberts, K. Do beginners learn printed words better in context or isolation? Child Development, 1979, 50, 675-685.

Ehri, L. C., & Wilce, L. S. The mnemonic value of orthography among beginning readers. Journal of Educational Psychology, 1979, 71, 26-40.

Ehri, L. C. & Wilce, L. S. Do beginners learn to read function words better in sentences or in lists? Reading Research Quarterly, 1980, 15, 451-476.

Ehri, L. C. & Wilce, L. S. The influence of orthography on readers' conceptualization of the phonemic structure of words. Applied Psycholinguistics, 1980, 1, 371-385.

Ehri, L. C. & Wilce, L. S. Development of word identification speed in skilled and less skilled beginning readers. Journal of Educational Psychology, 1983, in press.

Gibson, E. J., and Levin, H. L. The Psychology of Reading: Cambridge, Mass.: The MIT Press, 1975.

Goodman, K. S. Behind the eye: What happens in reading. Reading Process and Program. Commission on the English Curriculum, National Council of Teachers of English, 1970, Part I.

Goodman, K. S. Reading: A psycholinguistic guessing game. In H. Singer & R. B. Ruddell (Eds.), Theoretical Models and Processes of Reading. Newark, Del.: International Reading Assoc., 1970.

Guttentag, R. E. & Haith, M. M. Automatic processing as a function of age and reading ability. Child Development, 1978, 49, 707-716.

Juel, C. Comparison of word identification strategies with varying context, word type, and reader skill. Reading Research Quarterly, 1980, 15, 358-376.

LaBerge, D. & Samuels, S. J. Toward a theory of automatic information processing in reading. Cognitive Psychology, 1974, 6, 293-323.

Spring, C., Blunden, D. & Gatheral, M. Effect on reading comprehension of training to automaticity in word reading. Perceptual and Motor Skills, 1981, 53, 779-786.

Stanovich, K. E. Toward an interactive-compensatory model of individual differences in the development of reading fluency. Reading Research Quarterly, 1980, 16, 32-71.

