

F. W. Fischer, I. Y. Liberman and D. Shankweiler

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READING REVERSALS AND DEVELOPMENTAL DYSLEXIA: A FURTHER STUDY¹

F. William Fischer, Isabelle Y. Liberman and Donald Shankweiler²

(University of Connecticut)

Use of the label "dyslexic" can be said to express an intent to be more specific than might be implied by use of the designation, "backward in reading". At the very least, the term is ordinarily reserved for those whose achievements in reading are markedly below what would be reasonably predicted from other information we have about the child: his intelligence level, his social-cultural background and his achievement in other academic areas. A dyslexic child, in short, might be distinguished from others who are backward in reading by the presence of a significant disparity between expectation and performance (Benton, 1975).

This disparity is certainly a necessary condition for use of the term. But, of course, more has usually been implied. The designation "dyslexic" carries an implication about the cause of reading failure; it assumes an underlying constitutional inadequacy in one or more of the abilities requisite for reading. It has been supposed, therefore, that there should be signs by which a dyslexic child can be recognized. The medical people who first described the occurrence of reading disability in normally bright children sought deficits in basic perceptual and cognitive functions characteristic of those exhibited by adults with damage or disease of the posterior cerebral hemispheres (Hinshelwood, 1917). Although many correlates have been proposed in the long history of clinical study of dyslexia, there are still no generally accepted criteria that can unequivocally be applied to distinguish the dyslexic child from others who are backward in reading.

It can be argued that one possible reason for failure to define dyslexia satisfactorily stems from insufficient attention to the reading process itself (Shankweiler and Liberman, 1972). If the underlying deficits, which have proved so elusive, are indeed specific to reading and reading-related tasks, then we would be well advised to look very closely at the kinds of reading

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² Drs. Liberman and Shankweiler are also at Haskins Laboratories, New Haven, Connecticut.

errors so-called dyslexic children make. One classification of error to which diagnostic significance has been attributed is the tendency to read letter sequences in reversed order and to reverse the orientation of individual letters. Although it has been proposed that dyslexic children are especially prone to reversal tendency (Orton, 1925, 1937), the belief has never been put to a systematic test.

The question could not meaningfully be raised without data on the kinds of errors normal children make at various stages of learning to read. An earlier study (Lieberman, Shankweiler, Orlando, Harris and Berti, 1971) explored the occurrence of reversal errors in an entire school population of second graders in an elementary school. It was found that letter confusions and reversals of sequence occurred with appreciable frequency only among the children in the lowest third of the class on a standard test of reading achievement. Even among those children, reversals of order and sequence accounted for only 10 and 15 percent, respectively, of the total of misread letters. Moreover, within this group of poorer readers, only some reversed to an appreciable extent. Thus, poor readers who are slightly beyond the earliest stage of reading acquisition are not generally characterized by a high rate of reversal errors. This raises the possibility, which we consider in the present study, that reversal errors, though not characteristic of poor readers in general, might serve to distinguish reading disability of a specific kind, from those backward in reading from diverse causes.

To investigate this possibility, we focused on a special population of severely retarded readers selected by the staff of the John F. Kennedy Institute, Baltimore, on the basis of both psychoeducational and medical criteria. The Institute group, chosen as it was to meet conventional criteria for the diagnosis of dyslexia, might be expected to differ in various ways from the group of poor readers studied by Lieberman et al. (1971) that had been selected by means of IQ and standard reading test scores alone. Our purpose in the present study was to determine the incidence of commission of reversal errors in the "dyslexic" group with the same test materials from which we had obtained our earlier findings on second grade school children from a Connecticut town. We hoped, thereby, to discover whether children designated as dyslexic exhibit a distinctive pattern of reading errors, and, in particular, to discover whether the pattern of their reversal errors in letters and words differs from that of other poor readers.

