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ABSTRACT

Speech research suggests why phoneme segmentation is more difficult than syllable segmentation. This study provides direct evidence of a developmental ordering of syllable and phoneme segmentation abilities in the young child. By means of a task which required preschool, kindergarten, and first grade children to tap out the number of segments in spoken utterances, it was found that though ability in both syllable and phoneme segmentation increased with grade level, analysis into phonemes was significantly harder and perfected later than analysis into syllables. The relative difficulties of the different units of segmentation are discussed in relation to reading acquisition. (Author/SW)

Explicit Syllable and Phoneme Segmentation in the Young Child*

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Explicit Syllable and Phoneme Segmentation in the Young Child[1]

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To write a language, one must decide which of its several kinds and sizes of segments should be represented. The choice of kind arises from the fact that all languages have a dual structure, comprising segments that have meaning and segments that do not. Each kind of segment offers, in turn, its own set of options in size: meaningful segments can, for example, be as long as sentences or as short as words (or morphemes); among the meaningless segments, the most likely candidates for a writing system are syllables and phonemes, the phonemes being the shortest (and least numerous) segments of all.

In the historical development of writing (Diringer, 1948; Gelb, 1963), systems that used meaningful units came first. Some were historically related; others are supposed to have developed independently. Something like the word was the segment most commonly represented, at least in those systems that have a transparent relation to speech. One thinks of Chinese writing (and the kanji part of Japanese) as a present-day approximation to this method, the segment represented being the word.

Writing with meaningless units is a more recent development. As with the older system, this more recent one may have developed independently several times. Among writing systems that use the meaningless kind of segment, the segment size that was represented in all the earliest examples was, at least approximately, that of the syllable. An alphabet, representing segments of phonemic size, was developed later. It is clear, moreover, that the alphabet developed historically out of a syllabary and, further, that this important development occurred just once.

But if a writer is to represent a segment of whatever kind or size, he must first have succeeded in explicitly abstracting it from the acoustic stream of speech. We are tempted to suppose, then, that the historical development of writing might reflect the ease (or difficulty) with which that explicit segmentation can be carried out. Yielding to that temptation, we should conclude that in order of increasing difficulty there is the word, the syllable, and, hardest of all, the phoneme. More to the point of this paper, we should suppose that for the child there might be the same order of difficulty and, correspondingly, the same order of appearance in development.

In a review of the literature on the development of segmentation, Gibson and Levin (1973) conclude that meaningful units are, in fact, the first segments abstracted by the child and take priority in his analysis of speech. But our concern in this paper is more pointedly with the meaningless kind of segment. What of the syllables and phonemes, then? We have suggested elsewhere (Liberman, 1971, 1973; Shankweiler and Liberman, 1972), and Gibson and Levin concur, that segmentation into phonemes may be quite difficult for the young child and more difficult, in any event, than segmentation into syllables. However, the evidence for this conclusion has nowhere been very direct. Rather, inferences have been made from informal observation of some of the problems in rhyming and in abstracting initial and final consonants from spoken words, for example, which children have in the early stages of reading acquisition (Monroe, 1932; Savin, 1972). Reports of attempts to train pre-reading children also suggest that phoneme analysis may be relatively difficult (Calfee, Chapman, and Venesky, 1972; Elkonin, 1973; Gleitman and Rozin, 1973; Savin, 1972).

The purpose of the experiment to be reported here is to obtain evidence that bears more specifically on this matter of explicit syllable and phoneme segmentation in the young child. Before describing the experiments, however, we should, by way of further introduction, say more about explicit segmentation. In particular, we should note how it differs from ordinary speech perception and also consider what is now known about speech that might be relevant to our understanding of the problems that face the child when he goes about the segmentation task.

It must be emphasized that the difficulty a child might have in explicit segmentation is not necessarily related to his problems, if any, with ordinary speech perception. Thus, young children might, in the ordinary course of speaking and listening readily distinguish (or identify) words like bad and bat that differ in only one phonemic segment. Indeed, there is evidence now that infants at one month of age discriminate ba from pa (and da from ta); moreover, they make this discrimination categorically, just as adults do, when the physical difference between the two phonemes is very small (only 20 msec. in the onset of the two parts of the acoustic pattern) [Eimas, Siqueland, Jusczyk, and Vigorito, 1971]. But it does not follow from the fact that a child can easily distinguish bad from bat that he can therefore respond analytically to the phonemic structure that underlies the distinction—that is, that he can demonstrate an explicit understanding of the fact that each of these utterances consists of three segments and that the difference lies wholly in the third.

