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ABSTRACT

Focusing on research about children's acquisition of reading and spelling skills, this paper discusses the larger picture of reading acquisition, issues addressed by research, and results of this research. The paper cites numerous studies on the subject, including studies on whether environmental print experiences enable young children to process graphic cues, how beginning readers get started using graphic cues to read words, whether beginning readers could learn to read words more easily using visual or phonetic cues, how phonetic cue readers learn to read and spell words and how they differ from cipher readers, how beginning readers acquire a lexicon of printed words, how spelling can perform a mnemonic function, and how children's memories function for words containing silent letters. Other studies tested the theory that creating and storing a special spelling pronunciation for words should boost memory for the spellings, examined the influence of spellings on children's conceptions of phonemes in words to see if learning spellings would alter children's ideas about speech, and observed whether spellings influence pronunciations. Conclusions and results of the studies are provided. References and tables of findings are included. (EL)

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Learning to Read and Spell

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My plan today is to talk about research we have done investigating how children learn to read and spell.[1] Lee Wilce has assisted me with much of this work. First I will review the larger picture of reading acquisition. Then I will tell you about some of the issues we have addressed in our studies and what positions our results have led us to take.

Besides being informative, I have another motive. I am concerned about the current low level of interest in questions about how children acquire decoding skill, word reading and word spelling skills. Although the great debate may be over, it is not true that all the mysteries of decoding are solved. There are plenty inviting attention. We know that code emphasis programs produce better beginning readers than meaning emphasis programs (Chall, 1967). However, we do not yet understand how or exactly why. There are lots of ways to structure phonics instruction. Sounding out and blending may or may not be taught. Phonemic segmentation may or may not receive attention. Practice may or may not be provided on words exhibiting the letter-sound regularities that are taught. Or practice may include many words

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that violate the letter-sound regularities (Juel & Roper/Schneider, 1985). We need to understand whether these variations make a difference. It is not the case that meaning emphasis programs are totally ineffective. Some children appear to acquire decoding skills on their own without being formally taught. We need to study how this happens. Also we do not understand the relationship between reading instruction and spelling instruction. Some children are taught to spell right away in first grade as soon as reading begins. Others do not begin spelling until a year later. It may be that spelling instruction operates behind the scenes to strengthen decoding skill (Ehri, in preparation). Another point to note is that English spellings are not completely phonetic. Although the majority of letters in words correspond to sounds, there are enough exceptions and variations to complicate the course of acquisition. How do beginning readers and spellers handle phonetic anomalies in word spellings? Do they ignore the letters, or given them special pronunciations, or mark them as silent in memory? At some point readers and spellers must graduate from a phonetic understanding of spellings to a morphemic understanding where they recognize spelling patterns that recur in words to make them systematic. Knowing this helps learners to make sense of lots of letters that previously appeared to be phonetically deviant. We do not understand how or when this transition occurs in beginning readers. These and a lot more questions need to be studied. Today I will lead you through some of the questions we have raised and the answers suggested by our findings. Hopefully you will see why our enthusiasm for this work runs high, and why we feel that research on this aspect of reading is important and holds much promise.

First, it is necessary to describe our conceptualization of the reading process. From eye movement data (Carpenter & Just, 1981), we know that when mature readers read text, they do not pass over words and look only at those that they cannot predict from context. Rather their eyes fixate on most of the words. Less mature readers fixate on every word, often more than once. Also analyses of oral reading miscues suggest that every word is processed (Weber, 1970). The most common error is to substitute other words for those appearing in text. This happens much more often than omitting words or inserting extra words. Both lines of research suggest that the text reading process includes a step for fixating and identifying each printed word as it comes up. How are these words identified? Our view and that of others is that readers access up to four sources of information stored in memory. These four sources are listed in Table 1 of your handout. There are two sources of information that may be active before the print is seen. One involves semantic information. The other syntactic information. There are two other sources that are activated when the word comes into view. One is the reader's memory for specific printed words. The other is the reader's letter-sound knowledge. I'll explain each more fully.

Readers possess semantic and syntactic information that enables them to form expectations about upcoming words in text (Goodman, 1970). They may expect words from a particular semantic category such as a kind of animal, or from a particular syntactic form class such as a noun or verb. These expectations are derived from their knowledge of the world, from knowledge about the structure of their language, and from information already read in the text. In identifying a word, readers can use semantic and syntactic expectations to predict what the word is or at least what features it has. Also these expectations can be used to confirm words identified by other sources.

Readers also possess two sources of graphic information in memory that enables them to identify words from their printed forms. One is the reader's store of printed words, also referred to as a print lexicon or a sight vocabulary. The word store contains the spellings of individual words amalgamated with their pronunciations and meanings. When words in this store are encountered in print, the printed form activates all this information in memory (Ehri, 1978, 1980a, 1980-b; Ehri & Roberts, 1979; Ehri & Wilce, 1980-a).

The other source of graphic information is the reader's letter-sound knowledge, or general decoding skill. This information may be used to identify unfamiliar words by transforming and blending letters into sounds. Also it may be used to confirm words identified by other sources. For example, the reader might use semantic expectations to guess that the word is "kitten" and then check the letter-sound correspondences to make sure. Some or all of these sources of information may be involved in identifying any particular word during text reading. When more than one source yields the same identification, this creates redundancy in the system. Such redundancy is thought to enhance the accuracy and fluency of the text reading process (Perfetti, 1984).

One of the issues that have divided researchers is the question of whether individual words are read or only sampled during text reading (Stanovich, 1980). The main objection to individual word reading appears to be that it consumes too much attention, effort and time to execute. However, if one examines the nature of word reading skill and the course of its development, one finds that this is not true. According to LaBerge and Samuels (1974), learning to read individual words passes through three successive phases. During Phase 1, an unfamiliar word is recognized with increasing <u>accuracy</u> as readers attend to letter-sound relations each time they read it. In Phase 2, as a result of more practice, a familiar word comes to be recognized <u>automatically</u> 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 as identification processes are consolidated in memory (Ehri & Wilce, 1983). 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 words automatically, try labeling the pictures in Figure 1 of your handout. Name the pictures as rapidly as you can. Ignore the words printed on the pictures. (WAIT....) 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. Guttentag and Haith (1978) have used this task and found that children as young as the end of first grade can process known words automatically. My point is that if readers can recognize words this easily when they are wishing to ignore them, then they certainly can recognize the same words easily when they encounter them in text. Thus, individual word reading is not an obtrusive or time consuming process.

From our findings and those of others, it is clear that learning to process graphic cues accurately, automatically, and rapidly is the hardest part of learning to read. It is the part that consumes the greatest learning time. It is the skill that most clearly separates good readers from poor readers (Stanovich, 1980). For these reasons, we have chosen to focus much of our attention on how beginners become skilled at graphic cue processing.

To remind you of the general course of reading and spelling acquisition, I have summarized in Table 2 several events that occur during the first three stages. These stages are adapted from Jean Chall's (1979) scheme. Stage 0 covers the prereading period from birth until children become able to read print. During this stage children acquire oral language skills. They are exposed to and begin to participate in the activities of a literate culture. They acquire concepts about reading and writing, for example, what print looks like, where it is found, how to write their names, and so on. They learn the shapes and names of alphabet letters and how letters differ from numbers. Often this is assisted by learning the alphabet song. They learn to identify signs in their environment such as McDonald's, Coca Cola, and Stop.

Stage 1 is the initial reading and decoding stage. Chilren learn how to segment meaningful language into words and phonemes. They learn how letters symbolize phonemes in words. They begin to acquire a sight vicabulary and use this to read simple text. Based on Biemiller's (1970) research, Chall (1979) distinguishes two phases of text reading during this stage. At the outset, readers identify unfamiliar words by using context cues to guess. However, once readers learn about letter-sound relations, they stop guessing and attempt to decode letters. Chall (1979) refers to this as becoming glued to print rather than to meaning, and she suggests that children must go through this phase in order to move into the next phase when they become unglued from print and able to attend both to graphic and to contextual cues in their reading. This ungluing happens during Stage 2 when readers' decoding skills are stronger. Also during Stage 2 readers become able to read many more words accurately, automatically and rapidly.

In the development of spelling skill, three stages can be distinguished (Ehri, in preparation; Gentry, 1982; Henderson, 1981, Morris, 1981). Once prereaders have learned letter names, they can use this information to invent semiphonetic spellings of words. They distinguish 1 or 2 sounds, usually the first or last, and represent these with letters. The letters they choose are ones whose names contain these sounds. For example, "giraffe" might be spelled J-F. When children move into Stage 1 and learn more about letter-sound relations and about phonemic segmentation and decoding, their spellings become more complete phonetically and the letters they choose are more conventional. For example, "giraffe" might be spelled GERAF. During

Stage 2, as children learn more about spelling patterns in English words, their commitment to the principle of one letter for every sound is relaxed, and they adopt morphemic as well as phonetic patterns to spell. For example, in writing past tense verbs, they use the letters E-D consistently regardless of whether the final sound is /t/ as in the word "stepped" or /d/ as in "jogged," or /əd/ as in "sprinted."