MATERIAL AND METHOD

Subjects

The subjects for this study were drawn from a group of children who, because of their extreme reading disability, had been selected for inclusion in a special

remedial program at the John F. Kennedy Institute in Baltimore, Maryland. This group had been chosen on the basis of an extensive series of multidisciplinary evaluations carried out by members of the medical and psychological staff of the Johns Hopkins Hospital. The children selected by the Institute were retarded in reading by at least 18 months according to test norms (*Gray Oral Reading Test, Form A*) based on age. Only those children in good health and with average or above-average intelligence were included. Extensive neurological and psychological screening excluded children with gross signs of brain damage, end-organ deficiencies or severe psychiatric problems. Those children exhibiting the soft signs of neurological dysfunction (for example, general awkwardness, mixed and/or confused laterality) with the exception of strabismus, were allowed to remain in the study sample.

In order to replicate insofar as possible the age and sex characteristics of the subjects used in the Liberman et al. (1971) study, the subjects for the present investigation were further limited to boys between the ages of 8 and 10 (mean age = 8.9 years). The total number meeting these criteria in the Institute group was 13. The children ranged from the second to the fourth year of elementary school.

Procedure

The children were investigated using the same tasks and procedures as those employed by Liberman et al. (1971). The tasks were given individually to all subjects on successive days. A Word List, which is described below, was administered twice to each child, the list order being reversed on the second day. Data from the two presentations of the list were combined in scoring the responses of each subject, but were available separately for assessment of test-retest reliability.

(1) *Word list.* The list comprised 60 monosyllabic words including a selection of primer-level "sight" words, most of the commonly-cited reversible words and, in addition, a group of consonant-vowel-consonant (CVC) words that provide ample opportunity for reversing letter orientation. Each word was hand-printed in manuscript form on a separate 3" × 5" white index card. The children were asked to read each word aloud to the best of their ability.

(2) *Recognition of briefly-exposed single letters.* The test comprised 100 items in which a given letter was to be matched to one of a group of five, including four reversible letters in manuscript form³ (*b, d, p, g*) and one nonreversible letter (*e*) that was added as a reliability check. There were 20 such items for each letter. The order of the resultant 100 items was randomized, as was the order of the multiple choice sequence for each item on the answer sheet. The standard was presented tachistoscopically for matching with one of the multiple-choice items on the answer sheets. Tachistoscopic exposure of the 2" × 2" slides of each letter was projected for 1/125 sec in the center of an 11" × 14" screen mounted 5 feet in front of the subject. A brief training session preceded the presentation of the test stimuli.

³ The letter *g*, is, of course, a distinctive shape in all type styles, but it was included among the reversible letters because, historically, it has been treated as a reversible letter. It indeed becomes reversible when printed with a straight segment below the line. (In manuscript printing, as was used in preparing the stimulus materials for this study, the tail of the *g* is the only distinguishing characteristic).

Error analysis of word transcription

The children's responses to the word list were recorded on magnetic tape and also phonetically transcribed by the examiner. Scoring procedures were the same as those established by Liberman et al. (1971). Five categories were included in the scoring.

(1) *Reversals of sequence (RS)*. Scored when a word or a part of a word was read from right to left (for example, when *lap* was read as [pæl] or [pleI]; *form* as [fram]).

(2) *Reversals of orientation (RO)*. Scored when *b*, *d*, *p* and *g* were confused with each other, as when *bad* was read as [dæd], [pæd] or [bæg]. If *bad* was given as [dæb], it was scored as a sequence error instead. Both types of reversal were scored when *nip* was read as [bIn].

(3) *Other-consonant error (OC)*. Included all consonant omissions and additions as well as all consonant substitutions other than reversals of orientation. A response could contain both a sequence reversal and a consonant error, as in the case of the response [træp] for the stimulus word *pat*. It could also contain both an orientation reversal and a consonant error, as in the case of the response [træp] for the stimulus word *tab*. However, confusions among *b*, *d* and *g* were scored only as reversals of orientation, not as consonant errors.

(4) *Vowel error (V)*. Included all vowel substitutions, such as [pIg] for *peg*. A vowel error was not charged when a consonant error in the response forced a change in the pronunciation of the vowel, provided the vowel sound produced in the response was a legitimate pronunciation of the original printed vowel (for example, response [ræt] for the stimulus word *raw*).

