Exploring the Relations between Reading and Speech*

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ABSTRACT

Acknowledgment of the priority of the spoken language and the derivative nature of the writing system is an essential starting point for an investigation of reading acquisition in children. The relations between the language and the writing system are manifold and complex so that spoken sounds and alphabetic characters cannot be related in a one-to-one fashion. There is reason to believe that the phonetic level of representation plays an especially significant role in the acquisition of reading in the young child. We considered that a primary function of a phonetic representation is to yield an adequate span in working memory to permit linguistic interpretation of the temporally arrayed segments of the message. Results of our studies of short-term memory in good and poor readers suggested that the poor reader is deficient in forming a phonetic representation from speech as well as from script. In order to learn to read an alphabetically written language, the child must have, in addition to a phonetically organized short-term memory, the ability to make explicit the phonemic segmentation of his own speech. The findings indicate that in contrast to the tacit appreciation of phonemic differences in ordinary language use, explicit knowledge of the phonemic level is difficult to attain. Many children lack phonemic awareness when they start to learn to read and this may be a cause of reading failure.

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Given so little agreement on how best to teach children to read, it is perhaps not surprising to find divergent conceptions of the nature of reading itself. Among these, we find two contrasting positions concerning the relationships between reading and speech. On the one hand, some writers (e.g., Goodman, 1968; Smith, 1973) have tended to ignore the relationship, choosing instead to emphasize the relative autonomy of reading and writing. Their counsel is, in effect, to forget about speech when teaching reading. A major target of their criticism has been the so-called phonic approach to reading instruction, which stresses the letter-to-sound mappings while failing to appreciate that we cannot read simply by concatenating individual letter sounds. On the other hand, we and a few other investigators (Huey, 1908; Mattingly, 1972; Shankweiler and Liberman, 1972; Rozin and Gleitman, in press) have emphasized the importance of the derivative nature of reading and writing and the intimate connection between speech and the alphabet. In defending this aspect of the study of reading, however, we give due weight to the complexity of the relationship. We believe that many of the criticisms that have been raised would apply only to a very simplistic view of how spoken sounds and alphabetic characters are related.

Central to the understanding of how reading is acquired, in our view, is the question of how reading builds on the speech processes of the child. We know, of course, that spoken language is historically prior to reading and writing in the development of the race, ontogenetically prior in the life of the individual, and logically prior to the relation of written symbols to their speech referents. Further evidence of the derivative status of writing and reading and the practical importance of the priority of speech is readily at hand. Consider the contrasting situations of the congenitally blind and the congenitally deaf. The blind acquire spoken language normally; the profoundly deaf, even under the most favorable conditions, are so effectively isolated from language that they show severe deficiencies in every aspect of language development (Furth, 1966). Since the blind child learns to read by means of the substitute sense of touch, we may ask why the deaf child cannot effectively exploit his intact visual channel for reading. Presumably he cannot do so because deafness blocks the development of a foundation in primary language so necessary as a basis for learning to read. If reading were, as some have argued, an alternative and coequal language reception system, then it would be hard to explain why the deaf could not learn language by eye as readily as the hearing learn it by ear. Our interest, of course, is to understand the acquisition of reading in children with intact sensory capacities. We make reference to reading in the blind and the deaf only to emphasize how closely reading is tied to speech.

