



1986

Dyslexia, Theories of Causation and Methods of Management: An Historical Perspective

Nancy M. Millichap
Loyola University Chicago

Follow this and additional works at: https://ecommons.luc.edu/luc_theses



Part of the [Education Commons](#)

Recommended Citation

Millichap, Nancy M., "Dyslexia, Theories of Causation and Methods of Management: An Historical Perspective" (1986). *Master's Theses*. 3426.
https://ecommons.luc.edu/luc_theses/3426

This Thesis is brought to you for free and open access by the Theses and Dissertations at Loyola eCommons. It has been accepted for inclusion in Master's Theses by an authorized administrator of Loyola eCommons. For more information, please contact ecommons@luc.edu.



This work is licensed under a [Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 License](#).
Copyright © 1986 Nancy M. Millichap

DYSLEXIA: THEORIES OF CAUSATION AND METHODS OF MANAGEMENT:
AN HISTORICAL PERSPECTIVE

by

Nancy Millichap

A Thesis Submitted to the Faculty of the Graduate School
of Loyola University of Chicago in Partial Fulfillment
of the Requirements for the Degree of

Master of Arts

January

1986

© 1985, Nancy Millichap

ACKNOWLEDGEMENTS

I am indebted to my Thesis Director, Dr. Steven I. Miller, for his helpful criticisms and suggestions in the planning and outline phase of the thesis, and to the Reverend Walter P. Krolikowski, my teacher and member of the thesis committee, for his kind comments and encouragement.

My research requiring reference to original articles published in various specialty journals could not have been completed without access to a number of libraries in the Chicago area. I wish to acknowledge the assistance provided by the librarians of my own university, Loyola University of Chicago, the Archibald Church Medical Library of Northwestern University, the John Crerar Library of the University of Chicago, the public libraries of Chicago and Wilmette, and the library of Barat College in Lake Forest.

VITA

The author, Nancy Millichap, was born December 18, 1942 in Chicago, Illinois. She is married to J. Gordon Millichap, M.D. and is the mother of two boys, Gordon Thomas and John Joseph.

Her secondary school education was obtained at the Marywood highschool in Evanston, Illinois, where she graduated in 1960 as president of her class. In 1960, she entered Marymount College, Arlington, Virginia; in 1961, she transferred to Northwestern University, and in 1964, received the degree of Bachelor of Science with a major in education and with honors in her senior year. While attending Marymount College, she was elected secretary of the freshman class, and at Northwestern University she was elected a member and assistant rush chairman of Delta Gamma.

In 1964, she was appointed secretary in the Department of Labor, Washington, D.C. and a member of the White House Seminar. In 1965, she was a teacher in the Argentinian school system and at the British Argentinian Institute. In 1966, she joined the North Shore School District as a substitute teacher and in 1967 became a member and, later, manager and assistant buyer in the Management Training Program of Marshall Fields. Since 1970, she has been active in community service, and in 1977 she was named one of the Outstanding Young Women in the United States.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS.....	ii
VITA.....	iii
LIST OF TABLES.....	v
Chapter	
I. INTRODUCTION.....	1
II. DEFINITIONS AND TERMINOLOGY.....	9
III. THEORIES OF CAUSATION.....	14
Developmental Brain Anomalies.....	14
Hereditary Familial Factors.....	17
Impaired Dominance.....	18
Environmental Factors.....	19
Prenatal and Perinatal Brain Damage and MBD...	20
Delayed Cerebral Maturation.....	21
IV. METHODS OF TREATMENT.....	23
Ancient and Modern Reading Methods.....	23
Methods of Treatment of Dyslexia.....	31
The "One Best Method" Approach.....	37
Teaching Prerequisite Reading Skills.....	48
Matching Learning Strengths and Methods...	53
Behavior Modification Approach.....	56
Optometric Training Methods.....	58
Medical Treatments.....	59
V. DISCUSSION.....	64
REFERENCES.....	71

LIST OF TABLES

Table	Page
1. Terminology of Dyslexia.....	10
2. Presumptive Causes of Dyslexia.....	15
3. Dyslexia in Twins.....	17
4. Methods of Treatment for Dyslexia.....	36
5. Categories of Remedial Reading Methods.....	38