(5) *Total error (TE)*. Simply the sum of all preceding error types.

RESULTS

The Institute children, diagnosed "dyslexic" after extensive clinical assessment (that included IQ and school achievement testing among its components), are to be compared with a group of elementary school children selected by Liberman et al. (1971) purely on the basis of standard tests of IQ and school achievement. The latter group consisted of all of the children from a public school second grade who met the criteria of testing average or above in IQ and fell in the lower third of the grade in reading achievement. The two groups are fairly well matched for IQ, since both selection procedures excluded children of low IQ. For the Institute children, the Verbal Scale quotient on the WISC ranged from 90 to 140 with a mean VIQ of 107. Liberman et al. (1971) reported for their group a Full Scale IQ range from 85 to 126 with a mean IQ of 99.

Severity of the Reading Deficit

It is of initial interest to discover whether the groups of poor readers selected by quite different criteria do actually differ in the degree of backwardness in reading.

On the *Gray Oral Reading Test*, which measures the reading of connected prose, the difference between the Institute children and those studied by Liberman et al. (1971) was minor. The Institute group achieved a mean level of performance equivalent to 1.4 years of schooling, while the Liberman et al. (1971) children earned a mean reading score of 1.7 years.

However, a task requiring the children to decode isolated words differentiated the groups more sharply than the Gray test. On this analytic reading test (the "Word List"), the Institute group encountered more obvious difficulty, making significantly more errors ($p < .05$). Thus, while both groups of children were lacking in decoding skills, the Institute group was somewhat more deficient in these skills and had learned to recognize significantly fewer words.

Reversals in relation to other errors

Mean errors per subject in the various error categories derived from the Word List are shown in Table I. In addition, the table gives the data for errors in recognition of singly presented, tachistoscopically exposed reversible letters. Since the opportunities for error among the different error types were not constant, the data were analyzed by basing percentages on opportunities for error. This analysis reveals that although the Institute children were poorer readers, the distribution of errors among the various error categories paralleled the pattern produced by the Liberman et al. (1971) school sample.

In both groups the vowel and other-consonant categories accounted for the bulk of all errors made. The Institute children made more errors in reading other consonants and vowels, demonstrating that they are the less proficient group in reading. However, in spite of their greater reading deficit, it is of major interest to note that the Institute children made relatively the same proportion of reversal errors in reading words as did the children in the school sample (8.3 percent vs. 6.7 percent, respectively, for reversals of sequence; 11.4 percent vs. 12.5 percent for reversals of orientation). Thus, frequency of the two kinds of reversal errors is not an aspect of reading performance that distinguishes these two groups of children.

Although the proportion of the two kinds of reversal errors was the same for the two groups, a discrepancy in their association was noted. Reversals of sequence and reversals of orientation were correlated among the Institute children ($r = .55$; $p < .05$) in reading the word list, but not among the children from the School sample ($r = .03$). These statistics indicate that whereas both groups of children reverse letters and words with roughly the same overall frequency, the children of the Institute group were more consistent in their reversal error, tending to reverse both orientation and letter sequence. For them the situation is as Orton (1937)

TABLE I
*Errors by the Institute and School Groups on the Word List and the Letter Recognition Test,
 Presented as a Function of Opportunities for Error*

	Reversed sequence		Reversed orientation		Other consonant		Vowel		Single letter recognition	
	Inst.	Sch.	Inst.	Sch.	Inst.	Sch.	Inst.	Sch.	Inst.	Sch.
Mean errors	10	8	10	11	50	25	50	33	14	7
Opportunities for error	120	120	88	88	152	152	124	124	100	100
Percent	8.3	6.7	11.4	12.5	32.9	16.4	40.3	26.6	14.0	7.0

supposed: the two kinds of reversals are associated. In contrast, the absence of a correlation between sequence and orientation errors among the School sample means that within that group an individual's frequency of reversing letter sequence cannot be predicted from his frequency of reversing letter orientation.