If reading and speech are so closely linked, we would expect them to share much of the same neural machinery. As Halwes (1968) has pointed out, it is unparsimonious to imagine a completely parallel language understanding system (for reading) that borrowed nothing from the primary speech system. Rather than developing a separate device for reading, it would be more parsimonious to expect that the would-be reader modifies the speech perception system to accept optical information. We assume that the speech system works by mapping the acoustic signal into progressively more abstract representations, and we assume that the reading device must tie in with that system at some level. How much visual processing must be done before script can be represented in the common language processing system (as though the input had been speech rather than script)? To put the question another way, what is the level of representation at which script is recoded?
Certain facts about the writing system must constrain how we conceive of the reading process. All writing systems make contact at some point with the spoken language. Some, like Chinese and Japanese logographs, tie in at the level of words, others at the level of the syllable. Some—the alphabets—link their primary symbols to distinctive aspects of the sound structure of the language. In the case of English, there is good reason to believe that script makes contact with the primary language system at more than one level. At times, similarity of spelling may denote not similarity of sound, but similarities of origin and root meaning, as in such word pairs as sign and signal. Such cases are not uncommon. Moreover, the assignment of grammatical class is sometimes preliminary to determining the correct phonetic form. To use an example of Rozin and Gleitman (in press), the written word contract is ambiguous until we know whether it functions as a noun or as a verb. The correct phonetic representation of such ambiguous words cannot be fully attained without reference to more molar representations. These observations obviously constrain our choices when we attempt to model the perceptual system in reading. Thus, we do not assume that the reader is tied to a rigid hierarchy of successive processing stages. Rather, we suppose that the transformation of script into speech occurs at a number of levels concurrently and in parallel.

To recapitulate, the fundamental task of the beginning reader is to construct a link between speech and the arbitrary signs of script. Although the alphabet is roughly a cipher on the phonemes of speech, this does not imply that learning to read is merely a matter of acquiring letter-to-sound correspondence. English spelling does not fully reflect the phonetic facts of the language, and at times seems deliberately to ignore them in order to convey other kinds of information helpful to the easy comprehension of what is read. We assume that the experienced reader learns to detect and to exploit such multileveled representation, though the complexity of the orthography is surely an added source of difficulty for the beginning reader.

FUNCTIONS OF THE PHONETIC REPRESENTATION

Although English spelling is not a faithful phonetic transcription, there is reason to suppose that the phonetic level of representation plays an especially significant role in the acquisition of reading in the young child. Even in English the alphabet is largely keyed to the sound structure. Hence, new words can be given at least an approximate pronunciation on first encounter if the reader understands how the alphabet works. Obviously, the reader must re-code phonetically if he is to obtain the phonetic realization of a new word. But what does he do with words and phrases he has read many times? Does he in these cases construct a phonetic representation, or does he, as some believe, bypass the phonetic level and go directly from visual shape to meaning?

It seems likely that phonetic recoding might occur even with frequently read materials, and that its persistence in older, more experienced readers is not to be regarded merely as a habit that has ceased to be functional. The possibility we are proposing is that the reader needs a phonetic base on which to extract the message from its encipherment in script; that is, the normal primary language processes of storing, indexing, and retrieving from the dictionary in our heads are carried out by means of a phonetic code. Moreover, in addition to the possibility that the dictionary may be indexed phonetically, consider what cues we use to decode the syntax of the message. Here we are aided by the rise and fall of the speech melody and its pattern of rhythms and
stresses. These are not given directly in script, and it may require the mediation of an internal phonetic representation to enable the reader to construct those prosodic features so necessary to comprehension (Liberman, Shankweiler, Liberman, Fowler, and Fischer, in press).

Since the perceiver cannot process each message unit fully at the time of its arrival, we may be sure that short-term memory is one of the primary linguistic processes essential to comprehension of both written and spoken language. The perceiver, whether functioning as reader or hearer, must hold a sufficient number of shorter segments (words) in memory in order to apprehend the longer segments (sentences). Obviously, if he had a span of only two words, the perceiver's comprehension of connected discourse would be extremely limited. But does the reader form a different kind of memory representation than the hearer? Although we do not rule out the possibility that read words can be held temporarily in some visual form, we have indicated reasons above for supposing that the reader typically engages in recoding from script to some phonetic form. [See Liberman, Mattingly, and Turvey (1972) for a fuller exploration of the suggestion that the phonetic representation is uniquely suited to the short-term storage requirements of language.]

Apart from these speculations, there is much relevant experimental evidence for phonetic recoding. In many investigations it has been found that when lists of letters or alphabetically written words are presented orthographically to be read and remembered, the confusions in short-term memory are based on phonetic rather than visual similarity (Sperling, 1963; Conrad, 1964, 1972; Baddeley, 1966, 1968, 1970; Hintzman, 1967; Kintsch and Buschke, 1969). From these findings, it has been inferred that the stimulus items had been stored in phonetic form rather than in visual form. Conrad (1972) has emphasized that the tendency to recode visually presented items into phonetic form is so strong that subjects do this even in experimental situations in which to do so penalizes recall.