CHAPTER I

INTRODUCTION

The term, "dyslexia," of Greek origin, meaning difficulty with words, was first suggested by Professor Rudolph Berlin of Stuttgart, Germany, in 1887 in his monograph, "Eine besondere Art der Wortblindheit (Dyslexia)" (a particular kind of word blindness). The earliest references to the condition date as far back as A.D.30 when Valerius Maximus and Pliny described a man who lost his ability to read after being struck in the head by a stone (Holland,1601). In 1676, a report by Schmidt who provided a detailed description of a man with apoplexy who could not read but had retained the ability to write (Benton and Joynt, 1960).

Dyslexia is a disorder manifested by a difficulty in learning to read, despite conventional instruction, adequate intelligence, and socio-cultural opportunity (World Federation of Neurology definition, Waites, 1968). The condition may be inherited, congenital or inborn, occurring in children, and commonly of unknown cause, or acquired, usually in adults but sometimes in children, and due to a selective injury or disease in the language areas of the brain. The term "word-blindness," coined by Kussmaul, a

physician, in 1877, to describe the loss of ability to understand words read in the written form, while retaining adequate sight and the ability to speak, was applied to adults with acquired lesions of the brain and a disability occurring as a sequel to loss of consciousness. "Congenital word-blindness" was first described by Dr. Pringle Morgan, a general practitioner in England, in 1896, who reported the case of a 14 year old boy who was bright and intelligent but was unable to read, despite laborious and persistent training with the help of tutors since he was seven years old.

Historically, several famous people and otherwise high achievers have been reported to suffer from reading disability during childhood. Thomas Edison, Albert Einstein, President Woodrow Wilson, and Governor Nelson Rockefeller are among those listed as dyslexics, yet their names are indelibly written in the papers of history. Thomas Alva Edison, inventor, was diagnosed as mentally ill by his teacher; his father thought he was stupid; he never learned to spell; and up to the time of his manhood his grammar and syntax were appalling (Josephson, 1959; Goertzel, 1962; Thompson, 1966). Albert Einstein, physicist and Nobel prize winner, did not talk until he was four nor read until nine. He was considered backward by his teachers and his father (Thompson, 1966; Clark, 1971). Woodrow Wilson, President of the United States, did not learn his

letters until he was nine or learn to read until he was eleven. There are letters from relatives who thought it odd that young Woodrow was so dull and backward and expressed sorrow for his parents (Thompson, 1966, 1969). Nelson A. Rockefeller, the former governor of New York State and vice president of the United States, in an article written in the TV Guide, 1976, entitled "Don't accept anyone's verdict that you are lazy, stupid or retarded," recalled his difficulties as a dyslexic boy before there were special schools and teachers for reading disabled children.

The credit for the development of the concept of dyslexia is usually accorded to Dr. James Hinshelwood, an ophthalmologist and surgeon at the Glasgow Eye Infirmary in Scotland, who, in December 1895, published a paper in the Lancet on the subject of word-blindness and visual memory. Hinshelwood's earliest case reports concerned adults who had lost the ability to read while retaining other normal faculties. These patients were previously fluent readers and were suffering from acquired word-blindness as a result of brain injury or disease. Subsequently, he published several reports of both acquired and congenital word-blindness written over a period of 22 years, completing his impressive bibliography on the subject with a monograph entitled, "Congenital Word-blindness", published in 1917, just two years before he died.

Pringle Morgan is correctly given the distinction of

describing the first case of "congenital word-blindness" in his paper published in The British Medical Journal, November 7, 1896, although a general reference to the condition was made a few weeks earlier by Dr. James Kerr, Medical Officer of Health to the City of Bradford, England, not in a scientific journal, but in a report to a school board, concerning "School hygiene, in its mental, moral and physical aspects". In 1896, Kerr was awarded the Howard Medal by the Royal Statistical Society for his essay that was published one year later in the journal of that society, September 1897. The reference points out that "word-blindness" is seen in children who are not generally dull but are mentally exceptional. Kerr suggested that these children could be cared for in the regular classroom if the teacher were aware of their peculiarities.

