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DYSLEXIA: AN OVERVIEW

Dyslexia describes a condition first mentioned in English around the turn of the century (Morgan, 1896; Hinshelwood, 1900). Since then the characteristics, causes, and nature of the disability have been discussed by scores of investigators. However, a great deal of disagreement persists among educators, psychologists, clinicians, and physicians, as well as the general public (Reid, 1968). The purpose of this paper, therefore, is to present a short overview of what is known and not known about dyslexia. The discussion will cover four topics: an operational definition of dyslexia, some attendant characteristics, four competing accounts of the nature of the disorder,[1] and some brief suggestions for remediation.

Definition

Dyslexia, sometimes defined as reading at least two years below grade level (Eisenberg, 1966), is often referred to as a *specific* reading disability. "Specific" here means "occurring in the absence of other deficiencies." That is, dyslexia can be diagnosed confidently only in those of average or better intelligence, who have no sensory deficits (e.g., with normal hearing and vision), no gross brain damage, no severe emotional disorders, and no instructional or socioeconomic disadvantages. In other words, the term "dyslexia" applies only to poor readers who have no other organic, psychological, or environmental handicaps.[2]

Moreover, *dyslexia* should not be confused with *alexia*, which is an *acquired* disorder of language affecting reading in particular. Alexia is due to specific cortical damage caused by lesion, tumor, or trauma. Typically, this damage is localized in the angular gyrus of the dominant hemisphere.[3] Alexia, then, is the result of acquired damage to the cerebal cortex, whereas dyslexia occurs in the absence of identifiable neurological damage.

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Attendant Characteristics

It has been noted that several characteristics occur sporadically with dyslexia and may or may not be significant. First, dyslexia occurs four times as often in males as in females (Benton, 1975). Second, it occurs more often in families of dyslexics (Finucci et al., 1976). Third, dyslexics may have trouble with other forms of representational learning, such as telling time, or naming the months and seasons of the year or days of the week; they may have trouble identifying right and left or up and down. Fourth, dyslexics sometimes exhibit what are called neurological "soft signs," such as abnormal reflexes, minor coordination difficulties, or deviant EEG's. Finally, they may exhibit faulty, nearly illegible penmanship; slow, labored writing; and misspellings, more often omitting letters than including extra letters (Critchley, 1975). It should be emphasized, however, that none of these characteristics is sufficient or necessary to diagnose dyslexia. That is, the inability to tell time, for example, should not be taken as evidence of dyslexia, any more than the ability to tell time is evidence of the absence of the disorder.

Theories of Dyslexia

The oldest and most popular hypothesis concerning the nature of dyslexia is the *visual deficit theory*, first proposed by Orton (1925). According to this theory, dyslexics actually "see" letters and words in reverse (e.g., *p* for *q*, *d* for *b*, *was* for *saw*, *ton* for *not*). Orton, particularly impressed with such letter and word reversals, reasoned that images of letters are stored in both halves of the brain, but those in the nondominant hemisphere (usually the right) are mirror images of those in the opposite hemisphere. He thought that letter and word reversals in reading and writing were due to delayed lateral dominance,[4] which resulted in the failure to suppress the "reversed" letter images in the nondominant hemisphere. The net result was that the dyslexic would actually "see" letters and words in reverse. Even though this theory has persisted for the last fifty-five years, there is reason to doubt its accuracy. First, if dyslexia were due to a general dysfunction in visual analysis, the deficiency should extend into other areas of behavior besides reading and writing. Researchers have found, however, that this is not the case. That is, dyslexics do not seem to be generally disoriented in space (Benton, 1962). Second, contrary to what the visual deficit theory would predict, investigators have found that standard optometric exams do not discriminate poor and normal readers (Fox et al., 1975). Third, others have found that letter and word reversals account for only about 25% of all reading errors among dyslexics, even though the tests they used were constructed to maximize such mistakes (Liberman et al., 1971). Fourth, other research indicates that dyslexics reverse letters when writing from dictation but not when copying (Lovell et al., 1964). If the problem were primarily visual, it should affect copying as well. Finally, cases of mirror writing are often cited in support of the visual deficit theory. This phenomenon, however, is probably best

explained as a function of learning a new orthography. For example, I have noticed that students learning phonetic transcription often reverse unfamiliar symbols (e.g., ɤ̌ for ɣ̌, ɕ for ɔ, and ɿ for ʃ). Similarly, one learning to write might be expected to make the same kind of mistake (e.g., *d* for *b*, *p* for *q*, Ƨ for *S*, and И for *N*). In short, the evidence suggests that dyslexics probably are not deficient in their visual perception of letters, but rather have simply not learned them completely.