There is evidence from a similar kind of experiment (Erickson, Mattingly, and Turvey, 1973) that phonetic recoding occurs even when the linguistic stimuli are not presented in an alphabetic form that represents the phonetic structure, but in a form (the Japanese kanji characters) that represents the semantic message more directly. Moreover, under some circumstances, even nonlinguistic stimuli may be recoded into phonetic form and stored in that form in short-term memory. In this connection, Conrad (1972) found that in recall of pictures of common objects, the confusions of children aged six and over were clearly based on the phonetic forms of the names of the objects rather than on their visual or semantic characteristics.

To be sure, none of these experiments dealt with wholly natural reading situations, since most involved the reading of isolated words and syllables rather than connected text. They are nevertheless relevant to the assumption that even the skilled reader might recode phonetically in order to gain an advantage in short-term memory and to utilize the primary language processes he already has available to him. It remains to be determined whether good and poor readers among children in the early states of reading acquisition are distinguished by greater or lesser tendencies toward phonetic recoding.
PHONETIC RECODING IN GOOD AND POOR BEGINNING READERS

In view of the short-term memory requirements of the reading task and evidence for the involvement of phonetic coding in short-term memory, we might expect to find that those beginning readers who are progressing well and those who are doing poorly will be further distinguished by the degree to which they rely on phonetic recoding.

In exploring this possibility, we studied three groups of school children nearing completion of the second year of elementary school who differed in level of reading achievement as measured by the word recognition subtest of the Wide Range Achievement Test (Jastak, Bijou, and Jastak, 1965). The first group, the superior readers, comprised 17 children reading about two years above their grade placement. The other two groups (whom we originally designated marginal and poor readers) can be considered together as the "poor readers" since their performances in these experiments were not significantly different from each other. Together the poor readers included 29 children averaging from one-half to a full year of reading retardation and roughly equated with the superior readers in mean age and IQ.

The experimental procedure was similar to one devised by Conrad (1972) in which the subject's performance is compared on recall of phonetically confusible (rhyming) and nonconfusible (nonrhyming) letters. Our expectation was that phonetically similar items would maximize phonetic confusability and thus penalize recall in subjects who use the phonetic code in short-term memory. Strings of five uppercase letters were presented tachistoscopically in a simultaneous 3-sec exposure. Half were composed of rhyming consonants (drawn from the set B C D G P T V Z) and half were composed of nonrhyming consonants (drawn from the set H K L Q R S W Y).

The test was given twice: first with immediate recall, then with delayed recall. In the first condition, recall was tested immediately after presentation by having subjects print as many letters as could be recalled in each letter string, in the order given. To make the task maximally sensitive to the recall strategy, we then imposed a 15-sec delay between tachistoscopic presentation and the response of writing down the string of letters. The children were requested to sit quietly during the delay interval; no intervening task was imposed. We have reason to believe that the subjects used this period for rehearsal, since many were observed mouthing the syllables silently.

The responses were scored in two ways, with and without regard to serial position. In the first scoring procedure, only those items listed in the correct serial position were counted correct. The second scoring procedure credited any items that occurred in the stimulus set regardless of the order in which they were written down. The pattern of results was remarkably similar, given data derived from each method of scoring. Ability to recall in correct serial order is apparently not the major factor that distinguishes good and poor readers on this task.

As was to be expected, the phonetic characteristics of the items influenced the rate of correct recall. This may be seen in Figure 1, which shows the results summed over serial positions. The circles give the error rates for strings of rhyming items (labeled "confusible"); the triangles give errors on recall of the nonrhyming ("nonconfusible") strings. In all groups, there were
Figure 1: Mean recall errors summed over serial positions.
significantly more errors on recall of the confusable items. However, there were notable differences in the effects of phonetic similarity on the recall of children who differed in reading level. It is apparent from the figure that the main differences are between superior readers and the other groups.