This provides you with a general idea about the course of reading and spelling acquisition. Now I would like to turn to our research and some of the questions we have addressed. One question is, how do prereaders move into Stage 1? What knowledge sources, skills, and experiences enable them to begin reading words by processing graphic cues, without any help from pictures or other context cues? One explanation proposed is that this ability evolves naturally and spontaneously out of children's prereading experiences, the same way that their oral language develops. Harste, Burke and Woodward (1982) and the Goodmans (Goodman & Goodman, 1979; Goodman & Altwerger, 1981) have developed this explanation. During the preschool years, children become able to identify print that they frequently see in their environment, for example, stop and exit signs, labels on milk and cereal cartons, and names of fast-food restaurants. Acquiring these print-meaning associations provides the foundation for learning about the graphic system. First, children become aware that print is distinctively different from nonprint cues. Although they are not able to read signs, they can point to the place where it says "McDonald's." Gradually as a result of repeated exposure to these labels and signs, the print itself becomes decontextualized and can be recognized from graphic cues alone without its characteristic environment.

An alternative explanation is that in order to begin using graphic cues, children must acquire certain prerequisite skills such as alphabet letter knowledge (Ehri, 1983). When prereaders exhibit an ability to read signs in their environment, they are "reading" the environment, not the print (Mason, 1980). In order for them to shift their attention from environmental cues to the print itself, they need to know the alphabet. Because there are so many letter shapes to be learned and to be associated with meaningless, arbitrary sounds, it is likely that acquisition requires explicit instruction and practice. It is not picked up simply through exposure to the letters.

We performed a study to see whether environmental print experiences enable young children to process graphic cues (Masonheimer, Drum, & Ehri, 1984). Our approach was to select preschoolers who were experts at reading signs and labels in their environment. Children were shown 10 colored photographs displaying the signs and labels, for example, a Pepsi label on a bottle, a McDonald's sign on a restaurant. They had to identify at least 8 labels correctly to be included in our study. We tested 228 children and found 102 who met our criterion. They ranged in age from 3-5 years old.

First we wanted to find out how many of these experts were able to process graphic cues. We presented the 10 labels printed in manuscript type on cards along with some preprimer words. We reasoned that if environmental print experiences lead to gradual decontextualization of graphic cues, then we ought to observe a normal distribution of scores in our word reading task. Results showed just the opposite, a bimodal distribution. Most of the children, 94%, read few if any words. The remaining 6 children read most of the words. There were no children in the middle of the distribution. Also we found that these nonreaders and readers differed greatly in their ability to name capital and lower case letters. Whereas all of the readers could name at least 98% of the letters, very few nonreaders could name them this well. Nonreaders' mean was 62% correct. Thus, in our sample of experts, we found very few subjects who could process graphic cues effectively.

We went on to examine our experts' ability to identify signs and labels both alone and accompanied by context cues and logos. Results revealed that the children who could read had no trouble reading labels in any condition. Nonreaders had no trouble when label were accompanied by logos or context cues. However, when these cues were removed and only the stylized print remained, identification dropped to 23%. These results show that most of our experts were not attending to graphic cues but rather were reading environmental cues.

The same children were called back for a second experiment. We wanted to take another look at graphic cue processing with a measure we thought might be more sensitive. This time children were shown labels accompanied only by their logos, for example, a McDonald's sign backed by golden arches. In each label one of the letters was altered by replacing it with another letter having a very different shape. For example, on the "Pepsi" label, the P was replaced by X. An example of this is presented in Figure 2 of your handout. The new letters were printed in the same letter style, and none altered the overall shape of the label. New letters appeared either in first, medial or final positions in the words. Subjects were shown each of the 6 altered labels. First they were asked to tell what the labels said. If no letter changes were noticed, they were asked, "Is there anything strange or wrong about this picture? Is there a mistake?" After all the labels had been presented, they were shown again, this time alongside the original label, and subjects were asked whether both were the same or whether there were any mistakes.

In analyzing our results, we found that the nonreaders were oblivious to graphic cues. When asked what the print said, they responded with the contextual label. They noticed few if any letter changes even when they were asked whether there was a mistake. When they compared altered labels to original labels, only about one-third of the changes were detected. These findings reveal very clearly that most of our environmental print experts were not processing graphic cues.

Results of these studies provide little support for the view that children move closer to acquiring reading skill after they have accumulated substantial experience with environmental print. Why is this so? Why isn't reading acquisition like oral language acquisition? Our explanation is that during the prereading stage, there is no "press" on children to look beyond the cues that are easiest to discern and most obvious. From a functional point of view, little purpose is served by attending to letters in the environment. All the information prereaders need can be obtained from non-alphabetic sources. Moreover, if letters are not familiar forms, there is even less reason to notice them. Acquisition of written language may contrast with oral language development in this respect. The process of learning to speak is driven by semantic and pragmatic forces plus the necessity of processing linguistic information. Children have a strong need to make sense of what other people say to them, and non-vocal sources of information do not do the job. As a result, children are pushed to discover, tacitly of course, the grammatical structures underlying these utterances (Slobin, 1971). Also their search may be assisted by a brain uniquely suited for this purpose (N. Chomsky, 1968). In contrast, the task of extracting meaning from environmental print is not nearly so complicated and does not depend solely upon discriminating and interpreting graphic units correctly. As a result, preschoolers never analyze written language sufficiently to discover how the alphabetic system works.

If environmental print experiences are not sufficient to move prereaders into Stage 1 reading, then how do they become able to process graphic cues? We have suggested that one thing they need to have mastered is the alphabet (Ehri, 1983). Some evidence for this was uncovered in our print expert study. Whereas all of the readers could name practically every upper and lower case letter, only 6% of the nonreaders performed this well. We have observed this relationship in other studies too (Ehri & Wilce, 1985-a). In fact it is common knowledge that one of the best predictors of reading achievement at the end of first grade is the ability to name letters upon entering first grade (Chall, 1967). It is a better predictor even than IQ (Share, Jorm, Maclean & Matthews, 198'). Our explanation for the relationship is that knowledge of letters provides children with the foundation for beginning to process graphic cues in printed words. Knowing shapes helps them distinguish and remember the visual constituents of words. Knowing letter names helps them associate relevant sounds with letters because most of the names contain these sounds. Research on the spellings invented by young children reveals that they are very good at analyzing sounds in letter names. Of course knowing letter names is just a starting point, since there are many more sounds to be learned that are not found in the names.

How do beginning readers get started using graphic cues to read words? We have been involved in a dispute with Phil Gough over this question, and we have conducted two studies to attempt to settle the issue. Gough and Hillinger (1980) propose that beginning readers pass through two stages in their use of graphic cues to read words. We will call children in the first stage <u>cue readers</u> and children in the second stage <u>cipher readers</u>. During the first cue reading stage, the mechanism of selective paired associate learning is used to read words. Readers select a visually distinctive cue located in or around the printed word and associate this with the word. For example, the tail on the final g in the spelling of "dog" might be used, or the bumps on the m in "camel" might be used to read these words. More often though, the visual cues bear no relation to the meanings of the words. In attempting to employ this technique with more and more printed words, cue readers run into trouble. It becomes harder to find a unique visual cue in each printed word to form an association. Different words sharing the same features are mistaken for each other (Otto & Pizillo, 1970). Because they are arbitrary, associations are often forgotten. As a result learners are unable to read words reliably over time (Mason, 1980). The mounting confusion and frustration eventually results in a shift to cipher reading, the second stage of development. Cipher reading becomes possible when readers master letter-sound mapping relations and phonemic segmentation. Deciphering skill is what we have been calling decoding skill. It enables readers to pronounce spellings they have never seen before, to distinguish among similarly spelled words, and to read words accurately and consistently over time.

This is Gough's view. Our dispute with him is not over his portrayal of cipher reading or his depiction of the first stage as selective paired associate learning. We are in complete agreement here. What we disagree about is the nature of the graphic cue he claims that cue readers use to read words before they become cipher readers. We don't think they use arbitrary visual cues. At least we don't think this is true for children who have moved into Stage 1 and can read several words out of context. What we propose is that beginners use phonetic cues to form associations between printed words and their pronounciations. The phonetic cues are drawn from their knowledge of letter names or sounds. To illustrate, beginners might learn to read the word "jail" by associating the names of the letters J and L with sounds heard in the word's pronunciation. These associations are stored in memory and retrieved the next time the word is seen. Phonetic cue reading should be more effective than visual cue reading because the associations between spellings and pronunciations are systematic rather than arbitrary and thus are easier to remember. Although letter-sounds are used, this is not cipher reading because readers process only some of the letter-sound relations, not all of them, and also because they cannot decode new words.