Reversed orientation of letters: the nature of the confusions

Perception of reversible letters was studied in two ways: by embedding them in words and by presenting them in isolation. A comparison of the frequency and distribution of errors on these different tasks enables us to separate linguistic and contextual contributions to the error rate from the contribution that is purely visual.

In the task of recognition of singly presented reversible letters, the Institute group made appreciably more errors than the School group (14.0 percent vs. 7.4 percent), as can be seen in Table I. However, examination of the individual subject data in the Institute group reveals that the two subjects with the highest number of errors made at least twice as many errors as the third ranking subject. Omitting the data for these two subjects and recalculating the mean gives 9.3 percent, which is only slightly higher than the figure obtained for the School group. We then see that it is in the main true for the Institute group, as it was for the School group, that more reversals of *b*, *d*, *p* and *g* occur in the context of reading words than in recognizing these letters in isolation.

Confusions among the four reversible letters in word context are presented in matrix form in Table II. The matrix shows, for a given letter, the

TABLE II

Confusions Among Reversible Letters in Word List. Percentages Based on Opportunities

Presented	Obtained group ¹	b	d	p	g
b	Inst.		17.0	6.1	2.2
	Sch.	—	10.2	13.7	0.3
d	Inst.	10.1		1.0	1.4
	Sch.	10.1	—	1.7	0.3
p	Inst.	3.3	0.8		2.6
	Sch.	9.1	0.4	—	0.7
g	Inst.	0	1.3	0.4	
	Sch.	1.3	1.3	1.3	—

¹ Inst. = Institute group
Sch. = Public school group

frequency with which it was correctly read or replaced by another phoneme. The column at the left of the matrix lists the reversible letters and each row of the matrix gives the distribution of responses to a given letter made by the children in oral reading. The error frequencies are expressed as percentages of the total occurrences of each letter in the list (that is, in terms of opportunities for error).

Several similarities between the two groups of children may be noted from inspection of Table II. For both groups, the errors were essentially confined to the truly reversible letters, *b*, *d*, and *p*. The letter *b* presented the greatest difficulty for both groups, followed by the letters *d* and *p*, respectively. In misreading these letters, both groups of children confined their substitutions to letters of similar form. Substitutions other than *b*, *d* or *p* rarely occurred.

A question of considerable interest concerns the directional characteristics of the reversals of letter orientation. The bulk of the misreadings of these letters for both groups involved a substitution from within the set (*b*, *d*, *p*, *g*). Moreover, most of these errors were produced by a single 180 degree rotation. Thus, rotations that occurred in the horizontal plane produced confusions among *b* and *d*, or *g* and *p*, and those in the vertical plane produced confusions among *b* and *p*, or *g* and *d*.

The frequencies of horizontal and vertical transformations of the set are presented in Table III. Data for the Word List are shown in the top row. It may be seen that the Institute children differed from the School sample

TABLE III

Horizontal and Vertical Transformation of Reversible Letters. Percentages Based on Opportunities

Task	Institute Group		School Group	
	Horizontal ¹	Vertical ²	Horizontal	Vertical
Word context	7.5	2.8	5.6	6.1
Single letter	9.3	4.0	3.5	1.1
Recognition				

¹ b-d, d-b, p-g, g-p.

² b-p, p-b, d-g, g-d.

in making a disproportionate number of reversal errors in the horizontal plane. The School group made horizontal and vertical reversals with about the same frequency.

The frequencies of horizontal and vertical rotations for multiple-choice recognition of the briefly exposed single letters are given in Row 2 of the table. Here we find for both groups a predominance of rotations in the

horizontal plane. On both tasks, the Institute children made errors involving horizontal transformation more than twice as often as errors involving a vertical rotation. The School children, on the other hand, showed a bias (favoring horizontal rotation) only when perceiving the letters out of word context.