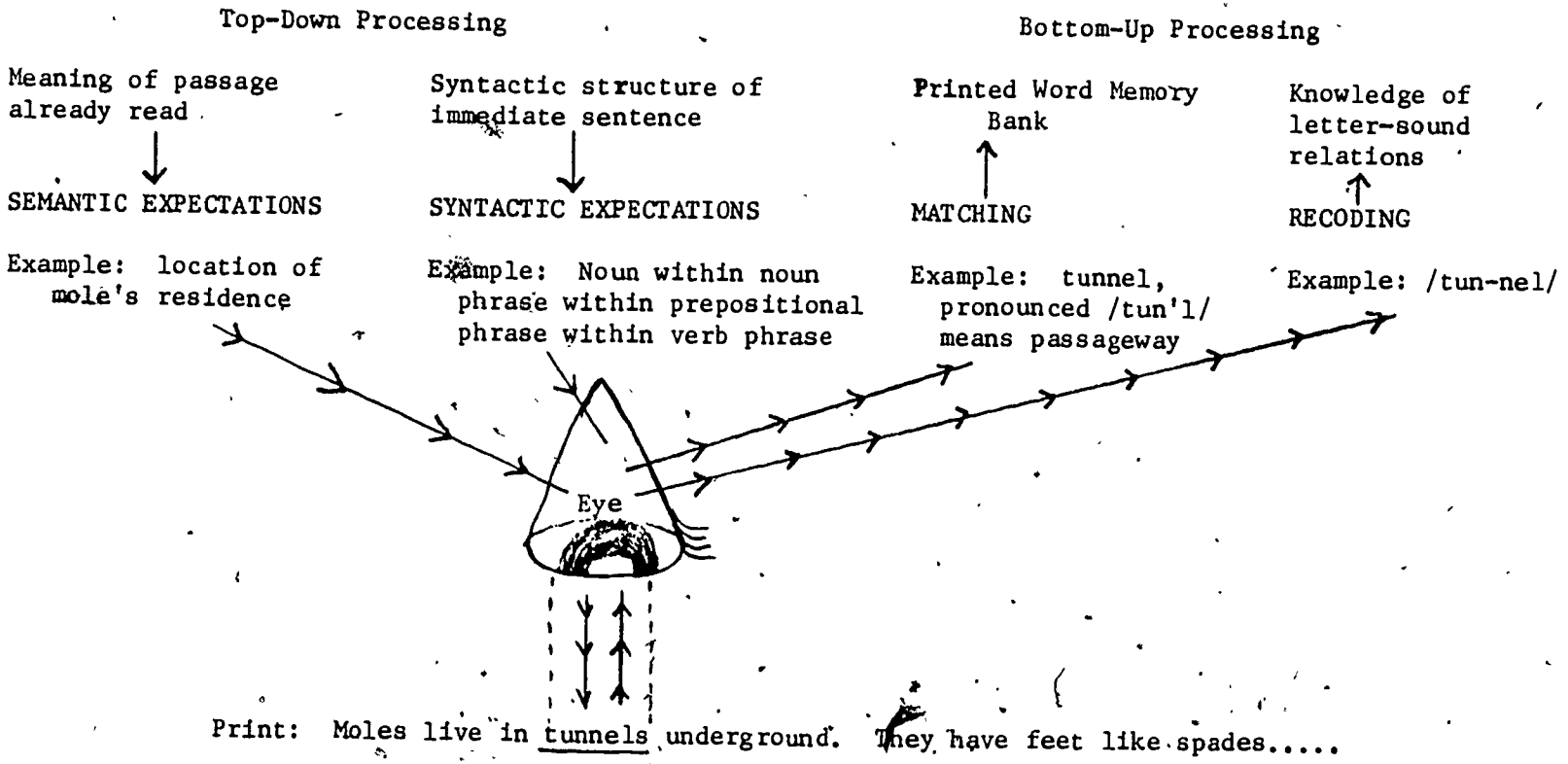
Stanovich, K. E., West, R. F., and Feeman, D. J. A longitudinal study of sentence context effects in second-grade children: Tests of an interactive model. Journal of Experimental Child Psychology, 1981, 32, 185-199.

Weber, R. A linguistic analysis of first-grade reading errors. Reading Research Quarterly, 1970, 5, 427-451.

West, R. F. & Stanovich, K. E. Automatic contextual facilitation in readers of three ages. Child Development, 1978, 49, 717-727.

Wildman, D. M. & Kling, M. Semantic, syntactic and spatial anticipation in reading. Reading Research Quarterly, 1978-79, 14, 128-164.

Zola, D. The perception of words in reading. Paper presented at the annual meeting of the Psychonomic Society, Phoenix, Arizona, Nov. 1979.



What reader says:: (errors)		Source of Information Used
	"tables"	syntactic (noun), graphic (initial, final letters)
	"holes"	semantic (residence), syntactic (noun)
	"turn"	graphic (3 letters)
	"tunles"	graphic (6 letters, sounding out)