The net effect of phonetic confusability on recall was much greater in the superior readers than in the others. It would be difficult to explain this result by assuming that the groups differ merely in general memory capacity. Superior readers were clearly better at recall on nonconfusable items than were the poor readers, while, at the same time, failing to show a clear advantage on the confusable items. We regard this as an interesting result. It is a relatively easy matter to demonstrate that poor readers do less well than good readers on a variety of language-dependent tasks. But here, by manipulation of the phonetic characteristics of the items, we have virtually eliminated the advantage of the superior readers.

As we said, recall was measured on half the trials immediately after presentation of the display, and on the other half after a 15-sec delay. Turning back to Figure 1, we see that delay magnified the penal effect of phonetic confusability, but only in the superior readers. Figure 2 shows plots of the error rates at each serial position. Viewing the results of the delay condition (shown in the lower portion), we see that the superior readers are sharply distinguished from the others in recall of nonconfusable items and nearly indistinguishable in their recall of confusable items. Why should imposing a delay between stimulation and recall affect good and poor readers differently? Is it simply the case that good readers try harder and rehearse the items more vigorously? Although we cannot be sure, we do not think that vigor or rate of rehearsal is a factor that chiefly distinguishes good and poor readers on this task. Certainly we know that the poor readers were attempting to rehearse because they so often mouthed the items during the interval (Liberman et al., in press).

We considered and rejected other explanations of the pattern of results obtained by good and poor readers. (1) The difference between the groups cannot easily be attributed to briefer memory span in the poor readers. Even if it were generally true that poor readers have briefer spans, the differential effect of phonetic similarity on recall performance by the two groups would still require explanation. (2) To suppose that the poor readers suffer mainly from a difficulty in reproducing the order of the items in the memory set encounters the same difficulty. Moreover, as we said, the pattern of results is much the same when the scoring credited the correct items in each string regardless of serial position.

The interpretation we find most plausible and interesting is that the results reflect genuine differences between good and poor readers in their use of a phonetic code. Of course we cannot argue that phonetic coding is entirely absent in the poor readers, since they demonstrated significant effects of confusability, though of lesser magnitude. A weak or defective phonetic representation in the poor readers could account for the failure of rehearsal to be effective.
Figure 2: Recall data replotted as a function of serial position.
AN AUDITORY ANALOG AND ITS VISUAL COUNTERPART

In light of the foregoing results, it seemed reasonable to suppose that poor readers may have a specific difficulty in constructing a phonetic representation from script. Before we could accept this hypothesis, however, we needed to find out what would happen when confusable and nonconfusable items were presented by ear. Since phonetic coding is presumably inescapable when speech material arrives auditorily, presentation by ear should force the poor reader into a phonetic mode of information processing. If an important component of his difficulty is a deficiency in recoding visual symbolic material into phonetic form, then the phonetic similarity of auditorily presented rhyming items should affect him as much (or as little) as it does the superior readers. Quantitative differences in memory capacity between the two groups may still show up in the general level of recall on the auditory presentation, but the statistical interaction of reading level and phonetic confusability should be diminished. If, on the other hand, the interaction remained, then it would follow that the difference between good and poor readers in regard to the use of a phonetic representation is not specifically linked to the visual information channel.

Two new experiments were carried out on the same subjects in order to clarify this important point. Since auditory presentation requires successive input, a parallel experiment was designed with visual serial presentation. Except in minor details, the results are like those previously obtained for simultaneous presentation of the letters, and, to our surprise, the visual and auditory experiments differed hardly at all in their results. The findings of each experiment are displayed in Figure 3, which gives serial position curves for recall of auditorily presented and visually presented items. As in the earlier experiment, the performances of the groups representing the extremes of reading ability differed mainly on the phonetically dissimilar items. Once again, phonetic similarity produced a greater impact on the superior readers than on the poor ones. It made practically no difference to the results whether the items to be recalled were presented to the eye or to the ear. Apparently, the crux of the difficulty for the poor reader on these tasks cannot be pinpointed as specifically as we originally believed. Though poor readers may indeed experience difficulty in the transformation of visual features into phonetic ones, the root problem is more general.

