Reading and the Awareness of Linguistic Segments

Isabelle Y. Liberman, Donald Shankweiler, Bonnie Carter, and F. William Fischer

ABSTRACT

Since many children who can understand spoken language cannot learn to read, we have asked what the child needs for reading beyond that which he already commands for speech. One important extra requirement is conscious awareness of phonemic segmentation. In speech, phonemic segments are normally encoded into units of approximately syllabic size. Awareness of linguistic structure at the phoneme level might therefore be difficult to attain, more difficult in any case than at the syllable level. Using a task which required our four-, five-, and six-year-old subjects to tap out the number of segments in spoken items, we found that analysis into phonemes is, indeed, significantly harder than analysis into syllables. At all three ages, far fewer children reached criterion with the phoneme task; those who achieved criterion required a greater number of trials to do so.

There are many children who readily acquire the capacity to speak and understand language but do not learn to read and write it. It is of interest, therefore, to ask what is required in reading a language that is not required in speaking or listening to it. The first answer which comes to mind, of course, is that reading requires visual identification of optical shapes. Since our concern here is with reading an alphabetic script, we may well ask whether the rapid identification of letters poses a major obstacle for children learning to read. The answer is that for most children perception of letter shapes does not appear to be a serious problem. There is considerable agreement among investigators that by the end of the first year of school, even those children who make little further progress in learning to read generally show no significant difficulty in the visual identification of letters as such (Vernon, 1960; Shankweiler, 1964; Doehring, 1968; I. Liberman, Shankweiler, Orlando, Harris, and Berti, 1971; Kolers, 1972).

+University of Connecticut, Storrs, and Haskins Laboratories, New Haven.
++University of Connecticut, Storrs.

Acknowledgment: The authors are indebted to Dr. A. M. Liberman, Haskins Laboratories, for many helpful suggestions and a critical reading of the text.

[HASKINS LABORATORIES: Status Report on Speech Research SR-31/32 (1972)]
Beyond identification of letters, learning to read requires mastery of a system which maps the letters to units of speech. There is no evidence, however, that children have special difficulty in grasping the principle that letters stand for sounds. Indeed, children can generally make appropriate sounds in response to single letters, but are unable to proceed when they encounter the same letters in the context of words (Vernon, 1960).

Another possible source of difficulty is that the relation in English between spelling and the language is often complex and sometimes highly irregular. But even when the items to be read are carefully chosen so as to include only those words which map the sound in a simple, consistent way and which are part of their active vocabularies, many children continue to have difficulties (Savin, 1972).

There remains at least one other possible barrier to reading acquisition. As suggested by several investigators (I. Liberman, 1971; Mattingly, 1972; Savin, 1972; Shankweiler and I. Liberman, 1972), in order to read an alphabetically written language, though not necessarily to speak and listen to it, the child must be quite consciously aware of phonemic segmentation. Let us consider the child trying to read the orthographically regular word bag. We will assume that he can see the written word and can identify the letters b, a, and g. We will assume also that he knows the sounds of the individual letters, which he might say as [bʌ] [æ] [gʌ]. But if that is all he knows, then he would presumably read the word as the trisyllable "buhaguh," which is a nonsense word and not the meaningful monosyllable "bag." If the child is to map the three letters of the printed word bag onto the one-syllable spoken word "bag" that he already knows, he must be consciously aware that the spoken word consists of three phonemic segments.

As we have said earlier, we believe that it is this requirement, this need to be consciously aware of the phonemic segmentation of the spoken word, that presents real difficulties for many children learning to read. But why should this pose special difficulties? If the sounds of speech bore a simple one-to-one relation to the phonemic units in the spoken message, just as the letters do (at least in the orthographically regular case), it would be hard to see why the child should be unaware of the phonemic segmentation. That is, if there were in the word "bag" three acoustic segments, one for each of the three phonemes, then the segmentation of the word that is represented in its spelling would presumably be quite apparent.