Figure 1 Various Sources of Information Influencing the Text Reading Process

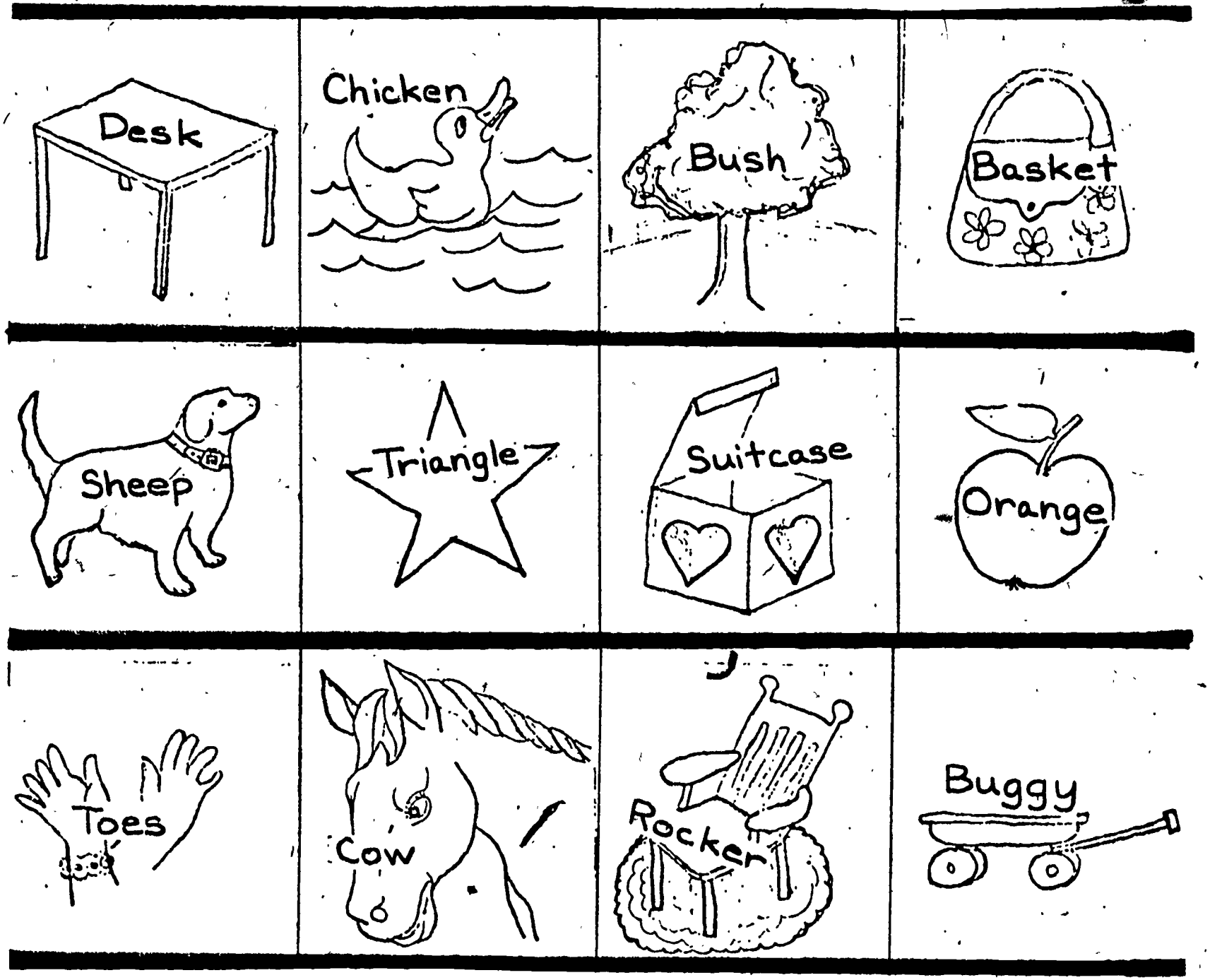
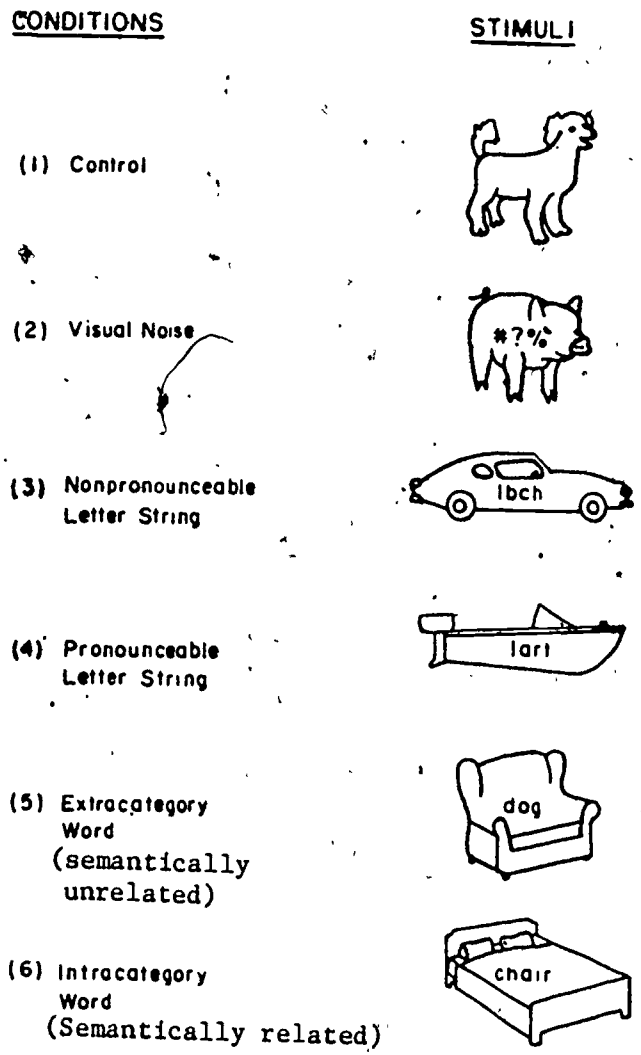