These new experiments lead us to expect that differences between good and poor readers will turn on their ability to determine and use a phonetic representation and not merely on their ability to recode from script. We suspect that individual differences in the availability of phonetic recoding strategies on recall tasks may indicate limits of the reader's active awareness of those aspects of language structure to which the alphabet is most directly keyed. This is a possibility that we shall wish to explore directly. We turn now to those aspects of cognitive development that are most relevant to use of an alphabet.

WHAT A CHILD NEEDS TO "KNOW" IN ORDER TO USE AN ALPHABET TO FULL ADVANTAGE

The preliterate child brings to the task of learning to read considerable competence in his spoken language. Our concern is to discover what additional abilities he needs in order to become a reader. Bolinger (1968) places the problem of the learner and the teacher of reading in proper perspective:
Figure 3: Recall data for the auditory analog experiment and its visual counterpart.
When a child who is already almost fully equipped with a language comes to the task of reading, anything that will help him transfer what he already knows to what he is expected to write and read is priceless (p. 177).

We have argued that an efficient short-term memory system is a requirement for good comprehension of language, both by eye and by ear, and that this requirement is most efficiently met by a phonetic representation. Reading, however, poses an additional requirement. The child must also have ready conscious access to certain aspects of the contents of that memory; he must have, in Mattingly's (1972) phrase, a degree of "linguistic awareness." In order to realize fully the advantages of an alphabet, the user--child or adult--must know quite explicitly what speech segments are represented by the strings of letters (Liberman, 1973; Liberman et al., in press).

It is appropriate at this point to remind ourselves of the benefits that alphabets confer. As we have said, a unique advantage is that each new word does not have to be learned as if it were an ideographic character before it can be read. That is, given a word that is already in his mental word store, the reader can apprehend the word without specific instruction, though he has never seen it before in print; or, given a word that he has never before seen or heard, he can closely approximate its spoken form until its meaning can be inferred from context or discovered later by asking someone about it. By functioning, however roughly, as a surrogate for phonemes, the alphabet gives its users immediate access to all items in a vast word store by means of a highly economical symbol set.

The savings may be had, however, only by the user who knows how the alphabet works. As in all complex cognitive skills, alternative strategies are possible. The very diversity of the orthographies that have developed during the course of evolution of writing is testimony to the flexibility of the perceptual apparatus. It is possible to read words written by an alphabet as though they were logograms. Many children undoubtedly begin to read in this way. However, the unique advantages of the alphabet are closed to the child who cannot use it analytically; though he may translate the logograms into phonetic representation, this will not help him to apprehend new words. In order to make the alphabet work for him, the child has first to be able to make an explicit analysis of the segments of spoken language. He has to be able to analyze speech into words, syllables, and phonemes. The last mentioned is of particular importance for users of an alphabet, because the phoneme is the principal point at which the writing system meshes with the speech system.

When we speak of explicit knowledge of the segments in the spoken message, we wish to make it very clear that something more is involved than the ordinary competence required in language use. That is to say, a person may be a completely adequate speaker-hearer of his language without having the dimmest awareness that the spoken word bed contains three phoneme segments and bend contains four. The immediate recognition of these as different words, failing the ability to indicate that /n/ is the unshared segment, is an example of what Polanyi(1964) has called "tacit knowledge." Such knowledge is sufficient, or course, for comprehension of the spoken message. Writing and reading, on the other hand, demand an additional analytic capability. Even before the advent of writing, those who used speech poetically in songs and chant must have been able to count syllables in order to form the meter, and been aware of the phonemic level in
order to make rhymes. Some such explicit knowledge of these properties of speech is a precondition for understanding the alphabetic principle.