What, then, is known about speech that might lead us to expect that a child who readily perceives speech might nevertheless find explicit segmentation into phonemes more difficult than explicit segmentation into syllables? If the acoustic structure of speech bore a simple one-to-one relation to the phonemic structure, just as the letters do (at least in the orthographically regular case), it would indeed be hard to see why phonemic analysis should pose special problems. That is, if there were in the word bat 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 readily apparent.

However, as extensive research in speech perception has shown (Fant, 1962; Liberman, Cooper, Shankweiler, and Studdert-Kennedy, 1967), the segmentation of the acoustic signal does not correspond directly or in any easily determined way to the segmentation at the phonemic level. Moreover, this lack of correspondence does not arise merely because the sounds of the phonemes are superficially linked 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 b-a-t (buhatuh) into the appropriate monosyllabic word bat. Instead, the phonemic segments are encoded at the acoustic level into larger units of approximately syllabic size. In bat, for example, the initial and final consonants are, in the conversion to sound, folded into the medial vowel, with the result that information about successive segments is transmitted more or less simultaneously on the same parts of the sound (Liberman, 1970). In exactly that sense, the syllable, bat, which has three phonemic segments, has but one acoustic segment. There is, then, no acoustic criterion by which one can segment the sound into its constituent phonemes. To recover the phonemes from the sound into which they are so complexly encoded requires a decoder which segments the continuous acoustic signal according to linguistic rules. Though we can only guess how such a decoder might work, we know that it functions quite automatically for all speaker-hearers of a language, even very young children (Liberman, et al., 1967; Liberman, 1973). In perceiving a spoken message, therefore, the listener need not be explicit about its phonemic structure, no more explicit, indeed, than he need be about its syntax.

But if it is apparent now why explicit segmentation into phonemes might be difficult, it is still reasonable to ask why syllables should be easier. A plausible answer is not hard to find. As we noted earlier, the consonant segments of the phonemic message are typically folded, at the acoustic level, into the vowel, with the result that there is no acoustic criterion by which the phonemic segments are dependably marked. However, every syllable that is formed in this way contains a vocalic nucleus and hence a peak of acoustic energy. These energy peaks provide audible cues that correspond very simply, if somewhat imperfectly, to the syllable centers (Fletcher, 1929). Though such direct auditory cues could not in themselves help a listener to define exact syllable boundaries, they ought to make it easy for him to discover how many syllables there are and, in that sense, to do explicit syllable segmentation.

As we have said, however, there has been no direct test of the assumption that young children do, in fact, find it difficult to segment words explicitly into phonemes and that this ability comes later and is more difficult than syllable segmentation. The present experiment was undertaken to provide such a test. The question posed was how well children in nursery school, kindergarten, and first grade can identify the number of phonemic segments in spoken utterances and how this compares with their ability to deal similarly with syllables.

Method

Subjects

The subjects were 135 white, middle-class boys and girls 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 preschoolers (mean CA = 59 months, SD = 5.40), 49 kindergarteners (mean CA = 70 months, SD = 4.10) and 40 first graders (mean CA = 83 months, SD = 5.50). All available children at the appropriate grade levels in the participating schools were used, with the following exceptions: among the nursery school children, 4 with speech and hearing problems, 12 who refused to enter into the testing situation at all, and 5 who were so inattentive and distractible that demonstration trials could not be carried out; among the kindergarteners, 1 who had returned to kindergarten after several months in first grade and 1 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 preschool level by the sporadic lack of participation of individual children. The final composition of the experimental groups was as follows: at the nursery school level, 20 in Group P and 26 in Group S; kindergarteners, 24 in Group P and 25 in Group S; first graders, 20 in each group.