The second most popular view of dyslexia is the *intersensory deficit theory*, originally proposed by Birch (1962). According to this theory, the dyslexic's reading handicap stems from an inability to integrate information received through different senses. That is, for example, dyslexics have unusual difficulty in matching what they see with what they hear. Birch first tested his theory in an experiment where he required poor and normal readers to match auditory patterns (knocks tapped out by the experimenter) with visual patterns (different arrays of dots). As predicted, the poor readers performed worse than the normal readers. There are, however, a number of problems with this theory. First, in the original experiment, the subjects *watched* the experimenter tap out the knocks. Thus, they were receiving visual as well as auditory information. In this case, the experiment simply did not test intersensory integration. Second, the more recent studies that claim to support this theory are marred by confounding memory and perception factors. That is, the experiments were designed in such a way that the subjects may simply have forgotten the stimulus before they were able to integrate it. Moreover, the results of these studies are further confounded by inadequate sampling techniques (Vellutino, 1979, 207). Finally, more recent research indicates that poor and normal readers differ only in intersensory integration tasks involving *linguistic* stimuli (Vellutino et al., 1975). In sum, the intersensory deficit theory, although meriting further investigation, is probably too general. That is, dyslexics do not appear to have a global intersensory transfer deficit, but rather a specific deficiency in relating visual linguistic symbols to the sounds of the words in their vocabularies.

The third view of dyslexia is that poor readers are deficient in *serial order perception.* Originally proposed by Bakker (1972), this theory states that dyslexics have unusual difficulty in perceiving the order of incoming stimuli. Thus, for example, when presented with the letters *w-a-s*, they actually perceive *s-a-w.* The fundamental assumption underlying this theory is that words are identified in both reading and listening by left-to-right processing of letters and sounds. There are a number of facts, however, that suggest that this assumption is incorrect. First, recent research has shown that neither reading nor listening involves simple left-to-right processing. For example, the findings of Mason (1975) suggest that good readers do *not* engage in left-to-right processing of printed words, whereas poor readers do. She states that "good readers process all six letters of any display type [i.e. word] simultaneously, whereas poor readers do not" (146). Mason bases her conclusion on the fact that the good readers in her study were faster than the poor readers in picking out target letters in six-letter words. The difference between the performance of the two groups

was enhanced when the target letter was the sixth letter. Findings such as these, of course, are exactly the opposite of what the serial order theory would predict. Second, Shankweiler and Liberman (1972) have found that sequencing errors on word lists containing reversible words (e.g., *tap, was, not, pit,* etc.) accounted for only about 15% of the errors, while mispronunciation of individual consonants and vowels accounted for approximately 75%. They further state that "although optical reversibility [of individual letters and words] contributes to the error rate for the children we have studied, it is of secondary importance to linguistic factors" (313). Finally, in almost all of the studies which are cited in support of the serial order deficit theory, poor readers performed worse than normal readers on both gross recall (general memory) and serial recall (sequential memory) experiments; however, it is important to keep in mind that such studies typically confound both types of task (Vellutino, 1979, 225). In short, the available evidence suggests that dyslexia is not the result of a simple specific deficiency in serial order perception.

The fourth and final view of dyslexia is that it is a deficiency in *linguistic processing.* This theory suggests that dyslexics may have a subtle linguistic deficit, which inhibits them from matching their knowledge of the language to the printed word. The implication is not necessarily that dyslexics are deficient in their internalized linguistic system; it may be that they are simply inefficient in utilizing that system.[5] In either case, however, the problem is seen as primarily a linguistic deficit rather than one of a more general nature. There seems to be ample support for this view. First, it has been noticed since the turn of the century that poor readers show a history of delayed language development (McCready, 1910; Bronner, 1917; Rabinovitch, 1959, 1968). Second, poor and normal readers typically differ only in tasks involving linguistic stimuli (Vellutino, 1979, 236-37). Third, in studies of oral language samples, poor second-grade readers have been shown to have more restricted vocabularies, to use less modification in predicate position, fewer subject-verb-object constructions, more contractions, more existential sentences, (i.e., sentences containing main verb *be*), and fewer transformations, and to make more subject-verb agreement errors (Fry et al., 1970). Fourth, other research indicates that poor fourth-grade readers are not able to recall syntactically well-formed nonsense sentences (e.g., *when they sivolved the veg, they hanashed zalfly*) any better than syntactically anomalous sentences (e.g., *zalfly they when, veg they hanashed, sivoled they*). Good readers, however, were able to recall the syntactically well-formed sentences much better than the syntactically anomalous ones (Weinstein and Rabinovitch, 1971). This indicates that normal readers are better able to tap their internalized syntactic knowledge. Fifth, other investigators have found that poor readers make significantly less use of the suprasegmental features of pitch, stress, and juncture in oral reading than normal readers do (Clay and Imlach, 1971). Since suprasegmental features apply to specific syntactic domains (e.g. sentence and phrase), the absence of these features in oral reading may suggest that poor readers have diminished access to syntactic structure. Finally, further research indicates that poor readers are less able