However, as extensive research in speech perception has shown (Fant, 1962; A. Liberman, Cooper, Shankweiler, and Studdert-Kennedy, 1967; Stevens, 1972), the segmentation of the acoustic signal does not correspond directly or in any easily determined way to the segmentation at the phonemic level. It should be emphasized that this lack of correspondence does not come about simply because the sounds of the phonemes are joined together, as are the letters of the alphabet in cursive writing or as may be implied by the reading teacher who urges the child to blend "buhaguh" into "bag." Rather, the phonemic segments are truly encoded in the sound. In the case of "bag," for example, the initial and final consonants are folded into the medial vowel, with the result that information about the successive phonemic segments is transmitted more or less simultaneously on the same parts of the sound. In exactly that sense, the syllable "bag" is not three acoustic segments, but one. This is not to say that the phonemic elements are not real, but only that the relation between them and the
sound is that of a very complex code, not a simple substitution cipher (A. Liberman et al., 1967). To recover the phonemic segments requires a correspondingly complex decoding process. In the normal course of perceiving speech, these processes go on quite automatically and, in the usual case, without conscious awareness.

That it might be more than a little difficult to bring the processes of phonemic analysis above the level of conscious awareness is suggested by the fact that an alphabetic method of writing has been invented only once (Gelb, 1963) and is a comparatively recent development in the history of writing systems. Of more immediate relevance to us is the evidence that children with reading disabilities may have difficulty even with spoken language when required to perform tasks that might demand explicit awareness of phonemic structure. These children are often reported, for example, to be deficient in rhyming, in recognizing that two different monosyllables share the same first (or last) phonemic segment (Monroe, 1932) and according to recent research (Savin, 1972), in speaking Pig Latin, which demands a conscious shift of the initial phonemic segment to the final position in the word.

As noted earlier, research on speech perception has found that the acoustic unit into which the phonemic elements in speech are encoded is of approximately syllabic dimensions. We would therefore suppose that the number of syllables (though not necessarily the location of syllable boundaries) might be more readily available to consciousness than the phonemes. If so, we might then have an explanation for the assertion (Makita, 1968) that Japanese kana, which is approximately a syllabary, is easier for the child to master. Since word segments are perhaps even more accessible, we might expect that an orthography which represents each word with a different character, as in the case of Chinese or the closely related Japanese kanji, would also not cause, in the beginning reader, the particular difficulties that arise in mastering the more analytic alphabetic system. Indirect evidence of the special burden imposed on the beginning reader by an alphabetic script can be found also in the relative case with which reading-disabled children learn kanji-like representations of language while being unable to break the alphabetic cipher (Rozin, Poritsky, and Solsky, 1971). It is worth noting, in the context of the foregoing observations, that since the time of the Greeks, methods of reading instruction (Mathews, 1966), have sporadically reflected the assumption on the part of educators that the phonemic structure is more easily taught through the use of syllabic units, presumably because the latter are easier for the child to apprehend.

---

It should be emphasized that the advantage of a logographic script is limited to the beginning reader. For the older child and adult, the kanji system presents other difficulties, such as the large number of characters to be learned (some 1,800 kanji for the daily newspaper, 5,000 for a novel). As to the Japanese kana, it appears an ideal writing system for the open-syllable Japanese language with its relatively small number of syllables (approximately 90) but would be hardly appropriate for the complex and highly variable syllable structure of English. Though neither the logograph nor the syllable would be recommended as substitutes for the alphabet in the English writing system, they might be considered for use as units in initial teaching methods. L. Gleitman and P. Rozin of the University of Pennsylvania (personal communication) have incorporated both into a teaching method which they consider to be promising with problem readers.
However, no research has been addressed specifically to the question of whether children, when they begin to read, do, in fact, find it difficult to make an explicit phonemic analysis of the spoken word and whether this ability comes later and is more difficult than syllabic analysis. In this study, we will see how well children at nursery school, kindergarten, and first grade ages can identify the number of phonemic segments in spoken words and will compare this with their ability to deal similarly with syllables.

**METHOD**

**Subjects**

The subjects were 135 white, middle class children from a public preschool program in the suburban town of Manchester, Connecticut, and from the elementary school in the adjoining town of Andover, Connecticut. They included 46 nursery schoolers ages 48 to 68 months, mean age 58 months (S.D. 5.40), 49 kindergarteners aged 63 to 79 months, mean age 70 months (S.D. 4.10), and 40 first graders aged 65 to 96 months, mean age 83 months (S.D. 5.50). The nursery school group contained 21 boys and 25 girls; the kindergarteners, 18 boys and 31 girls; the first graders, 15 boys and 25 girls. All available children at the appropriate grade levels in the participating schools were used, with the following exceptions: among the nursery school children, four with speech and hearing problems, 12 who refused to enter into the testing situation at all, and five who were so inattentive and distractible that demonstration trials could not be carried out; among the kindergarteners, one who had returned to kindergarten after several months in first grade and one whose protocol was spoiled by equivocal responses. No first graders were excluded.