We conducted a study to find out whether beginning readers could learn to read words more easily using visual or phonetic cues (Ehri & Wilce, 1985-a). Children were taught to read two kinds of word spellings. These are listed in Table 3 on your handout. One set consisted of simplified phonetic spellings of words. All the letters here corresponded to sounds found in the names of the letters. For example, J-R-F spelled "giraffe." The other set consisted of visually distinctive spellings. This was created by varying the height and ascending or descending positions of letters to give each word a unique contour. Also, each word had unique letters not appearing in other words. However, none of the letters in visual spellings corresponded to sounds in the words. For example, XGST spelled the word "balloon." Each set of spellings was taught on a separate day. The order was counterbalanced across subjects. Children were told the word that each spelling symbolized and they were given several trials to learn the words. Of interest was whether the visual spellings or the phonetic spellings would be learned in fewer trials.

The children participating in this study were kindergarteners. We gave them a word reading pretest and divided them into groups according to their word reading ability. Those who could not read any words we called prereaders. Those who read only a few words we called novices. And those who read 11 or more words we called veterans Notice that the novices are the readers of primary interest here, the ones who would be considered cue readers. We reasoned that if Gough is right, that cue readers use visual, not phonetic cues to read words, then our novices should learn the visual spellings faster than the phonetic spellings. However, if we are right that beginners are capable of using phonetic cues and that this is a more effective means of reading words, then the novices should learn the phonetic spellings faster than the visual spellings.

Results are displayed in Figure 3 on your handout. As you can see, the novices learned the phonetic spellings more easily than the visual spellings. Their performance learning visual and phonetic spellings was in fact similar to that of the more advanced beginning readers, the veterans. These findings support our claim that children who have just moved into word reading can use phonetic cues effectively to read words, better than they can use visual cues. Interestingly, the subjects who found visual cues easier to use were the prereaders. This suggests that Gough's portrayal of visual cue reading may apply more to nonreaders than to children who have moved into initial word reading.

I might mention that we examined children's knowledge of alphabet letters in this study and found that the novices had mastered letter names but the prereaders had not. These findings echo those in our print expert study where we also found that mastery of letters distinguished prereaders from readers. This is further support for our claim that one prerequisite for being able to process graphic cues effectively is knowing shapes and names or sounds of alphabet letters.

From results of our study comparing the use of visual and phonetic cues, we concluded that when children first become able to read words out of context, the kind of graphic cues they use to form associations and remember words are mainly the more salient letter-sound cues, perhaps only 1 or 2 of these. The purpose of our next study was to obtain more information about how phonetic cue readers learn to read and spell words and how they differ from cipher readers. We did not want to conduct another correlational study, however, because the results of such studies always leave you wondering whether the differences you observe on outcome measures are truly a result of the characteristic you used to differentiate subjects, or whether differences are caused by some other factor. To avoid this, we performed a training study and manipulated the difference between cue readers and cipher readers experimentally (Ehri & Wilce, 1985-b).

We gave pretests to a number of kindergarteners to select children who could not decipher nonsense words but who had moved into word reading and knew letter-sound relations. We taught half of these subjects to decipher nonsense words. These became our cipher readers. The other subjects rehearsed isolated letter-sound relations. These were our cue readers. After training, we compared cipher and cue readers' skill in learning to read a set of similarly spelled words and also their memory for the words' spellings.

Our aim was to find out how much easier it would be for cipher readers to learn to read and spell these words than for cue readers. We were also interested in whether cue readers would show any signs of using letter-sound relations in their reading and spelling. Based on our earlier study, we expected that they would process phonetic cues but that their attempts would not be completely successful since they would not be able to process enough letter-sound relations to distinguish among all the similarly spelled words.

Before I tell you about the results, let me provide a few more details on the design of our study. Kindergarteners were matched according to pretest scores and randomly assigned to either the cipher group or the cue reader group. Cipher training consisted of teaching children to decode 12 sets of similarly spelled words, mostly nonsense. I have listed these sets in Table 4 of your handout. In some of the sets, only the initial letter varied among the words. In other sets, only the final letter varied. In still other sets, single consonants and consonant clusters were varied. The words were formed out of 9 consonants and four short vowels. Words in each set were presented repeatedly until subjects could read them perfectly. Subjects first learned sets of CVCs to criterion, then sets spelled with consonant blends to criterion. Periodically sets were combined and practiced to criterion. This forced subjects to pay attention to variations in all letter positions in reading and remembering the words. There were 12 subjects who completed cipher training.

The other group, that is the cue readers, were given letter-sound practice. Each consonant letter was presented along with a word beginning with that letter, and subjects learned to produce the letter's sound followed by the word. For example, the letter B was presented, subjects said /b/ and then "book." Practice was continued to a criterion of three perfect trials. Since subjects knew most of these letter-sound relations already, this training just strengthened their knowledge.

After training, several transfer tasks were given. Subjects learned to read a set of 15 similarly spelled words. These words are listed in Table 5. There were CVCs and words with consonant blends. The same initial and final letters recurred in several words. Children received up to 7 trials to learn these words to a criterion of two perfect trials. Then they were asked to write the words from memory. Also a nonsense word decoding task was given to verify that cipher trained readers could decode and cue readers could not.

In analyzing results, first we checked individual scores in the decoding task. We found three nonconformists in each group, that is, 3 cipher-trained subjects who could not decode, and 3 untrained subjects who could decode. They were dropped from their groups, leaving 9 cipher readers and 9 cue readers.

In Figure 4 of your handout I have plotted scores of these two groups on the various measures. An asterisk appears atop those pairs of means that statistically differ from each other. The letters n.s. indicate no statistical difference. In the upper left corner are plotted the nonsense word decoding scores, labeled Measure A. You can see that cipher and cue readers differed greatly.

Next are plotted mean scores in the word learning task where subjects practiced reading 15 words. The dependent measure is the mean percentage of words read correctly on each trial. Clearly cipher readers outperformed cue readers. In fact, all but one cipher reader attained a perfect score on at least one trial. No cue reader did this well. Moreover, scores of cipher readers showed consistent gains on successive trials whereas scores of cue readers were somewhat erratic. Often cue readers would read a word correctly on one trial and then fail to read it correctly on a later trial. To show this, we counted the number of times that subjects read a word and then continued to read it correctly on later trials. This score was divided by the number of times words were read correctly at least once. This yielded a measure of subjects' word reading consistency. From Figure 4, Measure C on your handout, you can see that cipher readers read and continued to read 72% of the words they read correctly once, whereas cue readers, read and continued to read only 35% of the words. This indicates that cue readers were very often reading and then forgetting words or mixing them up with other words.

It was not the case that cue readers were attempting to process and remember visual cues. We looked at all the times that subjects produced some word or nonword other than the one that was printed. We calculated the proportion of letters in the printed words that appeared as sounds in the misreadings. High values would indicate that subjects were processing letter-sound cues in their misreadings. As you can see from Figure 4, Measure D, cue readers' misreadings included 52% of the letters they saw in spellings. This indicates that cue readers were using letter-sound cues. However, they were not quite as skilled as cipher readers who pronounced 66% of the letters in their misreadings. This indicates that cipher readers were attending to more graphic cues than cue readers.

We also had subjects write out these words. We were not surprised to find that cipher readers generally outperformed cue readers, not only because cipher readers were superior decoders but also because they had learned to read more of the words. As you can see in the bottom half of Figure 4, cipher readers spelled more words correctly than cue readers, and they included more correct letters, particularly consonant clusters where the difference was huge. In fact, cue readers spelled very few consonant clusters correctly. These results indicate that when readers learn to decode consonant clusters, they also become able to spell these sounds, even without direct spelling instruction.

There was one type of consonant cluster, however, that cipher readers learned to decode but did not carry into their spellings. This was the preconsonantal nasal which occurs between a vowel and a final consonant, for example, the M in the word "lamp," and the N in "blond." Six of the words on our list contained these preconsonantal nasals. From Measure I in Figure 4, you can see that very few preconsonantal nasals were spelled by either group, and the groups did not differ significantly. This is despite the fact that cipher readers completed training on these sounds and despite the fact that they learned to read the words they were spelling.

Why didn't decoding skill transfer to spelling performance in this case? We know from research on children's invented spellings that beginners usually omit the preconsonantal nasal in their spellings, apparently because it is not articulated as a separate segment (Read, 1971). Rather when you say "lamp," the nasal flap opens when the vowel sound begins and the vowel and nasal are articulated simultaneously. Although you might think that you pronounce the M separately, this is true only when you say the word slowly and stretch out the sounds. Otherwise the final /p/ sound follows the vowel. It may be that decoding training did not make learners sufficiently aware of this segment to remember it in their spellings. These findings suggest that decoding training may be sufficient for learning to spell some kinds of sounds, but perhaps not all sounds.