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 (SD = 18.20) for the syllable group and 109.19 (SD = 15.73) for the phoneme group. Across grade levels, the mean IQ was 112.11 (SD = 17.04) for the preschoolers, 108.90 (SD = 17.92) for the kindergarteners, and 107.73 (SD = 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 (SD = 11.25); of the phoneme group, 69.58 (SD = 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. The test items in both the syllable and phoneme tasks were presented by the examiner (and repeated by the child) in a natural speaking manner. Instructions were the same for all three grade levels. Procedure for the two experimental groups followed an identical format, differing only with respect to the test items used for the two tasks. 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 was 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 that were presented without prior demonstration and were 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 early June.

Stimulus Materials

The training trials for the phoneme task included the following four triads: (1) /u/ (as in moo), boo, boot; (2) /æ/ (as in cat), as, has; (3) /o/ (as in go), toe, tall; (4) /I/ (as in bit), ma, cut.

For the syllable task, the four training triads were: (1) but, butter, butterfly; (2) tell, telling, telephone; (3) doll, dolly, lollipop; (4) top, water, elephant.

It will be noted that in the items used for training trials of both experimental groups, 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 subsequent test trials.

As can be seen in Tables 1 and 2, both experimental test lists contained an equal number of randomly distributed one-, two-, and

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Insert Tables 1 and 2 about here

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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 3 to 6 years. No further control of linguistic content was attempted in the Group S items, except that the stress 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 non-words. The two-segment items in Group P were constructed by adding a consonant in the intial 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

Two measures were used to compare the performances of the children in the syllable and phoneme segmentation tasks: trials to criterion and mean errors to pass or fail. The first measure consisted of the number of trials taken by each child to reach a criterion level of six consecutive correct test trials without demonstration by the examiner. It was apparent from this measure that the test items were more readily segmented into syllables than into phonemes. In the first place, the number of children who were able to reach criterion was markedly greater in the syllable segmentation group, whatever the grade level. At the nursery school level, none of the children could segment by phonemes, while nearly half (46%) could segment by syllables.

Ability to perform phoneme segmentation was demonstrated by only 17% of the children at the kinderga ten level; by contrast, almost half (48%) of the children at that level could segment syllabically. Even at the end of first grade, only 70% succeeded in phoneme segmentation, while 90% were successful in the syllable task.

The relatively greater difficulty of phoneme segmentation was 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 taken to reach criterion by the successful children in the syllable group was 25.7 at the nursery school level, 12.1 for the kindergarteners, and 9.8 for the first graders. In contrast, in the phoneme group, no nursery school child reached criterion, while the mean number of trials for those who did in the kindergarten group was 26.0 and for the first graders, 25.6.

The contrast in difficulty between the two tasks is also seen in the proportion of children who achieved criterion 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% for the preschoolers, 16% for the kindergarteners, and 50% for the first graders. In striking contrast to this, we find that in the phoneme groups, no child at any grade level attained the criterion in the minimum time.

In addition to the trials-to-criterion measure which has been discussed up to this point, the data have also been analyzed in terms of mean errors. Mean errors to passing or failing a criterion of six consecutive correct trials without demonstration are plotted by task and grade in Figure 1. Errors on both the syllable and phoneme tasks

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Insert Figure 1 about here

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decreased monotonically at successive grade levels, but the greater difficulty of phoneme segmentation at every level was again clearly demonstrated. A two-way analysis of variance was carried out in order to assess the contribution of the variables of task and grade. The effect of task was highly significant, $F\ (1,129) = 42.86$, $p < .001$. The same high level of significance was also found for the effect of grade: $F\ (2,129) = 29.05$, $p < .001$. As the figure shows, there is no interaction between task and grade ($F < 1$).

Discussion

It was found that the explicit analysis of spoken utterances into phonemes is significantly more difficult for the young child than analysis into syllables and develops later. Far fewer children in the group which received the phoneme segmentation task were able to reach criterion level; those who did, made a larger number of errors, required a greater number of trials, and none reached criterion in the minimum time. Indeed, all the children in the nursery school group failed in performance of phoneme segmentation according to the criterion adopted in this study. Although it was found that syllabic segmentation was easier for young children than phoneme segmentation, it would be a mistake to suppose that syllable structure is completely transparent to the child. Sharp age trends, which are essentially parallel, were observed for both tasks.