Alphabetized class registers at each grade level were used to alternate the children between the two experimental groups, the one requiring phoneme segmentation (Group P) and the other, syllable segmentation (Group S). Equalization of the numbers of children assigned to each type of task was complicated at the nursery school level by the sporadic lack of participation by individual children. An attempt to equalize the numbers of boys and girls in the two task groups was hampered by the unequal numbers of the two sexes at all grade levels. The final composition of the groups is shown in Table 1.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Nursery School</th>
<th>Kindergarten</th>
<th>First Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task</td>
<td>P</td>
<td>S</td>
<td>P</td>
</tr>
<tr>
<td>Male</td>
<td>9</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>26</td>
<td>24</td>
</tr>
</tbody>
</table>

TABLE 1: Composition of phoneme (P) and syllable (S) groups across grade and sex.
The level of intelligence of all the subjects was assessed by the Goodenough Draw-A-Person Test (DAP). When computed across tasks, the mean DAP IQ was 110.06 (S.D. 18.20) for the syllable group and 109.19 (S.D. 15.73) for the phoneme group. Across grade levels, the mean IQ was 112.11 (S.D. 17.04) for the nursery schoolers, 108.90 (S.D. 17.92) for the kindergarteners, and 107.73 (S.D. 15.90) for the first graders. Two-way analyses of variance performed on the DAP IQ scores revealed no significant differences in IQ, either across tasks or across grade levels. In addition, the mean chronological ages of the two task groups were also found to be not significantly different. The mean age in months of the syllable group was 69.41 (S.D. 11.25); of the phoneme group, 69.58 (S.D. 11.18). Therefore, any performance differences in the two types of segmentation can reasonably be taken to be due to differences in the difficulty of the two tasks.

Procedure

Under the guise of a "tapping game," the child was required to repeat a word or sound spoken by the examiner and to indicate, by tapping a small wooden dowel on the table, the number (from one to three) of segments (phonemes in Group P and syllables in Group S) in the stimulus items. Four sets of training trials containing three items each were given. During training, each set of three items was first demonstrated in an order of increasing complexity (from one to three segments). When the child was able to repeat and tap each item in the triad set correctly, as demonstrated in the initial order of presentation, the items of the triad were presented individually in scrambled order without prior demonstration and the child's tapping corrected as needed. The test trials, which followed the four sets of training trials, consisted of 42 randomly assorted individual items of one, two, or three segments which were presented without prior demonstration and corrected by the examiner, as needed, immediately after the child's response. Testing was continued through all 42 items or until the child reached criterion of tapping six consecutive items correctly without demonstration. Each child was tested individually by the same examiner in a single session during either late May or June, 1972.

Instructions given to the two experimental groups at all three grade levels were identical except that the training and test items involved phonemic segmentation in Group P and syllabic segmentation in Group S. (See Stimulus Materials for further details.) The instructions used for the syllable task were as follows:

"We are going to play a tapping game today. I'm going to say some words and sounds and tap them after I say them. Listen, so you'll see how to play the game."

Training trials.

Step 1. (Examiner demonstrates with first training triad.) "But (one tap). Butter (two taps). Butterfly (three taps)."

"Now, I want you to do it. Say but...Good. Now, tap it...Good. Now, put your stick down. Say butter...Tap it...Good. Now, put your stick down. Say butterfly...Tap it...Now, put your stick down." (If the child makes an error in tapping, the entire triad is demonstrated again. If error persists, E goes on to Step 3. If tapping is correct, E goes to Step 2.)
Step 2. "Now, let's do it again to make sure you've got the idea. I'll mix them up and see if I can catch you. Say butter... Now, tap it... Say but... Now, tap it... Say butterfly... Now, tap it."

Step 3. "Let's try some more words. I'll do it first." (Demonstration is continued with the next three training triads, following all procedures in Steps 1 and 2 as needed.)

Test trials.

"Now, we'll play the real game. I'll say a word, but I won't tap it, because you know how to play the game yourself. So, you say the word after me and then tap it. After each word, be sure to put your stick down so I'll know you've finished tapping."