to segment words phonemically (i.e., divide words into their constituent sounds) than normal readers (Liberman et al., 1974). All of this suggests that dyslexics are deficient in their ability to use their internalized linguistic knowledge.

One factor that may exacerbate the effect of linguistic deficiencies among dyslexics is the match between the sound system of their language and the orthography used. For example, the incidence of dyslexia in Japan has been observed to be less than 1%, whereas that in the U.S. has been estimated to be around 10% (Makita, 1968). One explanation for this discrepancy may be the fact that there is no one-to-one correspondence between English phonemes and the Roman alphabet (e.g., /i/ = h*e*, s*ee*, p*ea*, k*ey*, mach*i*ne, rec*ei*ve, bel*ie*ve, etc.); whereas in the Japanese *kana* scripts, a one-to-one relationship does hold between sound and symbol (e.g., /i/ = い).

In brief, it is not clear if the dyslexic's problem is linguistic, orthographic, or both; more research is needed. However, existing evidence does suggest that dyslexia is probably *not* the result of a general sensory deficit involving vision, intersensory integration, or serial order perception.

Remediation

The linguistic deficit theory of dyslexia has a number of implications for remediation. For one thing, it is probably a waste of time to engage in what is called "basic process training," which encompasses exercises designed to improve motor coordination, visual and auditory discrimination, intersensory integration, and sequential memory. The reason is obvious: if dyslexia is caused by a linguistic deficit, such exercises should effect little or no improvement.

There are, however, positive steps that can be taken. Assessment should be restricted to specific deficiencies: word analysis (i.e., the ability to segment words into their constituent phonemes and letters), word synthesis (i.e., the ability to combine individual letters and phonemes into words), and word comprehension. More importantly, the poor reader should be provided with explicit information about the structure of the language and the effect of that structure on the correspondence between letters and sounds.[6]

There are a number of types of useful linguistic information. First, placing stress on a vowel has the effect of giving that vowel its full phonemic character. Consider the following pairs of words:

leg*a*l	/ə/	leg*a*lity	/ae/
an*a*lytic		an*a*lysis	/ae/
reb*e*l (N)		reb*e*llion	/ɛ/
tel*e*graph		tel*e*graphy	/ɛ/
pal*a*ce		pal*a*tial	/e/
civ*i*l		civ*i*lian	/I/

mal*i*ce	/ə/	mal*i*cious	/I/
avar*i*ce		avar*i*cious	/I/
symb*o*l		symb*o*lic	/a/
Mong*o*l		Mong*o*lian	/o/
ph*o*netics		ph*o*ne	/o/
cher*u*b		cher*u*ic	/u/

The italicized vowels in the words in the first column are all unstressed and pronounced / ə /. When stressed, however, as in the second column, these vowels take on their full phonemic value. If words like these were presented in pairs, it would provide a clue to the spelling of the member of the pair containing the unstressed vowel.

Second, the morphological structure[7] of a word affects its pronunciation and thus may have an effect on spelling. Note the following pairs:

bi*sh*op	/š/	mi*sh*ap	/s+h/
di*sh*rag	/š/	di*sh*armony	/s+h/
di*sh*eveled	/š/	di*sh*onor	/s+h/
fa*th*om	/ð/	kno*th*ead	/t+h/
apo*th*ecary	/θ/	po*th*ole	/t+h/
ano*th*er	/ð/	ou*th*ouse	/t+h/

In the first column, the italicized letters (*sh* and *th*) are part of the same morpheme, and are therefore pronounced as a single sound /s/; on the other hand, in the words in the second column, the *s*/*t* and *h* are part of different morphemes, and are thus pronounced as separate sounds. Explicit knowledge of the morphological structure of words would help the dyslexic to resolve the problem of one spelling which represents two different pronunciations.