How did cue readers perform on the spelling task? Although performance was not strong on most measures, there was one exception. Cue readers were able to spell the initial and final consonants of most words, and their performance did not differ significantly from that of cipher readers. In Figure 4, this is shown as Measure J. Cue readers' skill in spelling initial and final letters suggests that these letters may have served as the phonetic cues they tried to use during the word reading task. The spellings of one cue reader provided extra support for this. She spelled 97% of the first and final letters correctly but few middle letters correctly. In addition, when she wrote these words she capitalized the initial and final letters as they had appeared in the words she had seen, but she wrote most of the medial letters in lower case, even though these too had been seen in capital letters. These behaviors suggest that this cue reader attended to and remembered boundary letters during the word reading task but ignored medial letters.

We are pretty sure that cue readers' skill in remembering first and final letters was not a result of visual cue memory. In our previous study where cue readers learned to read visually distinctive spellings (Ehri & Wilce, 1985-a), a test of their memory for first and final letters revealed very poor performance. Only 26% of the letters were recalled. This value is much lower than the 79% observed in this study, indicating that phonetic cue processing is a more likely explanation.

In sum, findings of this study show that acquiring the ability to decipher print offers clear advantages. It enables readers to succeed in learning to read similarly spelled words. It also contributes to their ability to spell the words although spelling skill is not as strongly supported as reading skill.

Findings provide evidence for our claim that there is another way to process and remember graphic cues in words besides memorizing visual features or decoding letters into sounds. This way was exhibited by our cue readers who attempted to process a few salient letter-sound relations and store these associations in memory. The cue readers we studied were novice beginners and not very skilled at this process. It may be that with practice, cue readers become better at forming associations out of the more salient phonetic cues. We believe that this mechanism of word reading has much potential for explaining how poor readers are able to read words. We know from other studies that poor readers are cue readers. They have weak decoding skill and spelling skill yet often they are able to read many real words (Perfetti & Hogaboam, 1975; Ehri & Wilce, 1983). The explanation usually given for this is that poor readers notice and remember visual cues in the words (Gough & Hillinger, 1980). However, as we found in our earlier study (Ehri & Wilce, 1985-a), visual associations are harder to remember than phonetic associations. Since poor readers usually know the alphabet, they should be able to process phonetic cues. Because they have had more experience with print, poor readers ought to be able to do phonetic cue processing much better than our novice readers. This possibility needs to be investigated.

Now I would like to shift to another series of studies on printed word learning. The question that initiated this work was how do beginning readers acquire a lexicon of printed words (Ehri, 1978, 1980-a, 1980-b). Our focus here was upon cipher readers, not upon cue readers. The theory we proposed was that readers store spellings in memory by analyzing how the letters symbolize phonemic constituents in pronunciations. To do this requires deciphering skill. Readers must know the particular sounds that letters symbolize, and they must know how to segment pronunciations into phonemes. For example, in reading and remembering the word "rich" they must recognize how the graphemic units, R, I, and the digraph CH each symbolize a phoneme in the pronunciation. To the extent that letters are processed in this way, spellings of individual words are retained in memory.

To test this theory, we conducted several studies. In one set of studies, we showed that spellings can perform a mnemonic function, that letters can preserve nonsense sounds in memory when they provide an adequate printed symbol for the sounds (Ehri & Wilce, 1979). A common example of this mnemonic function is when you hear an unfamiliar name and attempt to enhance your memory for it by inquiring how the name is spelled. In this study, we used a paired associate learning task. Young readers were given several trials to learn four oral CVC nonsense syllables. Recall of these responses was prompted by numbers. During study periods children saw either correct spellings of the sounds, or misspellings, or they rehearsed the sounds. We found that children learned the sounds fastest when they viewed correct spellings during study periods. Looking at misspellings made it especially hard to learn the sounds. Our interpretation is that spellings improved memory for sounds because they were retained as visual symbols preserving the sounds in memory. In this study, we observed a very high correlation between young readers' ability to use letters mnemonically and the size of their print lexicons. This encouraged us in our belief that letter symbolization underlies readers' ability to store printed words in memory.

In another series of studies (Ehri & Wilce, 1982), we examined children's memory for words containing silent letters, for example, the T in "listen." We reasoned that if readers store spellings by analyzing how letters symbolize sounds, then they should find silent letters harder to remember. However, because silent letters are singled out as exceptions by this process, they may become more salient in the memory representation. We found supportive evidence. In this study we gave children two tasks to compare their memory for silent and pronounced letters in known words. First they imagined the spellings of the words and decided whether each contained a specified target letter. For example, they imagined the word "listen" and then decided whether it had a T. We measured reaction times to make these decisions. Then the target letters were presented again and subjects were asked to recall the word they had judged for that letter. In the imagining task, we found that subjects judged the pronounced letters more accurately than the silent letters although scores were high in both cases. This indicates that silent letters are harder to remember. However, we found that subjects' correct judgments of silent letters were more rapid than their pronounced letter judgments, and silent letters prompted better recall of the words than pronounced letters. These findings indicate that silent letters are salient in memory.

One way that readers might deal with silent letters in words is to mark them as exceptions in the memory representation. Another way is to phonemically encode spellings so that silent letters are assigned sounds, for example, pronouncing "lissen" as "lis-ten". Some spellers report using this strategy to enhance their memory for spellings. According to our theory, creating and storing a special spelling pronunciation for words should boost memory for the spellings since this is how letters are stored in memory, as sound symbols. Dee Drake and I performed a study to test this hypothesis. (Drake & Ehri, in press). Fourth graders were shown spellings of words divided into syllables, and they phonemically encoded each syllable as it was spelled. The words they studied contained some schwa vowels and silent letters. For example, the word "chocolate" was pronounced "chŏc-ō-lāte." The medial silent O was sounded, and the schwa vowel "uh" in "lut" was pronounced as it is spelled, with a long A sound, "late". The word "excellent" was pronounced "ex-cĕl-lĕnt" with the two schwa vowels transformed into short E sounds as symbolized in the spelling. Results of this study confirmed predictions. Subjects who produced phonemic encodings of the spellings remembered letters better than a control group who pronounced spellings conventionally in the manner prescribed by the dictionary. Memory for silent letters was superior. Also memory for schwa spellings was superior. However, memory for double letters which are not picked up in a phonemic encoding was not superior. Findings are interpreted as further evidence that spellings are retained in memory when spellers interpret letters as sound symbols.

I might point out that results of this study carry implications for spelling instruction, particularly for teaching spellers about schwa vowels. Let me remind you that schwa is what happens to vowel sounds when they occur in unstressed syllables in multisyllabic words. The distinctive vowel sound is reduced to a nondistinctive schwa or "uh" sound. For example, take the words "horizon" and "horizontal." The stressed long I in "horizon" becomes reduced to schwa when the stress is shifted to another syllable, as in "horizontal." Also let me remind you that schwa spellings are among the hardest letters to remember in words. The sound may be spelled with any of the five vowel letters or combinations. What our findings suggest is that if you want to improve students' memory for the spellings of schwa, you should teach them that schwa is not the true vowel sound in the word. Schwa is simply the result of stress reduction. Rather the true sound is that revealed in the spelling. To discover and remember the true sound, the spelling must be phonemically encoded. Our results suggest that teaching students this bit of fiction should help them remember the spellings of schwa vowels.

One other line of research also provided support for our view of printed word memory. In addition, this research led us into controversy. First, let me tell you about the research. We reasoned that if spellings are retained in memory by being analyzed as sound symbols, then they ought to influence speech when they are learned. They may influence people's beliefs about the sounds that comprise words, and they may even alter the way that people pronounce words. The chances of influence should be greatest for words containing ambiguous sounds and for words whose spellings are discrepant with their pronunciations. Also the chances of influence should be greatest in younger children who do not possess much awareness of phonemes when they begin learning to read. Learning to interpret spellings as symbols for sounds should clarify to them how the words are structured phonemically and perhaps even how the words are supposed to be pronounced. For example, spellings may teach readers to say "February" rather than "Febyuary."