"Here's the first word. __________. You say it and tap it." If the child taps incorrectly, E says, "Listen to the way I do it. Now, you do it the same way I did it." If the child still taps incorrectly, E says, "Okay, here's the next one," and goes on to the next word. If the child taps correctly, E says, "Good! Here's the next one."

The same procedure is continued until the end of the list of 42 items or until the child reaches criterion of tapping six consecutive items correctly without demonstration.

Stimulus Materials

The training trials for the phoneme task included the following four triads:

1) /u/ (as in moo)
   boo
   boot

2) /ae/ (as in hat)
   as
   has

3) /o/ (as in go)
   toe
   tall

4) /l/ (as in bit)
   ma
   cut

For the syllable task, the training trials were:

1) but
   butter
   butterfly

2) tell
   telling
   telephone

3) doll
   dolly
   lollipop

4) top
   water
   elephant

It will be noted that in both the Group P and Group S training trials, the first two triads were formed by adding a segment to the previous item, while in the third triad, the final item varied from this rule. In the fourth triad,
all three items varied in linguistic content, so as better to prepare the child for the random distribution of linguistic elements in the test trials.

\begin{table}[h]
\centering
\caption{Test list for the phoneme segmentation task.}
\begin{tabular}{llll}
1. & \textit{is} & 15. & /\textit{a}/ (as in \textit{bought}) \\
2. & /\textit{e}/ (as in \textit{bet}) & 16. & cough \\
3. & my & 17. & pot \\
4. & toy & 18. & /\textit{u}/ (as in \textit{boot}) \\
5. & /\textit{ae}/ (as in \textit{bat}) & 19. & heat \\
6. & /\textit{i}/ (as in \textit{beet}) & 20. & he \\
7. & soap & 21. & /\textit{a}/ (as in \textit{hot}) \\
8. & /\textit{I}/ (as in \textit{bit}) & 22. & pa \\
9. & his & 23. & mat \\
10. & pout & 24. & /\textit{\&}/ (as in \textit{but}) \\
11. & mine & 25. & so \\
12. & caw & 26. & /\textit{ai}/ (as in \textit{bite}) \\
13. & out & 27. & up \\
14. & red & 28. & /\textit{au}/ (as in \textit{bout}) \\
29. & /\textit{U}/ (as in \textit{bull}) \\
30. & toys \\
31. & cake \\
32. & cool \\
33. & /\textit{e}/ (as in \textit{bait}) \\
34. & Ed \\
35. & cup \\
36. & at \\
37. & book \\
38. & /\textit{\&k}/ (as in \textit{book}) \\
39. & lay \\
40. & coo \\
41. & /\textit{O}/ (as in \textit{boat}) \\
42. & oy \\
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\caption{Test list for the syllable segmentation task.}
\begin{tabular}{llll}
1. & popsicle & 15. & chicken \\
2. & dinner & 16. & letter \\
3. & penny & 17. & jump \\
4. & house & 18. & morning \\
5. & valentine & 19. & dog \\
6. & open & 20. & monkey \\
7. & box & 21. & anything \\
8. & cook & 22. & wind \\
9. & birthday & 23. & nobody \\
10. & president & 24. & wagon \\
11. & bicycle & 25. & cucumber \\
12. & typewriter & 26. & apple \\
13. & green & 27. & funny \\
14. & gasoline & 28. & boat \\
29. & father \\
30. & holiday \\
31. & yellow \\
32. & cake \\
33. & fix \\
34. & bread \\
35. & overshoe \\
36. & pocketbook \\
37. & shoe \\
38. & pencil \\
39. & superman \\
40. & rude \\
41. & grass \\
42. & fingernail \\
\end{tabular}
\end{table}

As can be seen in Tables 2 and 3, both experimental test lists contained an equal number of randomly distributed one-, two-, and three-segment items. These were presented in the same order to all children in each experimental group. The items had been checked against word recognition and vocabulary tests to insure that they were reasonably appropriate for the vocabulary level of the children. In addition, a pilot study carried out in a day-care center had confirmed the suitability of both the vocabulary level and the test procedure for children aged three to six years. No further control of linguistic content was attempted in the Group S items, except that the accent in the two- and three-segment items was always on the first syllable. In the Group P
list, an effort was made to include as many real words, rather than nonsense words, as possible. Of necessity, the one-segment items, which consisted of 14 different vowel sounds, usually formed nonwords. The two-segment items in Group P were constructed by adding a consonant in the initial position to six of the vowels and in the final position to the remaining eight vowels. All of the three-segment items in Group P, with one exception, were constructed by the addition of one consonant to a two-segment item in the list.