Following the British initiative for the recognition of a specific reading disability in children, reports began to appear in the literature from other countries in the early twentieth century. Foerster and Peters, of Germany, in 1904 and 1908, respectively, published reports of "kongenitale Wortblindheit" (congenital word-blindness). Wernicke of Argentina, in 1904, in a book on the subject, observed that the literature on congenital word-blindness was very limited and confined entirely to English. Schapringler, the first American author to mention congenital word-blindness, presented a paper concerning the problem in

pupils of the public schools at the meeting of the Ophthalmological Section of the New York Academy of Medicine, February 19, 1906. Schapringger gave credit to Morgan (1896), Hinshelwood (1895), Nettleship (1901), and Wernicke (1904) for prior awareness and reference to the disorder, congenital word-blindness.

The influence of the United States in the international recognition of specific reading disabilities of children was increased in 1928 by Dr. Samuel T. Orton, Neurologist and Neuropathologist, Director of the Greene County Mental Clinic in Iowa, who introduced the term "strephosymbolia" (twisted symbols) in reference to congenital word-blindness in a paper published in the Journal of the American Medical Association. Orton described the symptoms of strephosymbolia as follows: (1) confusion of letters like "p" and "q" and of words like "was" and "saw"; (2) a tendency to reverse letters or syllables; (3) reading from right to left; and (4) mirror reading and writing. He considered the cause to be physiological, not pathological, and related to the failure of one hemisphere of the brain to become dominant over the other, a neurological explanation in terms of developmental cerebral organization.

Orton's term for reading disability has not gained general acceptance, but his work has resulted in the establishment of The Orton Dyslexia Society that continues

to promote scientific symposia, research, and programs for the benefit of children with dyslexia. Since Orton's contributions, however, and those of neurologists and ophthalmologists, who took the responsibility for the earlier investigations and a congenital developmental concept of the disorder, the field of dyslexia has been invaded by sociologists and educational psychologists who are probing the complex question of scholastic inadequacy as the basis of the problem.

Many educational psychologists (Monroe, 1937; Robinson, 1947) reject the neurologists' approach and belief that there are hereditary and functional or structural cerebral causes of dyslexia, and object to the use of the word "congenital" that connotes a specific, constitutional organic defect. They regard the condition, not as a clear-cut entity, but as a nonspecific result of such causes as intellectual backwardness or subnormality, physical handicaps, social and cultural deprivation, emotional difficulties, irregular school attendance and inadequate teaching.

Psychologists favoring a new approach to dyslexic children include Monroe, Robinson, Burt, and Vernon. Monroe, in 1937, believed in a connection between character and personality and the ability to read; Robinson, in 1947, listed a constellation of causes including maladjusted homes, emotional problems, inappropriate teaching methods,

visual and hearing impairments, and some structural or functional deficiency of the brain; Burt, in 1950, emphasized the backward or subnormal child theory; and Vernon, in 1957, like Robinson, concluded that multiple causative factors must be considered, including intelligence, environment and emotional state.

Some psychiatrists have suggested that emotional-sociological explanations of reading failure have taken the place of older physiological theories in which dyslexia was ascribed to a specific developmental cause. Dreikurs, in 1954, wrote that reading disabilities arise from: (1) the child's discouragement, lack of confidence, and lack of faith in himself; (2) poor work habits, and (3) the child's antagonism toward school and learning. However, other psychiatric authorities disagree with this theory and favor the neurologists' concept of developmental and organic processes in etiology (Pearson, 1952; Rabinovitch, 1954).

In recent years, clinical psychologists (Clements, 1966; Conners, 1967), educators (Cruickshank, 1967; Lerner, 1976), speech pathologists (Johnson and Myklebust, 1967; Darley, 1967) and members of a relatively new medical specialty, the pediatric neurologists, (Bax and MacKeith, 1963; Schain, 1972), have grouped dyslexic children under the terms "learning disabilities" and "minimal brain dysfunction (MBD)", that are used interchangeably. Psychiatrists have substituted the term "attention deficit

disorder (ADD)" (American Psychiatric Association, 1980), claiming that this describes the clinical manifestations of the syndromes of learning disabilities more appropriately than MBD, a term emphasizing signs of neurological dysfunction that are not invariably present.