THE DIFFICULTIES OF MAKING SPEECH SEGMENTS EXPLICIT

Elsewhere (Liberman, 1971, 1973; Liberman, Shankweiler, Fischer, and Carter, 1974) we have considered why awareness of the phoneme might be rather difficult to attain. In brief, we referred to a fact about the acoustic structure of speech. Consonants and vowels are not discretely present in the signal, but are represented overlappingly in the syllable, a condition that has been called "encodedness" (Liberman, Cooper, Shankweiler, and Studdert-Kennedy, 1967). As a consequence, the word dig, for example, has three phonetic segments but only one acoustic segment. Analyzing an utterance into syllables, on the other hand, may present a different and easier problem. We expect this to be so because in most cases each syllable has a distinctive peak in acoustic energy. The cue of auditory amplitude is a crude one that could not be used to locate exact syllable boundaries, but it can serve to indicate to the listener how many syllables there are in an utterance.

The merging of phones in the sound stream complicates the process of discovery of the phonemic level of speech for the would-be reader. This is not to say, of course, that the young child has difficulty differentiating word pairs, such as bad and bat, that differ in only one phoneme. There is evidence (Read, 1971) that children hear these differences quite as accurately as adults. The problem is not, as many believe, to get the child to discriminate such word pairs, but rather to lead him to appreciate that each of these words contains three segments, and that they are alike in the first two and differ in the third. This is a further example of the distinction we drew earlier between tacit and explicit knowledge of the phonetic structure of language.

The encoded nature of the phonemes has another consequence that surely contributes to the difficulty of learning to read analytically. It makes it impossible to read by sounding out the letters one by one. In the example of dig, used above, reading letter by letter gives, not "dig," but "duhiguh." In order to learn to read analytically, one must instead discover how many of the letter segments must be taken simultaneously into account in order to arrive at the correct phonetic rendition. In the case of the word dig, there is reason to believe the number would be three. But, in fact, there is no simple rule for arriving at that number, and we suspect that learning to group the letters for the purpose of proper phonetic recoding is one of the really significant skills one must acquire. Thus, even in languages such as Finnish and Spanish in which the writing system closely approximates one-to-one correspondences between letters and phonemes, reading cannot be a simple matter of association between alphabetic characters and spoken sounds. In order to recover the spoken form, the reader must still "chunk" all the letters that represent the phonetic segments encoded into each syllable. In the case of reading a word in isolation, the coding unit is probably the syllable. In reading connected text, the number of letters that must be apprehended before recovery of the spoken form may at times be quite large, for reasons we have discussed. We do not know how the coding unit may vary with the prosody of the text and the reader's experience, but we may be sure that such units almost always exceed one letter in length. Therefore, we would stress that making analytic use of an alphabet does not mean reading letter-by-letter.
The foregoing discussion has stressed that explicit awareness of the phonetic structure of utterances is a very different thing from the ability to distinguish words whose phonetic structure differs minimally. The latter is easy for every normal child of school age, whereas the difficulty of explicit analysis has been noted by a number of researchers (Bloomfield, 1942; Rosner and Simon, 1971; Calfee, Chapman, and Venezy, 1972; Savin, 1972; Elkonin, 1973; Gleitman and Rozin, 1973). However, there had been no experiments designed to demonstrate directly that phonetic segmentation is more difficult for young children than syllabic segmentation, and that the ability to do it might develop later.

DEVELOPMENT OF THE AWARENESS OF SPEECH SEGMENTS IN THE YOUNG CHILD

Recently, we (Liberman et al., 1974) investigated the development of the ability to analyze words explicitly in syllables and phonemes. The task was posed to the child subjects in the guise of a tapping game, in which segments had to be indicated by the number of taps. We found steep age trends for analysis of words into each kind of segment, but, at each age, test words were more readily segmented into syllables than into phonemes. At age four, none of the children in our sample could segment by phoneme (according to the criterion we adopted), while nearly 50 percent could segment by syllable. Even at age six, only 70 percent succeeded in phoneme segmentation, whereas 90 percent were successful in the syllable task.