RESULTS

The number of trials taken by each child to reach criterion level (six correct test trials without demonstration by the examiner) is displayed in Table 4 for the phoneme (P) and syllable (S) task groups at three grade levels.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Nursery School (age four)</th>
<th>Kindergarten (age five)</th>
<th>First Grade (age six)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task</td>
<td>P</td>
<td>S</td>
<td>P</td>
</tr>
<tr>
<td>------</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>28</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Mean number</td>
<td>25.7</td>
<td>26.0</td>
<td>12.1</td>
</tr>
<tr>
<td>trials to reach criterion</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

152
It is apparent that the test items were more readily segmented into syllables than into phonemes. In the first place, we see from the table that the number of children who were able to reach criterion was markedly greater in the syllable group than in the phoneme group, whatever the grade level. This aspect of performance is shown graphically in Figure 1 in terms of the percentages of children in nursery school (age four), kindergarten (age five), and first grade (age six) who reached criterion in the two types of segmental analysis. One can see that at age four, none of the children could segment by phonemes, while nearly half (46%) could segment by syllables. Ability to perform phoneme segmentation did not appear at all until age five and then it was demonstrated by only 17% of the children; in contrast, almost half (48%) of the children at that age could segment syllabically. Even at age six, only 70% succeeded in phoneme segmentation, while 90% were successful in the syllable task.

If we now refer back to Table 4 we see that the relatively greater difficulty of phoneme segmentation is indicated not only by the fact that fewer children reached criterion level with the phoneme task than with the syllables, but also by the fact that those children who did reach criterion on the phoneme task took a greater number of trials to do so. The mean number of trials to reach criterion in syllable segmentation was 25.7 at age four, 12.1 at age five, and 9.8 at age six. For the phoneme segmentation group, on the other hand, we cannot say what the mean number of trials was at age four, since no child reached criterion at that age. At age five, only four children succeeded in phoneme segmentation, and their mean number of trials was 26.0, more than twice the mean of the 12 children of the same age who completed the syllable task. At age six, 14 children met the criterion in phoneme segmentation, and here the mean of 25.6 is nearly three times that of the 18 children who succeeded on the syllable task. Moreover, the mean of the phoneme group at age six is roughly equal to the mean of the syllable group at age four.

The contrast in difficulty between the two tasks can also be seen in Table 4 in terms of the number of children who achieved criterion level in six trials, which, under the procedures of the experiment, was the minimum possible number. For the children who worked at the syllable task, the percentage who reached criterion in the minimum time increased steadily over the three age levels. It was 7% at age four, 16% at age five, and 50% at age six. In striking contrast to this, we find that in the phoneme group no child at any grade level attained the criterion in the minimum time.

An analysis of variance was carried out to assess the contribution of the several conditions of the experiment. The measure on which the analysis was performed was the mean number of trials taken to reach criterion. For all those children who did not reach criterion, we here assigned an arbitrary score of 43, which is one more than the 42-trial minimum provided by the procedures of the experiment. Due to the unequal numbers of subjects in each cell and the necessity of retaining all the data, the harmonic mean was used in the computation (Lindquist, 1940). The three variables considered were task, grade, and sex. The analysis of variance for these variables and their interactions is summarized in Table 5.
TABLE 5: Analysis of variance summary table—main effects and interactions of task, grade level, and sex.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>134</td>
<td>5053.61</td>
<td>39.50**</td>
</tr>
<tr>
<td>Task (T)</td>
<td>1</td>
<td>5053.61</td>
<td>39.50**</td>
</tr>
<tr>
<td>Grade (G)</td>
<td>2</td>
<td>2718.91</td>
<td>21.25**</td>
</tr>
<tr>
<td>Sex (S)</td>
<td>1</td>
<td>693.18</td>
<td>5.42*</td>
</tr>
<tr>
<td>T x G</td>
<td>2</td>
<td>280.58</td>
<td>2.19</td>
</tr>
<tr>
<td>T x S</td>
<td>1</td>
<td>40.29</td>
<td>0.31</td>
</tr>
<tr>
<td>G x S</td>
<td>2</td>
<td>415.20</td>
<td>3.25*</td>
</tr>
<tr>
<td>T x G x S</td>
<td>2</td>
<td>19.24</td>
<td>0.15</td>
</tr>
<tr>
<td>Error</td>
<td>123</td>
<td>127.95</td>
<td></td>
</tr>
</tbody>
</table>