We may further examine the directional characteristics of the reversals of orientation by noting any asymmetries in frequency of reversing from left-to-right and from right-to-left. By rotating the axis in a left-to-right direction, one transforms the letter *d* to *b*, whereas rotation of the axis from right-to-left transforms *b* to *d*. From inspection of Table IV, we discover a definite difference in the behavior of the two groups. Among the Institute

TABLE IV
Directional Scan of Horizontal Transformations of Reversible Letters.
Percentages Based on Opportunities

Task	Institute Group		School Group	
	Left-to-Right	Right-to-Left	Left-to-Right	Right-to-Left
Word context	5.0	10.0	5.7	5.5
Single letter recognition	9.5	9.0	5.0	2.0

children, horizontal transformations involving a rotation in the right-to-left direction occurred twice as often as rotations in the left-to-right direction. Thus, in these children, confusions such as reading *b* as *d* occurred considerably more often than errors where *d* is read either as *p* or *b*. The bias of the Institute Children for an excess of right-to-left confusions is present only in reading words, however, not in recognition of individual isolated letters. In the School group, on the other hand, no directional bias was found in reversal errors that occurred in reading words. In recognition of briefly exposed single letters, this group showed a tendency to reverse from left-to-right.

Distribution of errors within the syllable

Notwithstanding these differences in the directional characteristics, the overall error pattern for both groups of children is remarkably the same. This is reflected both in the relative distribution among the various error types and in the position of errors within the syllable. As can be seen in Figure 1, both groups of children, when reading words, made approximately twice as many other-consonant errors in the final segment of the syllable following the vowel, as in the initial segment preceding the vowel. However,

this effect of position in the syllable did not occur with reversible consonants. For both group of children, reversible consonants produced equal numbers of errors in initial and final position. Thus, it would seem that reversible consonants present extra problems that override other difficulties children have in analyzing the structure of the word. At all events, although the error pattern within the syllable differs for reversible and nonreversible consonants, it differs in identical fashion for the "dyslexic" children and for those poor readers identified purely on a psychometric basis.

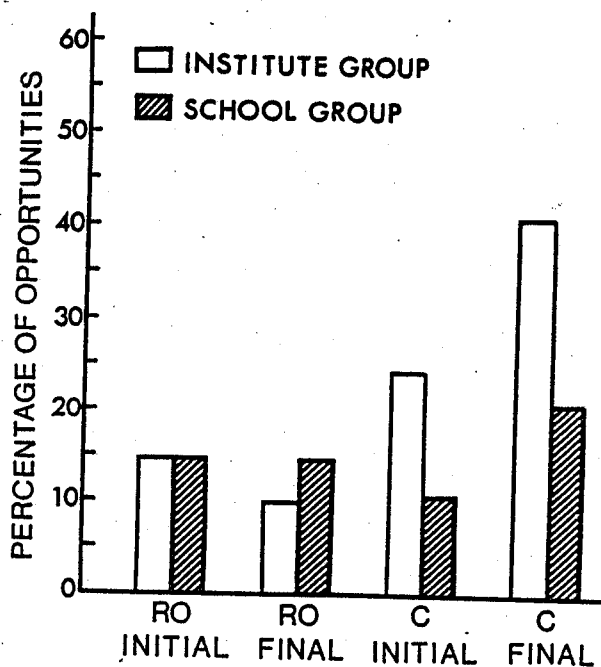


Fig. 1 — A comparison of errors according to syllable position, percentages based on opportunities for error.

DISCUSSION

The experiment was designed to compare the reading reversal tendencies of children diagnosed as dyslexic with those of a group of children reading in the lower third of a public school class. Before the question of reversal tendency could be explored, however, it was of some concern to determine whether the Institute (that is, dyslexic) group differed from the School sample in severity of overall reading backwardness. Although there was only a small difference between the mean scores of the two groups on a conventional test of reading prose (*Gray Oral Reading Test, Form A*), more marked differences in reading ability emerged when the children were

required to demonstrate their decoding skills without the assistance of contextual cues. The Institute children were unquestionably less proficient in decoding isolated words, making significantly more errors than the School group. We conclude, therefore, that whatever the label "dyslexic" might mean, it is clear that in our sample these children are the poorer readers.