Figure 2. Pictures printed with semantically related words. Try to name the pictures as rapidly as you can and ignore the printed words.



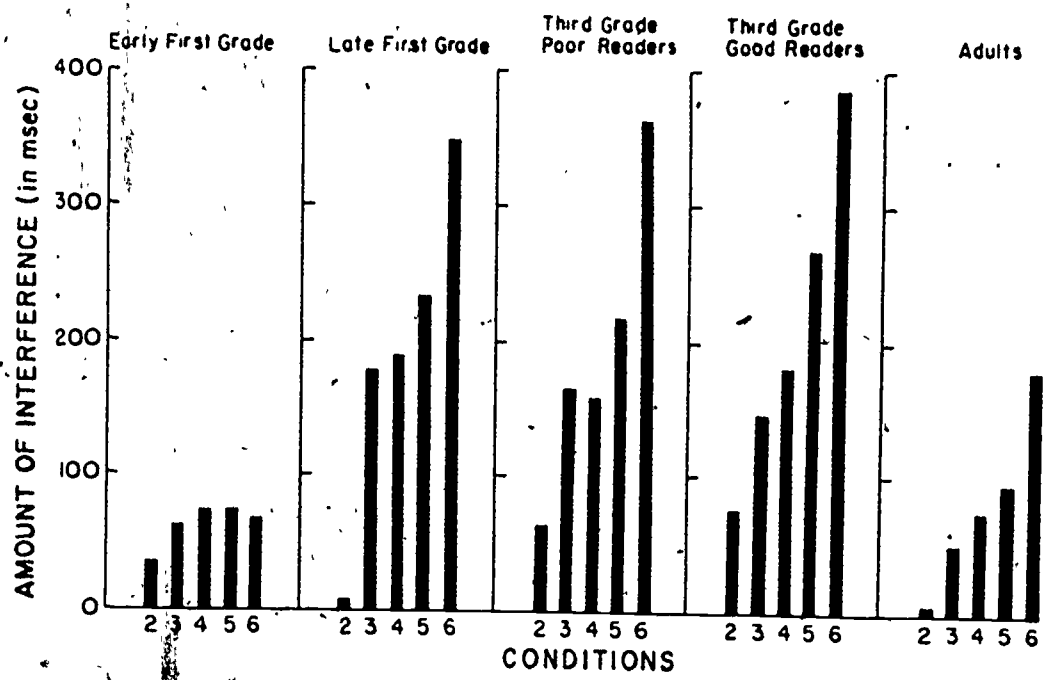


FIG. 2.—Amount of interference in each condition for each subject group

TABLE 2

SUMMARY OF RELIABILITY OF EFFECTS AND STANDARD DEVIATION OF RESPONSE LATENCIES FOR EACH GROUP

SOURCES OF INTERFERENCE	CONDITIONS	SUBJECTS				
		Early First Grade	Late First Grade	Third-Grade Poor Readers	Third-Grade Good Readers	Adults
Visual noise.....	1 vs. 2	$p < .10$	N.S.	$p < .05$	$p < .01$	N.S.
Letters.....	2 vs. 3	N.S.	$p < .01$	$p < .05$	$p < .05$	$p < .01$
Pronounceability..	3 vs. 4	N.S.	N.S.	N.S.	$p < .10$	$p < .05$
Word meaning . .	5 vs. 6	N.S.	$p < .05$	$p < .05$	$p < .05$	$p < .01$
SD (in msec)	. .	80	120	104	83	36