In our first experiment, we examined the influence of spellings on children's conception of phonemes in words (Ehri & Wilce, 1980-b). We selected seven words whose spellings contained an extra, potentially pronounceable letter. These are listed in Table 6 of your handout. For example, "pitch" has a T in its spelling. A sound for this letter can be found in the sequence of articulatory movements produced in saying the word. However, without the letter you probably would not distinguish a separate segment. For each of these extra-letter words, we selected a control word matched phonemically but lacking an extra letter in the spelling. For example, the control word for "pitch" was "rich." Control words are also listed in Table 6. We gave fourth graders a phonemic segmentation task to find out what sounds they thought were in these words. Children spoke each word, then divided it into segments by pronouncing each sound and marking it with a token. We counted the number of times that extra phonemes were detected in extra-letter words and in control words. As you can see in Table 6, there was a huge difference. Extra phonemes were frequently detected in words whose spellings symbolized these phonemes but they were rarely detected in control words. We also checked whether subjects knew the spellings of the words. Most did. However, subjects who could not spell the words also did not find extra segments in pronunciations. It was not the case that subjects were merely representing letters in the segmentation task. Most children ignored truly silent letters and they did not put down two tokens for digraphs such as CH. Also, by requiring subjects to say the sounds, we discouraged simple letter counting.

The "pitch-rich" study was followed up with a training study (Ehri & Wilce, 1980-b). Children were taught to read spellings of nonsense words structured like the real words used in the earlier study. Half of the subjects practiced reading word spellings that included extra letters. The other half read control spellings. The words were pronounced identically in both conditions. Then subjects were given a phonemic segmentation task. As we expected, subjects who saw extra letters in spellings included the extra phonemes in their segmentations whereas controls did not.

We conducted another training study to see if learning spellings would alter children's ideas about speech. In this study, we examined the influence of spellings on alveolar flaps (Ehri & Wilce, in press). Alveolar flaps are consonants that are spelled with D or T. They occur in the middle of words between two vowels, such as in "ladder," "metal," "attic," and "hottest." Although this sound is symbolized either with D or T in spellings, most Americans do not preserve the distinction in speech. Rather they pronounce it as a flap, something close to /d/. Our hypothesis was that readers who know spellings will not realize that the medial sounds in all these words are the same. Rather they will think of the sounds as being different, either T or D, depending upon the spelling, and they will preserve these spellings in careful speech. For example, if you ask them to pronounce the first syllable in the word "letter," they will say "let," converting the flap to a /t/. To test this hypothesis, we taught second graders to read 16 words containing these sounds. The words are listed in Table 7 of your handout. Control subjects practiced saying the same words but they never saw their spellings. Then we taught subjects to perform a rhyme judgment task. This was to find out whether they thought the medial sounds were /d/ or /t/. Subjects pronounced the first syllable of each word and then decided which picture name it rhymed with. To illustrate, for the word "meteor," they might say "meet" or "meed". Then they had to decide whether it rhymed with "feet" or "seed." I should point out that the experimenter never pronounced the syllables. They were always elicited from the subject. Also spellings were never shown or mentioned during the rhyme judgment task. Any influence came from subjects' memories for the spellings. As you can see in Table 7, subjects who had studied the printed words judged more of the flap sounds according to their spellings than control subjects who did not see printed words. Differences between the two groups were greater on words spelled with T than with D because control subjects judged more of the sounds as /d/ than as /t/. Of course their perception was accurate, since the sound is closer to /d/. These findings provide evidence that spellings have a distorting influence on readers' perception of sounds in words. According to our view, this is because the spellings are interpreted as symbols for pronunciations and are stored in memory this way.

I want to mention one other study where we observed spellings to influence pronunciations. In this study, we had fourth graders segment multisyllabic words into syllables (Ehri, 1984). The words we chose were ones whose spellings suggested that there might be an extra syllable in the word. For example, does the word "interesting" have three or four syllables? Is it pronounced "intresting" or "interesting?" We examined how many syllables our subjects thought were in the spellings of 11 words like this one. Also we examined whether they knew the spellings of the words. We found that subjects who knew spellings were more likely to segment words into the syllables represented in the spellings than subjects who did not know spellings. This is one more piece of evidence for the formative influence of print on speech.

I mentioned that our research on print-speech relations has led us into some controversies. The first controversy is over the relationship between phonemic segmentation and learning to read (Ehri, 1979). I'll remind you that phonemic segmentation refers to the ability to divide words up into their constituent sounds or phonemes. Several studies have shown that this is a very difficult task for young children who do not develop much skill until the age of 6 or 7. The task is difficult because there are no boundaries marking phonemes in speech. Rather sounds overlap, they may be co-articulated, and neighboring sounds may distort or alter their phonetic features. Furthermore, sounds are ephemeral. They last for a very brief time and so are hard to catch hold of and inspect. Liberman and Shankweiler (1979), Fox and Routh (1975, 1976, 1984), Gough and Hillinger (1980) and others have claimed that awareness of phonemes in speech is a prerequisite for learning to read and that children should be taught to segment phonemes before they begin reading instruction.

Our results have suggested another possibility, that phonemic awareness may be part of learning to read rather than something that is developed beforehand. We reason that one function of letters in spellings is to clarify what sounds are being heard in words (Ehri, 1984, 1985). Because phoneme segments are difficult to detect in speech, having a visible <u>picture</u> of the sounds should help tremendously. Many spellings in English can be regarded as phonemic transcriptions of speech. At least this is how beginning readers are taught to interpret them and this is how they store the spellings of words in memory, as we have shown in our studies. What we claim is that children should be taught phonemic awareness as they learn to read, not beforehand. Learning segmentation with letters ought to be more effective since the ultimate goal is to prepare beginners to process letters as phonemic symbols.

We performed a training study (Hohn & Ehri, 1983) and found that children who were taught phonemic segmentation with letters learned the skill better than those who were taught with blank markers. Bradley and Bryant (1983) also performed a segmentation training experiment. Their subjects were given phonemic segmentation training over a two-year period while they were learning to read. They found that experimental subjects were ahead of controls both in reading and in spelling at the end of two years. Training that included alphabet letters was the most effective. Others have performed studies on this question as well. In fact, the December, 1984, issue of the Journal of Educational Psychology contains three such studies, all providing evidence for the prerequisite claim. In addition, the one by Torneus (1984) failed to find evidence that phonemic segmentation develops as a consequence of learning to read and spell. As you can see, this is a hot issue and not settled yet.

The second controversy is over the issue of whether speech is primary and print merely a passive, reflected form of speech, or whether print exerts an active, formative influence on speech (Ehri, 1984, 1985). Linguists tend to believe that speech is primary and print is a reflection (C. Chomsky, 1970). In fact most linguists are not much interested in the study of writing. For example, Bloomfield (1933) described print as "merely a way of recording language by means of visible marks." Further on he says, "In order to study writing, we must know something about language, but the reverse is not true." (p. 21) In contrast, our research has led us to believe that print is not passive, that print shapes some aspects of speech, particularly during childhood when reading and spelling skills are acquired. We looked into the literature for additional support and found a variety of intriguing studies and arguments. I wish I had time to describe them all. I'll tell you about a few. You can read about the rest in two chapters on print-speech relations listed at the end of your handout (Ehri, 1984, 1985).

We found some psychological studies indicating that spellings sit in memory and influence performance in oral language tasks. For example, Seidenberg and Tannenhaus (1979) had subjects listen to a succession of nouns such as "glue" and "shoe" and decide whether each rhymed with the target word, "clue." They found that subjects responded faster to words having spellings similar to the target word, in this case, "glue," than to words with a different spelling, such as "shoe." Also it was found that when words had similar spellings but did not rhyme, for example, "bomb' and "tomb," subjects took longer to make a negative decision than when they said "No" to words with different spellings and pronunciations, for example, "bomb" and "room." Spellings of words were neither shown nor mentioned so their effects had to come from subjects' memories.

Another type of evidence we found in a book by the maverick linguist Householder (1971). Householder is to lingustics what Frank Smith is to the reading world. In his book, Householder argues for the primacy of writing over speech. He points out that historically there are many more instances where spellings have changed the pronunciations of words than where pronunciations have altered spellings. Also, the law is on the side of spellings. It cares little if people decide to pronounce their names differently, but court action is required to make an altered spelling legitimate.

The evidence that intrigued us the most was that printed language acts to constrain phonological drift. Phonological drift refers to changes in the pronunciations of words that occur in communities of speakers over time. According to Gelb (1952), English pronunciations have changed relatively little over the last four or five hundred years as a result of its writing system. This contrasts with dramatic shifts that occurred prior to that time. Also, this contrasts with rapid linguistic changes that are evident in modern primitive societies which lack a phonemic written language. Gelb (1952) points out that some American Indian languages are changing so fast that people of the present generation have difficulty conversing with people three or four generations older. We found further support for Gelb's (1952) claim in a study by Bright (1960) and Bright and Ramanujan (1962) who compared phonological drift in several South Asian Indian communities that spoke various dialects. He found less phonological drift in communities that had a written form of language than in communities that had only a spoken form. According to our theory, the reason why written language freezes pronunciations and inhibits phonological change is that spellings cast pronunciations into fixed phonemic forms. The letters specify which phonemes are there, and because speakers hold these in memory, they are reminded of the forms and adhere to them in their speech.