It may be that analysis of language, even of the most elementary sort, requires instruction. It is noteworthy, in this regard, that a steep increase in the ability to indicate segmentation of both phonemes and syllables occurred during the first school year. 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 intensive instruction in reading and writing during the first grade. But whatever the effects of instruction, the findings strongly suggest that a greater level of intellectual maturity is necessary to achieve the ability to analyze words into phonemes than into syllables. In any case, the possibility that 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 (and others) have noted elsewhere that the need to do explicit segmentation may be one of the important differences between speaking and listening, on the one hand, and reading and writing, on the other (Elkonin, 1973; Gleitman, et al., 1973; Liberman, 1971; Mattingly, 1972; Savin, 1972; Shankweiler, et al., 1972). If this is so, it might account for the fact that many children who readily acquire the capacity to speak and understand English do not so readily learn to read and write it. Consider in this connection, what we know of the performance of children who are resistant to early reading instruction. There is considerable agreement among investigators that these children typically show no significant difficulty in the visual identification of letters as such (Doehring, 1968; Kolers, 1972; Liberman, Orlando, Harris, and Berti, 1971; Shankweiler, 1964; Vernon, 1960). Moreover, these children can learn fairly quickly to approximate the letter-to-phoneme correspondence of the individual written letters (Vernon, 1960). That is, if they are asked to give the "sound" of the individual letter, they will say /bʌ/ for a b, /æ/ for an a, and /tʌ/ for a t. But if they are then shown the whole printed word bat and asked to read it, they may give any one of a variety of incorrect responses which indicate they cannot make appropriate use of this information. Pressed to try to "sound it out," or otherwise to use what they know about the letter-to-phoneme correspondences, they are likely to produce buhatuh. At that point, they are usually urged by the teacher to "say it faster, put the sounds together," or, in the phrase commonly used, "blend it." But no matter how fast they produce these syllables, or how diligently they try to put them together, they still may produce the nonsense word buhatuh, containing three syllables and five phonemic segments, and not the word bat which has three phonemes encoded into a single syllable. They cannot map the printed word bat, which has three segments, onto the spoken word bat, though it is already part of their lexicon, unless they are explicitly aware that the spoken word consists of three segments.

In any event, since explicit phoneme segmentation is harder for the young child and develops later than syllable segmentation, one would expect that syllable-based writing systems would be easier to learn to read than those based on an alphabet. We may thus have an explanation for the assertion (Makita, 1968) that the Japanese kana, roughly a syllabary, is readily mastered by first grade children. One might expect, further, that an orthography which represents each word with a different character (as is the case in Chinese logographs or in the closely related Japanese kanji) would also not cause the difficulties in initial learning that arise in mastering the alphabetic system. Indirect evidence of the special burden imposed by an alphabetic script can be found in the relative ease with which reading-disabled children learn kanji-like representations of language while being unable to break the alphabetic cipher (Rozin, Poritsky, and Sotsky, 1971).

It would, of course, be of primary interest to learn in future research whether first grade children who do not acquire phoneme segmentation are, in fact, deficient in reading and writing as well. If it should be found that explicit segmentation of this kind is an important factor in reading disability, we should think, as Elkonin (1973) does, that it would be possible (and desirable) to develop this ability by appropriate training methods.

References

Calfee, R., Chapman, R., and Venezky, R. How a child needs to think to learn to read. In L. W. Gregg (Ed.), Cognition in learning and memory. New York: Wiley, 1972.

Diringer, D. The alphabet. New York: Philosophical Library, 1948.

Doehring, D. G. Patterns of impairment in specific reading disability. Bloomington: Indiana University Press, 1968.

Eimas, P. D., Siqueland, E. R., Jusczyk, P., and Vigorito, J. Speech perception in infants. Science, 1971, 171, 303-306.

Elkonin, D. B. U. S. S. R. In J. Downing (Ed.), Comparative reading. New York: Macmillan, 1973.

Fant, C. G. M. Descriptive analysis of the acoustic aspects of speech. Logos, 1962, 5, 3-17.