Having established this, it remained to determine whether the two groups of children differed qualitatively in the nature of their reading difficulty. Since the claim is frequently made that reversal errors are more prevalent among dyslexic children, it was of critical interest to determine whether the two groups of children could be distinguished on the basis of reversal tendency.

Results obtained with the School group (Liberman et al., 1971) indicated that by the end of the second year at school, reversals occur in appreciable number only among the poorest readers. The Institute group, though in general lower in reading proficiency than the children in the School group, did not differ significantly from them in incidence of either word or letter reversals. Moreover, in both groups reversal errors accounted for only a small proportion of the total errors in reading the test words. That is, errors made by both groups on other consonants and vowels were far more frequent than reversal errors of either kind.

A further qualitative analysis of the errors on reversible letters was made possible by the fact that they were presented both in isolation and embedded in word context. Comparison of the frequency and distribution of errors on reversible letters under these two conditions enables us to separate linguistic and contextual contributions from the contribution that is purely visual. The results showed that with the exception of two Institute subjects, children in both groups made more letter reversals in the context of reading words than in recognition of the reversible letters in isolation. Thus, with the exception of the two Institute children, it seems that the problem with reversals cannot be attributed primarily to the perception of the individual letter forms.

Although no difference in the incidence of reversal errors was found between the two groups, discrepancies in the directional characteristics of the reversals were observed. In misreading reversible letters, the Institute group made more than twice as many reversals in the horizontal as in the vertical plane. In addition, these horizontal reversals were asymmetric in direction, showing a 2:1 bias toward right-to-left transformation as opposed to left-to-right transformation. The excess of horizontal reversal errors over vertical reversals occurred both in reading words and in recognition of isolated letters, whereas the sinistral directional bias was specific to the reading of words.

The School group also tended toward horizontal reversals on the isolated letters, but this asymmetry was not found in their reading errors on the

Word List. Moreover, no sinistral directional bias was present in the School group's errors on either the words or the isolated letters. The results for that group, as noted by Liberman et al. (1971), therefore, did not support Orton's (1937) view that reversals are symptomatic of a tendency to scan words in a sinistral manner, from right to left.

The Institute children, however, are clearly different. Qualitative analysis of their reversal error pattern, as we have seen, together with the fact that sequence reversals and letter reversals are correlated in this group, consistently point to the failure of these children to establish stable left-to-right habits of scan. Therefore, though Orton's (1925, 1937) emphasis on the reversal tendency as a diagnostic characteristic of the dyslexic reader is not substantiated here, his contention that dyslexics may be distinguished by sinistral directional bias in their reversals is given some support.

There are indications (Braine, 1968, 1972) that young children have a tendency to begin their inspection of a pattern from the right rather than the left, differing in this regard from older children and adults, who begin from the left. It is conceivable that the Institute group is behaving much as younger normal children do in their tendency to attack words from the right. Zangwill and Blakemore (1972) have noted sinistral scan in a young adult with a history of dyslexia. These findings clearly warrant renewed developmental study of the problem.

It is also noteworthy that two children from the Institute group differed from the remainder of their group as well as from the School sample in their performance on the task requiring recognition of tachistoscopically presented reversible letters. Whereas the remainder of the children made relatively few errors in recognition of single letters, these children made more errors here than on the word reading task. Their high error rate in recognition of tachistoscopically exposed letters may be related to perceptual factors specific to rapid exposure. It may also be that they are exhibiting a pattern of performance typical of younger children who tend to confuse visual forms that differ in orientation (see Gibson, Gibson, Pick and Osser, 1962). These possibilities should be explored further.

The analysis of reading errors in terms of linguistic categories revealed more similarities than differences in the two groups. Although the Institute children made quantitatively more errors in decoding words, the relative distribution of error types for each group was essentially the same. In both groups the incidence of vowel and other-consonant errors far exceeded the incidence of reversals of sequence and orientation. Moreover, the two groups did not differ significantly in the frequency with which they made reversal and other-consonant errors. One difference that did emerge concerned the vowels: while vowels were the more frequently misread category in both groups, the Institute children made significantly more errors in this category ($p < .05$) than the children from public school.