What we are suggesting here might be called orthographic determinism, a variant of linguistic determinism proposed many years ago by Whorf (1956). I must tell you that when we put this point of view and evidence all together, it was very exciting. We realized that this work should put reading and spelling research on the map. It shows that questions about how children learn to read and spell are not trivial, applied problems having to do only with skill acquisition and school achievement. These questions involve the development of basic human information processing equipment. During acquisition print works its way into the minds of learners and influences how they perceive and process speech. As such it is a major event during the course of language development. Linguists and psychologists can no longer regard it as unimportant or outside the domain of their interests. If one is studying how children's language develops or how adults process language, then consideration must be given to the influence of knowing how to read and spell.

Let me conclude by reviewing implications of our work for the teaching of reading and spelling. Results point to the importance of insuring that students have mastered the alphabet before they begin learning to read words out of context. Also results suggest the importance of moving students beyond a phonetic cue reading strategy and teaching them to become cipher readers. Note that we have not indicated specifically how to do this in our research. Although in one study we provided cipher training, I do not think this method is the best way to teach students deciphering skill. Rehearsing nonsense syllables over and over is boring and tedious, especially for young children. Our method was selected for experimental purposes only. More interesting ways of teaching deciphering skill need to be identified and evaluated for their effectiveness. Results of our studies suggest that to improve spelling skill, students need to be taught to take spellings seriously as maps for phonemes. They need to learn how to segment words into phonemes, how to match up spellings with phonemes, and how to resolve discrepancies when they are discovered. Some pretending may even be required in the form of believing that there are underlying "true sounds" in words that are only revealed in careful spelling pronunciations. I could go on with other implications that our work carries for instruction, but I have said enough. Thank you for your kind attention.

References

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

Bloomfield, L. (1933). Language. New York, N.Y.: Holt, Rinheart & Winston.

Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read -- A causal connection. Nature, 301, 419-421.

Bright, W. (1960). Linguistic change in some Indian caste dialects. In C. A. Ferguson & J. J. Gumperz (Eds.), Linguistic Diversity in South Asia. International Journal of American Lingustics, 26, 19-26.

Bright, W., & Ramanujan, A. K. (1962). Sociolinguistic variation and language change. In H. G. Lunt (Ed.), Proceedings of the Ninth International Congress of Linguists. Cambridge, MA: Mouton.

Carpenter, P. A. & Just, M. A. (1981). Cognitive processes in reading: Models based on readers' eye fixations. In A. M. Lasgold & C. A. Perfetti (Eds.), Interactive Processes in Reading. Hillsdale, NJ: Lawrence Erlbaum Assoc.

Chall, J. (1967). Learning to Read: The Great Debate. New York: McGraw-Hill Book Co.

Chall, J. S. (1979). The great debate: Ten years later with a modest proposal for reading stages. In L. B. Resnick & P. A. Weaver (Eds.), Theory and Practice of Early Reading (Vol. 1, pp. 29-56). Hillsdale, NJ: Lawrence Erlbaum Associates.

Chomsky, C. (1970). Reading, writing and phonology. Harvard Educational Review, 40, 287-309.

Chomsky, N. (1968). Language and Mind. New York: Harcourt Brace Jovanovich, Inc.

Drake, D. A. & Ehri, L. C. (in press). Spelling acquisition: Effects of pronouncing words on memory for their spellings. Cognition and Instruction.

Ehri, L. C. (1978). Beginning reading from a psycholinguistic perspective: Amalgamation of word identities, p. 1-33. In F. B. Murray (Ed.), The Recognition of Words, IRA Series on the Development of the Reading Process, International Reading Association.

Ehri, L. C. (1979). Linguistic insight: Threshold of reading acquisition. In T. G. Waller and G. E. MacKinnon (Eds.), Reading Research: Advances in Theory and Practice (Vo. 1), New York: Academic Press.

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

Ehri, L. C. (1980-b). The role of orthographic images in learning printed words. In J. Kavanagh and R. Venezky (Eds.), Orthography, Reading and Dyslexia. Baltimore, Maryland: University Park Press.

Ehri, L. C. (1983). Critique of five studies related to letter name knowledge and learning to read. In L. Gentile, M. Kamil, & J. Blanchard (Eds.), Reading Research Revisited (pp. 143-153). Columbus, OH: C. E. Merrill.

Ehri, L. C. (1984). How orthography alters spoken language competencies in children learning to read and spell, p. 119-147. In J. Downing and R. Valtin (Eds.), Language Awareness and Learning to Read, New York: Springer Verlag.

Ehri, L. C. (1985). Effects of printed language acquisition on speech. In D. Olson, N. G. Torrance, and A. Hildyard (Eds.), Literacy, Language and Learning: The Nature and Consequence of Reading and Writing, Cambridge University Press.

Ehri, L. C. (in preparation). Sources of difficulty in learning to spell and read. In M. L. Wolraich & D. Routh (Eds.), Advances in Developmental and Behavioral Pediatrics. Greenwich, Conn: Jai Press Inc.

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

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

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

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

Ehri, L. C. & Wilce, L. S. (1982). The salience of silent letters in children's memory for word spellings. Memory and Cognition, 104, 155-166.

Ehri, L. C. & Wilce, L. S. (1983). Development of word identification speed in skilled and less skilled beginning readers. Journal of Educational Psychology, 75, 3-18.

Ehri, L. C. & Wilce, L. S. (1985-a). Movement into reading: Is the first stage of printed word learning visual or phonetic? Reading Research Quarterly, 20, 163-179.

Ehri, L. C. & Wilce, L. S. (1985-b). [Effects of cipher training on word reading and spelling skill.] Unpublished raw data.

Ehri, L. C. & Wilce, L. S. (in press). The influence of spellings on speech: Are alveolar flaps /d/ or /t/? In D. Yaden and S. Templeton (Eds.), Metalingustic Awareness and Beginning Literacy. Exeter, New Hampshire: Heinemann Educational Books Inc.

Fox, B., & Routh, D. K. (1975). Analyzing spoken language into words, syllables, and phonemes: A developmental study. Journal of Psycholinguistic Research, 4, 331-342.

Fox, B., & Routh, D. K. (1976). Phonemic analysis and synthesis as word-attack skills. Journal of Educational Psychology, 68, 70-74.

Fox, B. & Routh, D. K. (1984). Phonemic analysis and synthesis as word attack skills: Revisited. Journal of Educational Psychology, 76, 1059-1064.

Gelb, I. J. (1952). A Study of Writing. Chicago, Ill.: University of Chicago Press.

Gentry, J. R. (1982). An analysis of developmental spelling in GNYS AT WRK. The Reading Teacher, 36, 192-200.

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

Goodman, K. S., & Goodman, Y. M. (1979). Learning to read is natural. In L. B. Resnick & P. A. Weaver (Eds.), Theory and Practice of Early Reading (Vol. 1, pp. 137-154). Hillsdale, NJ: Lawrence Erlbaum Associates.

Goodman, Y. M., & Altwerger, B. (1981). Print awareness in preschool children: A working paper. A study of the development of literacy in preschool children. Occasional Papers No. 4, Program in Language and Literacy, University of Arizona.

Gough, P. B. & Hillinger, M. (1980). Learning to read: An unnatural act. Bulletin of the Orton Society, 30, 180-196.

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

Harste, J. C., Burke, C. L., & Woodward, V. A. (1982). Children's language and world: Initial encounters with print. In J. Langer & M. Smith-Burke (Eds.), B.idging the Gap: Reader Meets Author (pp. 105-131). Newark, DE: International Reading Association.

Henderson, E. H. (1981). Learning to Read and Spell. DeKalb, Ill: Northern Illinois University Press.

Hohn, W. E. & Ehri, L. C. (1983). Do alphabet letters help prereaders acquire phonemic segmentation skill? Journal of Educational Psychology, 75, 752-762.

Householder, F. (1971). Lingustic Speculations. Cambridge, England: Cambridge University Press.

Juel, C. & Roper/Schneider, D. (1985). The influence of basal readers on first grade reading. Reading Research Quarterly, 20, 134-152.

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

Liberman, I. Y. & Shankweiler, D. (1979). Speech, the alphabet and teaching to read. In L. B. Resnick & P. A. Weaver (Eds.) Theory and Practice of Early Reading. Hillsdale, NJ: Erlbaum.

Mason, J. (1980). When do children begin to read: An exploration of four-year-old children's letter and word reading competencies. Reading Research Quarterly, 15, 203-227.

Masonheimer, P. E., Drum, P. A., & Ehri, L. C. (1984). Does environmental print identification lead children into word reading? Journal of Reading Behavior, 16, 257-271.

Otto, H. & Pizillo, C. (1970). Effect of intralist similarity on kindergarten pupils' rate of word acquisition and transfer. Journal of Reading Behavior, 3, 14-19.