Further research is needed to confirm and generalize these results. Since the syllable is also the unit of metric scan, it is conceivable that the motor response of tapping is more compatible with analysis by syllable than with analysis by phoneme. An alternative procedure, designed by Goldstein (1974), asks the child to indicate the number of segments in test words by counting out tokens, thus limiting rhythmic motor responses that might bias the outcome in favor of the syllable. Goldstein’s preliminary work with this alternative procedure confirmed that phoneme segmentation is genuinely more difficult than syllable segmentation.

We hope eventually to clarify the meaning of the age trends we found. On the one hand, the increase in ability to segment phonetically might result from the reading instruction that typically begins between ages five and six. Alternatively, it might be a manifestation of cognitive growth not specifically dependent on training. The latter possibility could be tested by a developmental study of segmentation skills in a language community such as the Chinese, where the orthographic unit is the word and where reading instruction therefore does not demand the kind of phonetic analysis needed in an alphabetic system.

SEGMENTATION AND READING ACQUISITION

There is some evidence that the difficulties of phoneme segmentation may be related to problems of early reading acquisition. Such a relation can be inferred from the observation that children who are resistant to early reading instruction have problems even with spoken language when they are required to perform tasks demanding some rather explicit understanding of phonetic structure. Such children are reported (Monroe, 1932; Savin, 1972) to be deficient in rhyming, in recognizing that two different monosyllables may share the same first
(or last) phoneme segment, and also in playing certain speech games, which require a shift of the initial consonant segment of a word to a nonsense syllable suffix.

In our segmentation experiment, we noted a sharp increase in the number of children passing the phoneme-segmentation task, from only 17 percent at age five to 70 percent at age six. Hence, the steepest rise in segmentation ability coincides with the first intensive concentration on reading-related skills in the schooling of the child. This result, together with the observations on the lack of "transparency" of the phoneme to which we referred earlier, suggests a connection between phonetic segmentation ability and early reading acquisition. In a pilot study, we have begun to explore this relation. We measured the reading achievement of the children who had taken part in our experiment on phonemic segmentation described above. Testing at the beginning of the second school year, we found that half the children in the lowest third of the class in reading achievement—as measured by the word-recognition task of the Wide Range Achievement Test (Jastak et al., 1965)—had failed the phoneme segmentation task the previous June; on the other hand, there were no failures in phoneme segmentation among the children who scored in the top third in reading ability.

We are hopeful that studies of preschool children's ability to segment speech may shed some light on the matter of reading readiness. We plan to examine the pattern of reading errors in children at different levels of reading ability in relation to their ability to indicate the segments of spoken speech. If the indications of our pilot work are borne out, failure on both the syllable and the phoneme tasks at the first-grade level will be prognostic of extreme reading difficulty.

SUMMARY AND CONCLUSIONS

We believe the priority of spoken language and the derivative nature of reading and writing are the starting points for any understanding of the nature of writings systems and their acquisition. Reading, however, presents special problems for the perceiver, the nature of which reflects the manner in which the writing system makes contact with the primary speech system. In the case of English, the ties between the language and its spelling are based only partly on the sound structure. Nevertheless, it is particularly appropriate to direct the child's attention to the phonemic level, because the phonemic correspondences are the entry points to any alphabetic writing system.

We considered that a primary function of a phonetic representation, whether for the listener or the reader, is to yield an adequate span in working memory to permit linguistic interpretation of the temporally arrayed segments of the message. Results of our studies of short-term memory in good and poor readers suggested that the poor reader is deficient in forming a phonetic representation from speech as well as from script.

In order to learn to read an alphabetically written language, the availability of a phonetically organized short-term memory is not sufficient. In addition, the child must have the ability to make explicit the segmentation of his own speech, particularly at the level of the phoneme. Data were presented indicating that explicit knowledge of the phonetic level is difficult to attain in contrast to the tacit appreciation of phonemic differences reflected in
ordinary language use. We and others have noted that phonemic awareness is lacking in many children when they start to learn to read, and may be a cause of reading failure. In sum, the relations between speech and reading are both intimate and subtle. It would seem appropriate for the early instruction in reading to place initial stress on making the child aware of the speech segments he will eventually learn to represent by written signs.

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