The preponderance of vowel errors in reading comes as no surprise. A number of earlier studies of beginning and disabled readers (Monroe, 1932; Weber, 1970; Shankweiler and Liberman, 1972) have documented the fact that vowels elicit more errors than consonants. This remains true despite systematic variation of the position of the vowel within the word (Fowler, Liberman and Shankweiler, in press). It has been proposed that the difficulty in decoding vowels may arise from their variable orthographic representation (Shankweiler and Liberman, 1972; Liberman, 1973), as well as from the continuous nature with which they tend to be perceived (Liberman, Cooper, Shankweiler and Studdert-Kennedy, 1967; Liberman, 1970). Consonants, on the other hand, are more strongly categorically perceived and few have multiple orthographic representations. For these reasons, they might, therefore, be expected to elicit fewer errors. Moreover, if vowel representation is indeed more difficult, then one would expect that children with generally inferior decoding skills would have correspondingly more difficulty with vowels.

In addition to examining the error pattern by linguistic category, we also looked at the errors in relation to their position within the syllable. Here the two groups showed identical patterns. In each group, other-consonant errors occurred more frequently in the final segment of the syllable than in the initial segment, whereas errors involving reversible consonants occurred equally often in the initial and final portions of the stimulus word. The position effect for other-consonant errors has been observed in a number of previous studies (Daniels and Diack, 1956; Weber, 1970; Shankweiler and Liberman, 1972; Liberman, 1973). It has been proposed in some of our earlier work (Liberman, 1971; Liberman, Shankweiler, Fischer and Carter, 1974) that in order to read, a child must be consciously aware of the phonemic segmentation of the spoken word and that the position effect may reflect the child's inability to perform that segmentation. The presence of a reversible consonant, the exact identity of which they are unsure, would, of course, be expected to nullify such a position effect for these children.

The persistence of reversal errors may be more important than their frequency of occurrence in identifying the more severe cases of dyslexia or in identifying dyslexia in older children. It is not unreasonable to suppose that older dyslexics may persist in making reversal errors after the age at which these errors normally disappear in other backward readers. Nevertheless, we might also expect that regardless of any differences in reversal tendency to be found in the reading performances of older dyslexics, their overall error pattern and that of other backward readers of normal intelligence will in important ways remain the same. That is, the principal source of reading errors for both groups would continue to be at an altogether different level. The common error pattern, as we have seen, reflects difficulties in phonemic

segmentation of words in the lexicon, in phonetic recoding, and in mastery of the orthography-difficulties, in short, with the linguistic characteristics of words rather than with their properties as visual patterns.

SUMMARY

The pattern of errors in reading isolated words was studied in two groups of children with respect, particularly, to reversals of letter sequence and letter orientation. One group (the Institute group) consisted of children 8 to 10 years old who had been diagnosed "dyslexic" according to medical and psychoeducational criteria. The other (the School group) included all the children in a second-year elementary school class (see Liberman, Shankweiler, Orlando, Harris and Berti, 1971) who fell into the lowest third on a standard test of reading achievement. Although the Institute children were somewhat poorer in word recognition than the backward readers selected purely on psychometric grounds, the groups did not differ significantly in the incidence of reversal errors. Also, for both groups, reversals represented a small proportion of the total number of reading errors. The performance of the two groups differed in two respects: in relation to directional bias in letter reversals and in the presence or absence of a significant correlation between letter-reversing and word-reversing tendencies. It was concluded from this that directional problems do not loom large in importance in most cases of reading backwardness, but may provide an additional source of difficulty for some dyslexic children. Other aspects of the error pattern were remarkably the same for both groups. The bulk of reading errors made by both groups reflect their common difficulties in phonemic segmentation of words in the lexicon, in phonetic recoding, and in mastery of the orthography — difficulties, in short, with linguistic characteristics of words rather than with their properties as visual patterns.

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Dr. Donald Shankweiler, Haskins Laboratories, 270 Crown Street, New Haven, CT 06510, U.S.A.