Perfetti, C. A. (1984). Reading acquisition and beyond: Decoding includes cognition. American Journal of Education, 93, 40-60.

Perfetti, C. A., & Hogaboam, T. (1975). Relationship between single word decoding and reading comprehension skill. Journal of Educational Psychology, 67, 461-469.

Read, C. (1971). Pre-school children's knowledge of English phonology. Harvard Educational Review, 41, 1-34.

Seidenberg, M. S., & Tanenhaus, M. K. (1979). Orthographic effects on rhyme monitoring. Journal of Experimental Psychology: Human Learning and Memory, 5, 546-554.

Share, D. L., Jorm, A. F., Maclean, R. & Matthews, R. (1984). Sources of individual differences in reading acquisition. Journal of Educational Psychology, 76, 1309-1324.

Slobin, D. I. (1971). Psycholinguistics. Glenview, Ill.: Scott, Foresman and Co.

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

Torneus, M. (1984). Phonological awareness and reading: A chicken and egg problem? Journal of Educational Psychology, 76, 1346-1358.

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

Whorf, B. L. (1956). Language, Thought and Reality. (Edited with an introduction by J. B. Carroll.) Cambridge, MA and New York: M.I.T. Press and John Wiley & Sons, Inc., 1956.

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Title: Learning to Read and Spell

AERA Invited Address

Table 1: Sources of Information and their Potential Contributions to Word Identification During Text Reading

Sources	Potential Contributions
1. Semantic	Predicting semantic features of words
a. Knowledge of the world	Predicting specific words
b. Knowledge of linguistic meanings	Confirming words
c. Memory for information already read	
2. Syntactic	Predicting form classes of words
a. Knowledge of sentence structures	Predicting specific words
b. Knowledge of the immediate sentence structure being read	Confirming words
3. Graphic: Printed Word Memory Lexicon of spellings, pronunciations & meanings; sight word vocabulary	Identifying known printed words Confirming predicted words
4. Graphic: Letter-Sound Knowledge Decoding (deciphering) skill	Decoding unknown printed words Confirming words

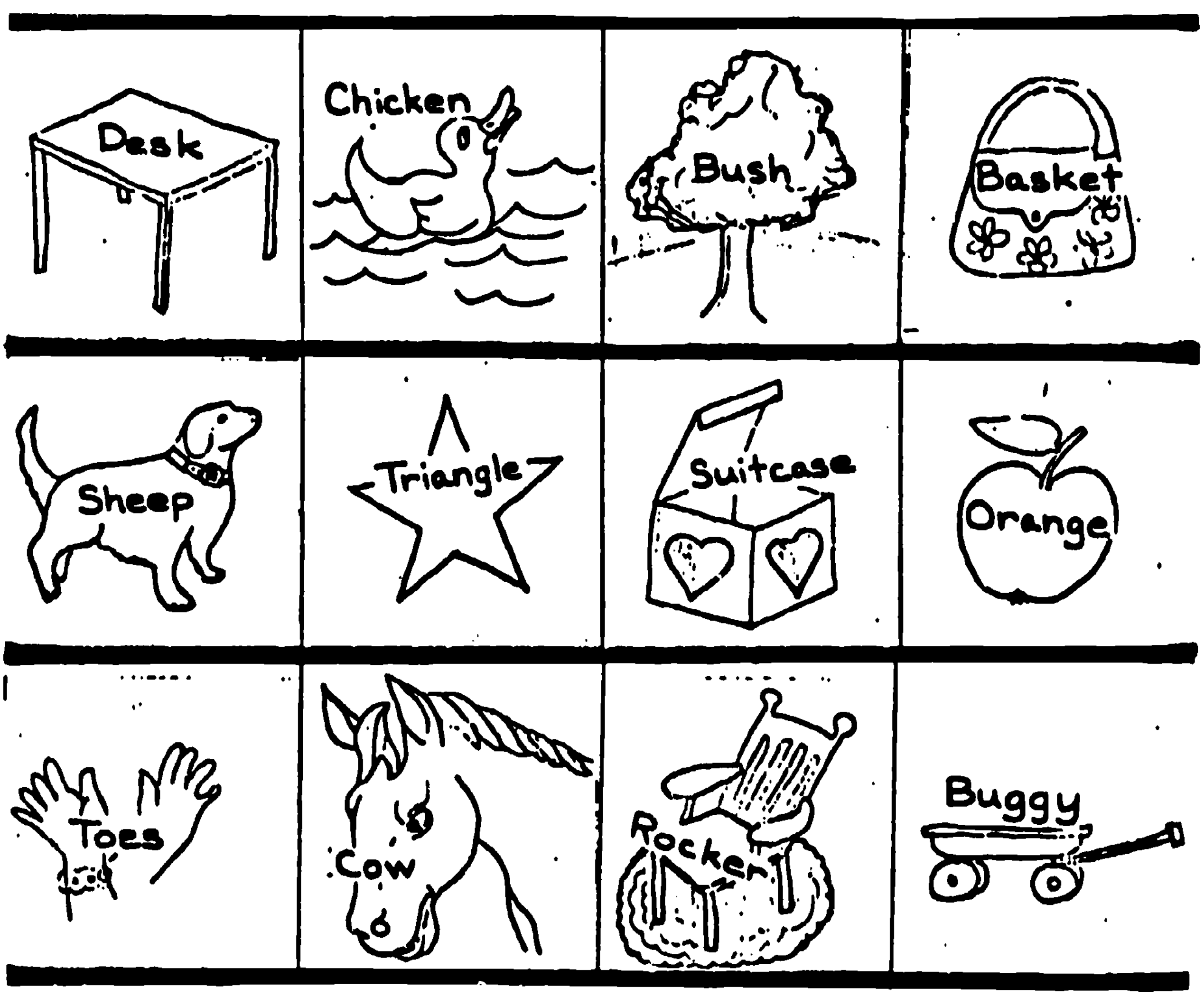

Figure 1. Pictures printed with semantically related words. Try to name the pictures as rapidly as you can and ignore the printed words.

Table 2: Stages of Reading Acquisition (Adapted from Chall, 1979)

Stage 0. <u>Prereading</u> (Grades: preschool; Ages: birth to 6 yrs.)

Acquiring oral language skills
Exposure to the activities of a literate culture
Learning to identify environmental print
Developing concepts about reading and writing
Learning letter shapes and names
Spelling: producing prephonetic spellings

Stage 1. <u>Initial Reading and Decoding</u> (Grades: 1-2; Ages: 6-7 yrs.)

Acquiring metalinguistic knowledge: phonemic segmentation and blending; word awareness; meanings of reading instruction terminology
Learning how letters symbolize sounds in written words
Learning to decode
Acquiring a printed word lexicon; recognizing frequently read words accurately and automatically
Phases of text reading: (1) learning to predict words from context
(2) learning to attend to graphic cues rather than context cues to read words
(3) learning to coordinate context and graphic cues to identify words
Spelling: learning to produce more complete phonetic spellings

Stage 2. <u>Confirmation, Fluency, Ungluing from Print</u> (Grades: 2-3; Ages: 7-8 yrs.)

Third phase of text reading is developed more fully (see above)
Strengthening decoding skill
Increasing size of printed word lexicon; increasing speed to identify familiar words
Spelling: learning morphemic as well as phonetic spellings

Figure 2.

Example of altered print

Table 3. Examples of Visual and Phonetic Spellings

Set A Phonetic Spellings	Visually Distinctive Spellings	Set B Phonetic Spellings
LFT (elephant)	WBC	JRF (giraffe)
DIPR (diaper)	XGST	BLUN (balloon)
KOM (comb)	uHE	MSK (mask)
RM (arm)	Fo	NE (knee)
PNSL (pencil)	QDJK	SZRS (scissors)
HKN (Chicken)	YMLP	
	YMP	TRDL (turtle)

Mean number of phonetic and visual spellings identified correctly in the word-learning task as a function of beginning reader group (left panel) and learning trials (right panel)