(from Guttentag and Haith, Automatic processing as a function of age and reading ability. Child Development, 1978, 49, 707-716).

Figure 3

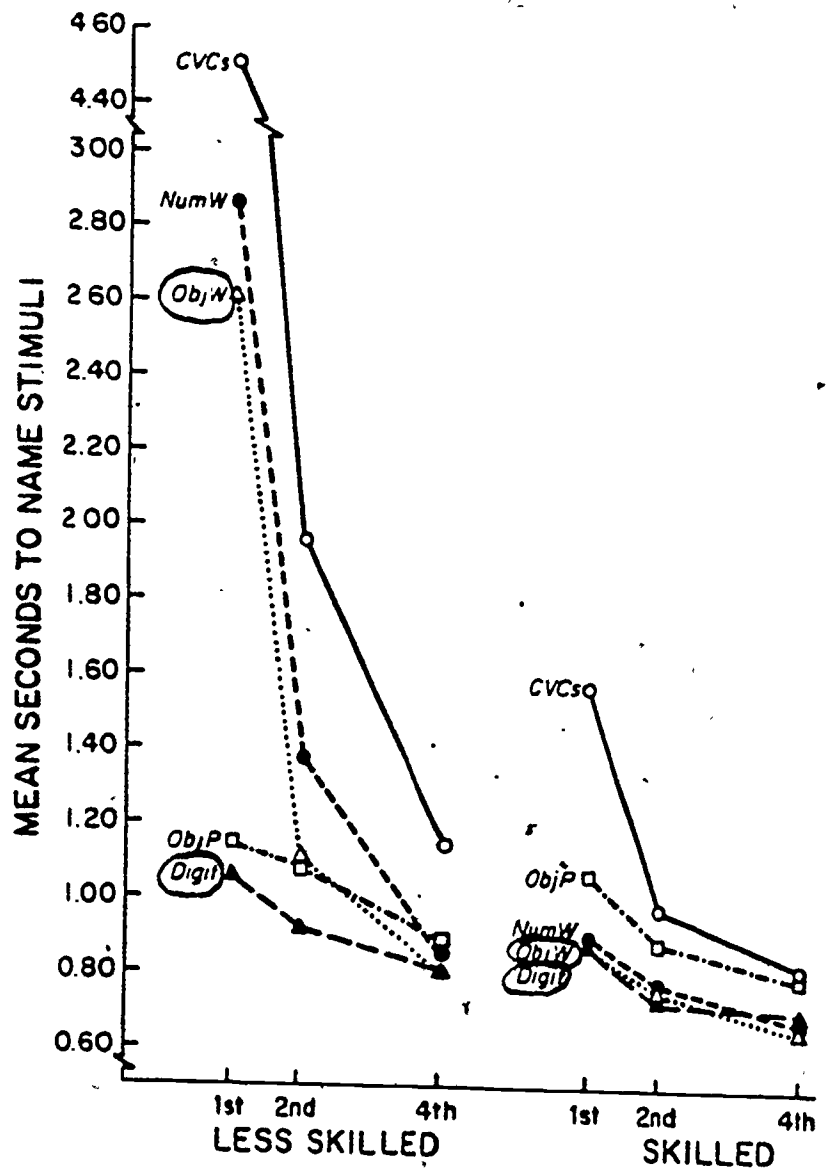


Figure 4 Mean number of seconds to identify stimuli as a function of grade and reading skill

(from Ehri, L. C. and Wilce, L. S. Development of word identification speed in skilled and less skilled beginning readers. Journal of Educational Psychology, in press.)