Fletcher, H. Speech and hearing. New York: Van Nostrand Co., 1929.

Gelb, I. J. A study of writing. Chicago: University of Chicago Press, 1963.

Gibson, E. J., and Levin, H. The psychology of reading. Cambridge: M.I.T. Press, in press.

Gleitman, L. R., and Rozin, P. Teaching reading by use of a syllabary. Reading Research Quarterly, in press.

Kolers, P. Experiments in reading. Scientific American, 1972, 227(13), 84-91.

Liberman, A. M. The grammars of speech and language. Cognitive Psychology, 1970, 1, 301-323.

Liberman, A. M. The specialization of the language hemisphere. In F. O. Schmitt and F. G. Worden (Eds.), The neurosciences: third study program. Cambridge: M.I.T. Press, 1973.

Liberman, A. M., Cooper, F. S., Shankweiler, D., and Studdert-Kennedy, M. Perception of the speech code. Psychological Review, 1967, 74, 431-461.

Liberman, I. Y. Basic research in speech and lateralization of language: some implications for reading disability. Bulletin of the Orton Society, 1971, 21, 71-87.

Liberman, I. Y. Segmentation of the spoken word and reading acquisition. Bulletin of the Orton Society, in press.

Liberman, I. Y., Shankweiler, D., Orlando, C., Harris, K. S., and Berti, F. B. Letter confusions and reversals of sequence in the beginning reader: implications for Orton's theory of developmental dyslexia. Cortex, 1971, 7, 127-142.

Makita, K. Rarity of reading disability in Japanese children. American Journal of Orthopsychiatry, 1968, 38(4), 599-614.

Mattingly, I. G. Reading, the linguistic process and linguistic awareness. In J. F. Kavanagh and I. G. Mattingly (Eds.), Language by ear and by eye: the relationships between speech and reading. Cambridge, Massachusetts: M.I.T. Press, 1972.

Monroe, M. Children who cannot read. Chicago: University of Chicago Press, 1932.

Rozin, P., Poritsky, S., and Sotsky, R. American children with reading problems can easily learn to read English represented by Chinese characters. Science, 1971, 171, 1264-1267.

Savin, H. What the child knows about speech when he starts to learn to read. In J. F. Kavanagh and I. G. Mattingly (Eds.), Language by ear and by eye: the relationships between speech and reading. Cambridge, Massachusetts: M.I.T. Press, 1972.

Shankweiler, D. Developmental dyslexia: a critique and review of recent evidence. Cortex, 1964, 1, 53-62.

Shankweiler, D., and Liberman, I. Y. Misreading: a search for causes. In J. F. Kavanagh and I. G. Mattingly (Eds.), Language by ear and by eye: the relationships between speech and reading. Cambridge, Massachusetts, M.I.T. Press, 1972.

Vernon, M. D. Backwardness in reading. Cambridge: University Press, 1960.

Footnotes

1. The authors are grateful to A. M. Liberman and David Zeaman for their critical reading of the manuscript and many helpful suggestions.

Table 1

Test List for the Phoneme Segmentation Task

1. is
2. /ɛ/ (as in bet)
3. my
4. toy
5. /æ/ (as in bat)
6. /i/ (as in beet)
7. soap
8. /I/ (as in bit)
9. his
10. pout
11. mine
12. caw
13. out
14. red
15. /ɔ/ (as in bought)
16. cough
17. pot
18. /u/ (as in boot)
19. heat
20. he
21. /a/ (as in hot)
22. pa
23. mat
24. /ʌ/ (as in but
25. so
26. /ai/ (as in bite)
27. up
28. /au/ (as in bout)
29. /ʊ/ (as in bull)
30. toys
31. cake
32. cool
33. /e/ (as in bait)
34. Ed
35. cup
36. at
37. book
38. /ʊk/ (as in book)
39. lay
40. coo
41. /O/ (as in boat)
42. oy (as in boy)