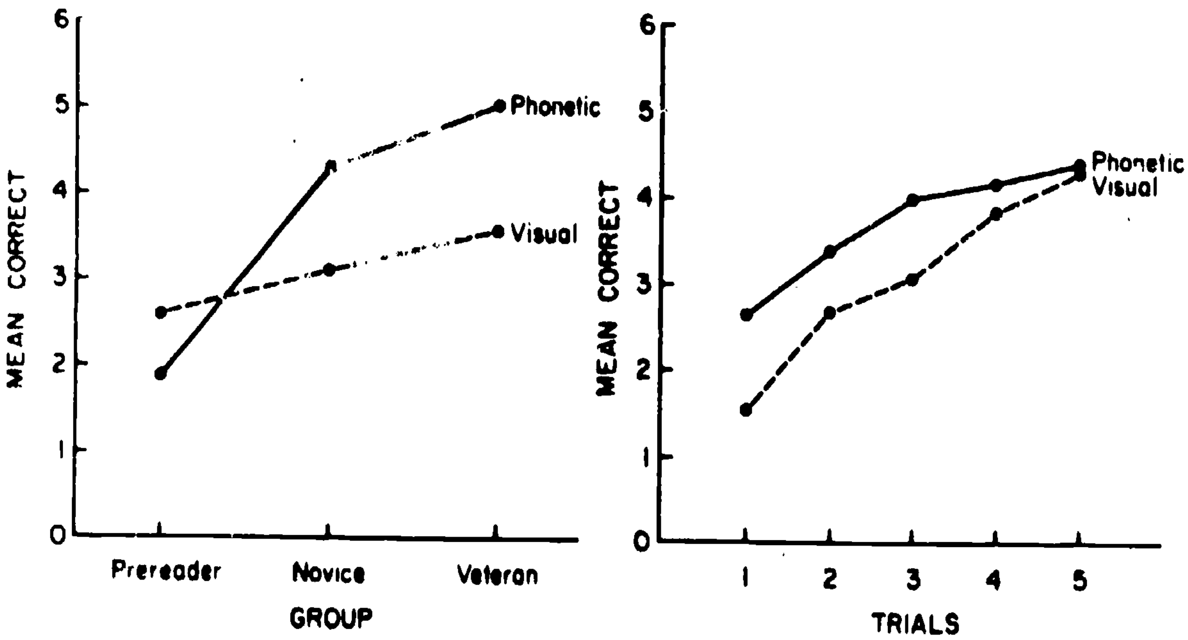

Figure 3

Table 4: Sets of Words Use to Teach Deciphering Skill

Set 1:	SAB, SAP, SAM, SAT, SAD, SAN, SAS
Set 2:	SIB, SIP, SIM, SIT, SID, SIN, SIS
Set 3:	SUB, SUP, SUM, SUT, SUD, SUN, SUS
Set 4:	LAS, RAS, SAS, BAS, DAS, PAS, TAS
Set 5:	LOS, ROS, SOS, BOS, DOS, POS, TOS
Set 6:	LUS, RUS, SUS, BUS, DUS, PUS, TUS
Set 7:	SIP, SIM, SIMP, SIN, SID, SIND, SIS, SIT, SIST
Set 8:	SUP, SUM, SUMP, SUN, SUD, SUND, SUS, SUT, SUST
Set 9:	DOS, ROS, DROS, BOS, LOS, BLOS
Set 10:	DIS, RIS, DRIS, BIS, LIS, BLIS
Set 11:	SUM, PUM, SPUM, TUM, STUM
Set 12:	SIM, PIM, SPIM, TIM, STIM

Table 5: Words Taught in the Word Learning Task

BEND	LAMP
BIB	LAP
BLAST	LIST
BLOND	SPIN
DOT	STAB
DRIP	STAMP
DRUM	STAND
DUMP	

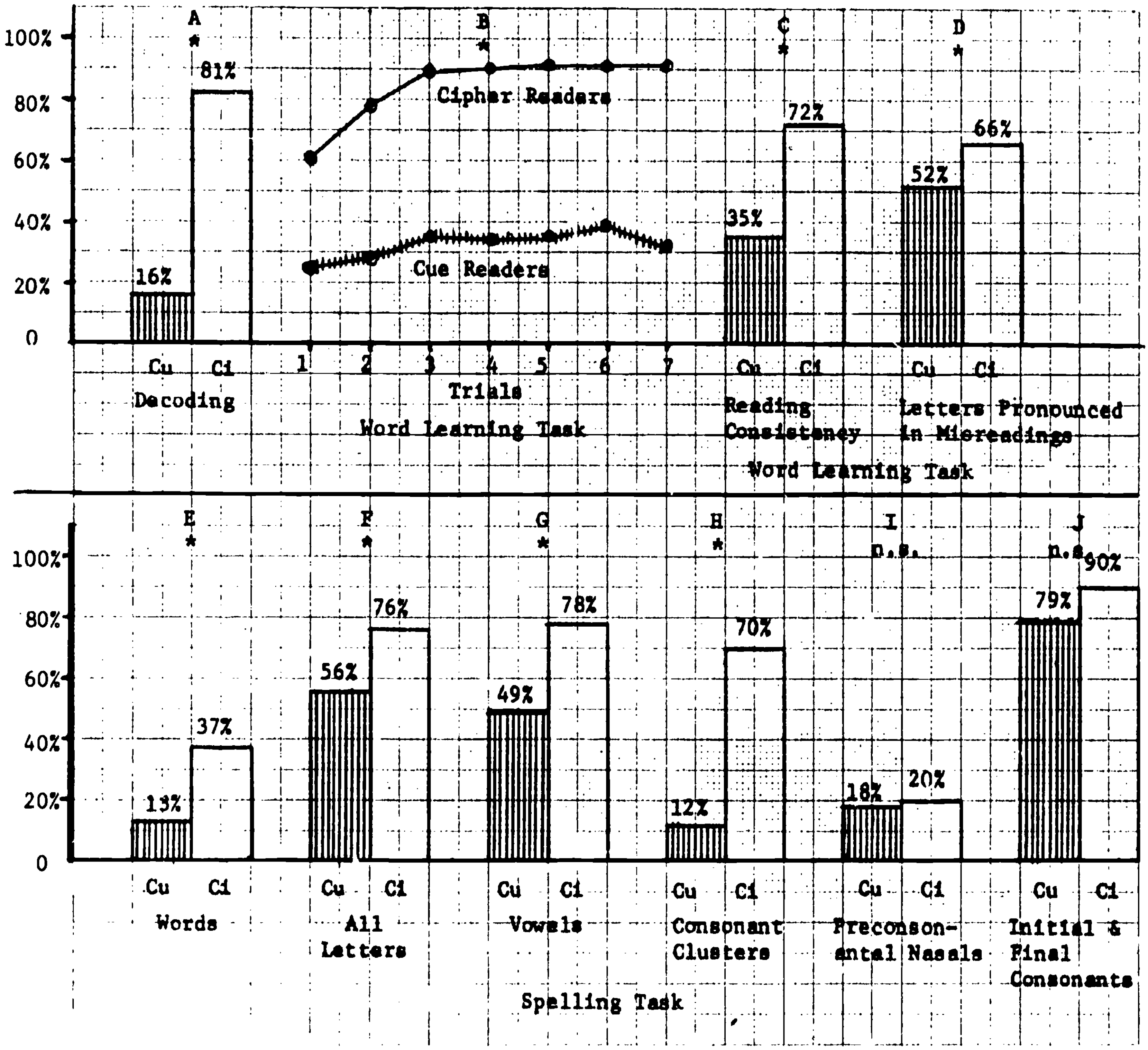

Figure 4. Mean Percent Correct in the Word Reading and Spelling Posttests for Cipher Readers and Cue Readers

Table 6. List of Extra-Letter and Control Word Pairs, Phonetic Description, Frequency that Extra Phonemes Were Detected (Phonemic Segmentation Task) and Frequency of Correct Word Spellings (Maximum = 24 Subjects per Word)

Word Pairs		Sound Structure		Phoneme Detection		Spellings	
Extra Letter	Control	Shared Phoneme	Extra Phonetic Element	Extra Letter	Control	Extra Letter	Control
catch	much	/č/	t alveolar tap	15	1	19	24
pitch	rich	/č/	t alveolar tap	13	3	18	24
badge	page	/ǰ/	d alveolar tap	13	0	17	24
can you	menu	/u/	y glide	19	0	24	20
new	do	/u/	w glide	18	0	24	24
own	old	/o/	w glide	12	0	19	24
comb	home	/m/	b bilabial stop	6	0	20	24
			Means	13.7	0.6	20.1	23.4

Table 7. Target Words and Number of Correct Response Rhymes in Each Training Group (Maximum Correct = 9)

Target Words[a]	Response Rhymes[b]	Groups: Experimental (Read)	Groups: Control (Pronounce)	Differences
Flap Spelled T:				
Gretel	jet-bed	9	4	+5
meteor	feet-seed	8	3	+5
glitter	mitt-kid	8	5	+3
attic	hat-dad	7	4	+3
notice	boat-road	8	6	+2
cheating	feet-seed	9	7	+2
	Mean	8.2	4.8	+3.4
Flap Spelled D:				
Cadillac	dad-hat	7	3	+4
huddle	mud-nut	8	8	0
pedigree	bed-jet	8	6	+2
modify	rod-pot	8	8	0
shredding	bed-jet	9	9	0
forbidden	kid-mitt	8	6	+2
	Mean	8 0	6.7	+1.3

Note. There were 9 subjects in each group.

[a] Flap-terminal syllable is underlined.

[b] Response which rhymes with flap-terminal syllable is listed first.