Third, the syntactic category of a word (e.g., noun, verb, etc.) affects its pronunciation. Consider the following pairs:

cónvict	(N)	/a/	convíct	(V)	/ə/
cómbat	(N)		combát	(V)	
óbject	(N)		objéct	(V)	

The words in column one above are nouns and have stress on the first syllable, so the *o* is given its full phonemic value /a/. Those in column two, however, are the corresponding verbs and have unstressed first syllables, so the *o* is pronounced /ə/. Again, presenting such words in pairs provides a clue to the spelling of the member of the pair containing the unstressed vowel.[8]

Finally, the etymology of a word affects its pronunciation. Consider the following pairs:

cell	/s/		cell	/č/	
*ch*eek	/č/		*ch*ic	/š/	
*g*eld	/g/		*g*el	/ ǰ/	
be*g*in	/g/	(Ger.)	*g*in	/ ǰ/	(Rom.)
*h*ome	/h/		*h*onest	∅	
*h*elp	/h/		*h*erb	∅	
*h*op	/h/		*h*onor	∅	

The words in the first column are Germanic, while those in the second are of Romance origin. The italicized letters in each row are identical, yet their pronunciation differs as a function of the origin of the word. As in the cases above, etymological information helps clarify the relationship between spelling and sound.

In conclusion, let me reiterate the main points: First, dyslexia is not simply the inability to read; instead it is a specific reading disability that occurs in the absence of other organic, psychological, and social handicaps. Second, a number of characteristics occur sporadically with dyslexia, such as the high incidence among males; however, none of these characteristics is diagnostic. Third, all available evidence suggests that dyslexia is primarily a linguistic deficit, rather than a deficiency in vision, intersensory integration, or serial order perception. Finally, remediation will require, at the very least, providing the disabled reader with explicit information about the structure of the language and its relationship to the orthography.

NOTES

[1] Except for the section on remediation, my discussion closely follows Vellutino (1979), a highly technical and thoroughly detailed survey of the research on dyslexia. However, my primary goal in writing this piece is not to add to the research literature on the subject, but rather to disseminate among teachers of composition what information is known that they may otherwise probably not be exposed to.

[2] This understanding of dyslexia is common in the medical field. Educators, on the other hand, generally regard dyslexia as the inability to read, regardless of cause. I have adopted the medical definition because it seems to me absolutely essential to factor out all confounding variables (e.g., poor instruction), if the specific nature of dyslexia is ever to be understood.

[3] The left hemisphere is dominant in approximately 98% of the population (Eccles, 1977, 205). The dominant hemisphere is the one that stores the language faculty.

[4] Until recently it was generally felt that neither hemisphere is dominant in humans at birth, but that one becomes dominant before the age of ten (Lenneberg, 1967). However, Geschwind and Levitsky (1968) reported that the planum temporal, an area in the temporal lobes of humans, was larger in the left hemisphere in 65% of the brains they studied. Later, Wada et al. (1975) found the same to be true of human fetal brains. This suggests that the left hemisphere in humans may be programmed for language dominance even before birth.

[5] This distinction between an internalized grammatical system and the implementation of that system to produce and understand sentences is essentially that between competence and performance, as outlined by Chomsky (1965).

[6] Reed and Sawyer (1970) follow this approach and some of the examples that follow are theirs.

[7] Morphology is the analysis of words into their smallest meaningful elements, each of which has a (relatively) constant phonological shape. For example, the words *photo*, *photograph*, and *photographer* contain the morpheme photo , even though the phonemic representation of this morpheme is slightly different in each of the three words: /fōtō/, /fōtə/, and /fətā/, respectively. In other words, a morpheme is a word or a part of a word that has a (relatively) constant sound-meaning correspondence. For a brief but revealing introduction to English morphology, see Falk (25-31).

[8] A similar alternation occurs in verb-adjective pairs. For example, the verbs *learned* and *aged* are monosyllabic and are pronounced /lɝ rnd/ and /ejd/, respectively. The corresponding adjectives, however, are bisyllabic: /lɝrnəd/ and /ejəd/.

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