* p < .05
** p < .001

It can be seen that the main effect of task was significant with p < .001. The same high level of significance (p < .001) was also found for the effect of grade. Somewhat less significant effects indicate that girls were superior to boys (p < .05) and that there was a grade-by-sex interaction (p < .05). Inspection of the test data suggested that the grade-by-sex interaction could be attributed mainly to the superior performance of first grade girls. T-tests showed no significant differences between boys and girls at the nursery school and kindergarten ages in either the phoneme or syllable tasks, but at the first grade level, the girls were superior in the syllable task (p < .02) and also, though less significantly, in dealing with the phonemes (p < .10).

DISCUSSION

We have suggested that one way in which reading an alphabetic script differs from perceiving speech is that reading, but not speech perception, requires an explicit awareness of phoneme segmentation. In our view, the awareness of this aspect of language structure might be particularly difficult to achieve because there is in the speech signal no simple and direct reflection of phonemic structure. Phonemic elements are encoded at the level of sound into units of syllabic size. It ought, therefore, to be easier to become aware of syllables. In this study, we have found that analysis of a word into phonemes is indeed significantly more difficult than analysis into syllables at ages four, five, and six. Far fewer children in the groups which received the phoneme task were able to reach criterion level; those who did, required a greater number of trials; and none achieved criterion in the minimum time.

P. MacNeilage (personal communication) has suggested that this is true of educated adults as well. In a recent experiment, he has found that his subjects show virtually perfect agreement as to the number of syllables words contain, but considerable variability in their judgments of the number of phonemic constituents.
Figure 1: Percentages of children reaching criterion in the phoneme and syllable groups at three grade levels.
The superiority of first grade girls on both tasks accords with the many indications of the more rapid development of language in girls (McCarthy, 1966). One might have expected, however, to find manifest superiority of girls at the earlier ages as well. At all events, it is appropriate to mention in this context that boys far outnumber girls among cases of reading disability (Vernon, 1960; Thompson, 1969; Critchley, 1970).

Though phoneme segmentation was more difficult than syllable segmentation at all three age levels, the phoneme task did show improvement with age. We cannot judge from this experiment to what degree these measured increases represent maturational changes and to what extent they may reflect the effects of instruction in reading. We would guess that the sharp increase from 17% at age five to 70% at age six in children reaching criterion level is probably largely a consequence of the intensive concentration on reading instruction in the first grade. To be sure, a certain level of intellectual maturity is undoubtedly necessary to achieve the ability to analyze words into phonemes. But there is no reason to believe that the awareness of phoneme segmentation appears spontaneously when a certain maturational level is reached. (If it did, we should think that alphabets might have been invented more frequently and earlier.) In any case, the possibility that these changes with age are relatively independent of instruction could be tested by a developmental study in a language community such as the Chinese where the orthographic unit is the word and where reading instruction does not demand the kind of phonemic analysis needed in an alphabetic system.

We are especially concerned to know more about those substantial numbers of first graders, some 30% in our sample, who apparently do not acquire phoneme segmentation. It would, of course, be of primary interest to us to know whether they show deficiencies in reading acquisition as well. It remains to be seen in further research whether inability to indicate the number of phoneme constituents of spoken words is, in fact, associated with reading difficulties. Our test can provide a measure by which differences in segmentation ability can be assessed directly. If we should find that performance on a test like ours can differentiate good from poor readers (let us say, among second and third graders), we should be encouraged to assume that inability to analyze words into phonemes is indeed a factor in reading disability. In any event, we would especially wish to determine whether more explicit instruction in phoneme segmentation by an extension of this procedure would be helpful in improving the reading ability of beginning readers.

We have here supposed that fairly explicit awareness of phoneme segmentation is necessary if the child is to discover the phonologic message and, ultimately, the meaning it conveys. But this is only a part, albeit an essential one, of a broader requirement: the orthographic representations must make contact with the linguistic system that already exists in the child when instruction in reading begins. Accordingly, the explicit awareness of linguistic structure with which we have been concerned is not necessarily the only condition that must be met, though we believe it is an important one.

REFERENCES