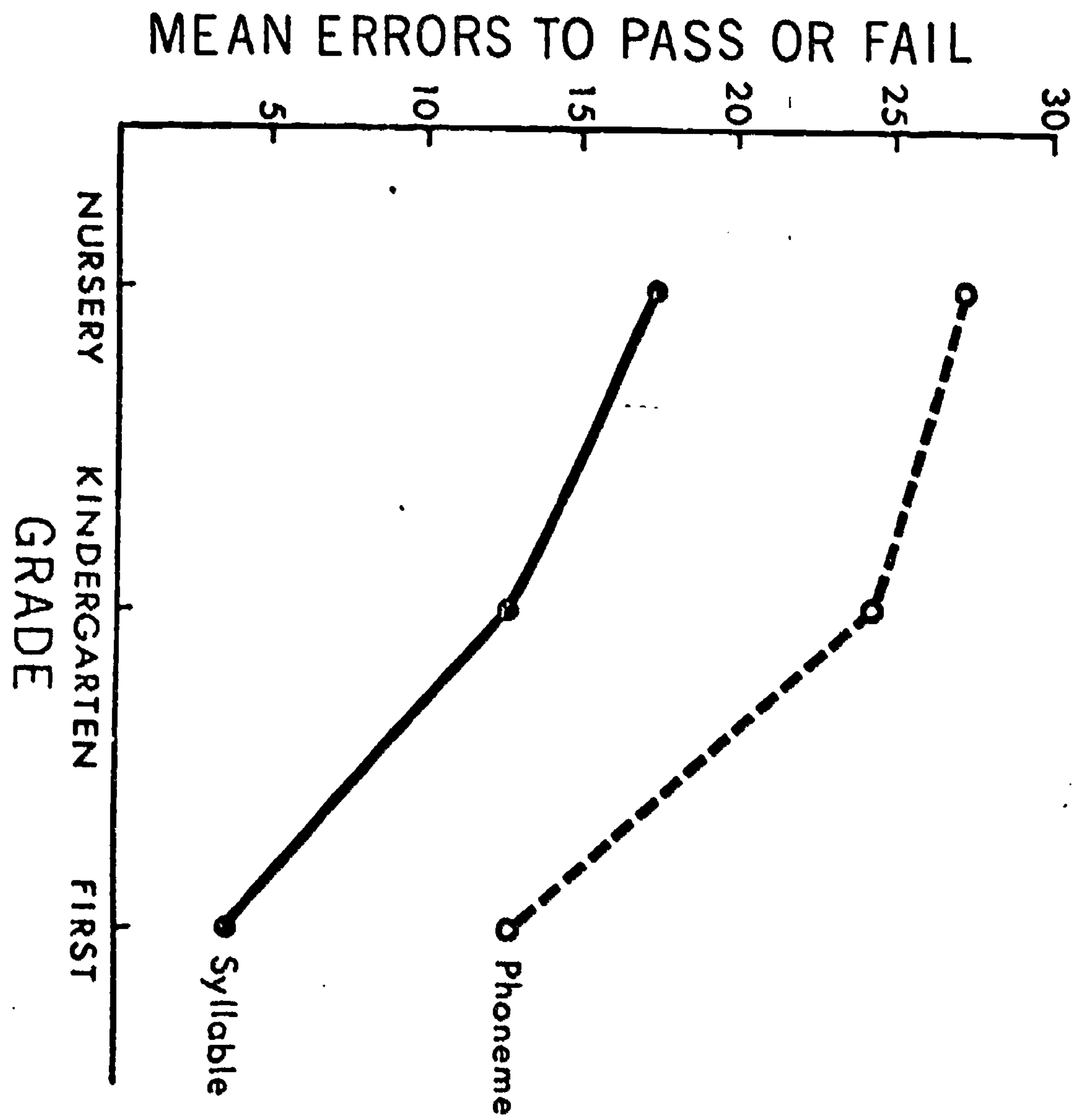
Table 2

Test List for the Syllable Segmentation Task

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

Figure Captions

Figure 1. Mean errors to passing or failing a criterion of six consecutive correct trials in the phoneme and syllable segmentation tasks for nursery school, kindergarten, and first grade groups.


MEAN ERRORS TO PASS OR FAIL
5
10
15
20
25
30
NURSERY
KINDERGARTEN
FIRST
GRADE
Syllable
Phoneme