The recognition of the problem of dyslexia as presented from an historical perspective can be credited to specialists in various professional fields but especially ophthalmology, neurology, psychology, and education. The numerous and diverse interests and, sometimes, prejudices of these investigators attest to the frequent controversies and lack of uniformity in theories of causation and methods of management.

In the definition of dyslexia, a greater conformity of opinion exists, and a clear distinction is usually made between cases acquired in adults who previously enjoyed normal reading skills and the so-called developmental or congenital dyslexias in children who experience difficulty in learning to read. In this presentation, the specific reading disabilities of children will be emphasized, and reference to adult cases will be made mainly in the correlation and localization of pathological lesions in the brain.

CHAPTER II

DEFINITIONS AND TERMINOLOGY

The definitions and terms for reading disorders have been subject to considerable controversy and heated discussion among specialists in the various professions with an interest in the subject. At the first meeting of the Research Group on Development Dyslexia and World Illiteracy, which took place in Dallas, Texas, in April, 1968, the following terminologies and definitions were formulated and unanimously approved (Waites, 1968):

1. "Specific developmental dyslexia": A disorder manifested by difficulty in learning to read despite conventional instruction, adequate intelligence and sociocultural opportunity. It is dependent upon fundamental cognitive disabilities which are frequently of constitutional origin.

2. "Dyslexia": A disorder in children who, despite conventional classroom experience, fail to attain the language skills of reading, writing and spelling commensurate with their intellectual abilities.

Since the word dyslexia was coined by Berlin in 1887, several different terminologies have been applied to patients with an inability to read. These terms, the source credited, and the year when first published, are shown in chronological order in Table I.

"Word-blindness", the initial term, proposed by Kussmaul in 1877 and used extensively by Hinshelwood between

Table I. Terminology of Dyslexia.

<u>Term</u>	<u>Source</u>	<u>Year</u>
Word-blindness	Kussmaul, A.	1877
Dyslexia	Berlin, R.	1887
Congenital word-blindness	Morgan, P.; Kerr, J.	1896
Congenital symbol amblyopia	Hinshelwood, J.	1900
Legasthenia (L. <u>leges</u> , words)	Clairborne, J.H.	1906
Typhlolexia (Gr. <u>typhlos</u> , blind)	Clairborne, J.H.	1906
Amnesia visualis verbalis	Variot, G., and Lecomte	1906
Analphabetia partialis	Witmer, L.	1907
Bradylexia (Gr. <u>brady</u> , slow)	Engler, B.	1917
Congenital dyslexia	Claparede	1917
Congenital alexia	Hinshelwood, J.	1917
Specific reading disability	Hinshelwood, J.	1917
Strephosymbolia (strepho, twisted)	Orton, S.	1928
Constitutional dyslexia	Orton, S.	1928
Specific language disability	Skydsgaard, H.B.	1942
Specific dyslexia	Gallagher, J.R.	1950
Angeborene schreiblese-schwache (defect in reading and writing)	Hallgren, B.	1950
Reading retardation	Walter, K.	1954
Developmental dyslexia	Rabinovitch, R.D.	1954
Minimal brain dysfunction	Benton, A.L.	1962
Learning disability	Bax, M., MacKeith, R.	1963
Specific developmental dyslexia	Kirk, S.	1967
Specific learning disability	World Fed. Neurology	1968
	U.S. Fed. Gov.	1970
	(Pub. Law 91-230)	

1895 and 1917, was applied to cases of acquired dyslexia in adults who had lost the ability to read as a result of brain disease or injury. "Congenital word-blindness," introduced by Morgan in 1896, described children who experienced difficulty in learning to read despite otherwise normal intellectual function.

The terms, congenital symbol amblyopia, legasthenia, typhlolexia, amnesia visualis verbalis, alphabetic partialis, bradylexia, congenital dyslexia and congenital alexia were proposed by various authors between 1906 and

1917 (Table I), only to be ignored in future literature. Orton's contributions of "specific reading disability" and more notably, "strephosymbolia," in 1928, are remembered and quoted but have not enjoyed general acceptance and usage.

Gallagher, in 1950, considered the term "specific language disability" preferable to specific reading disability, congenital dyslexia or congenital word-blindness, because it implies that the learning problem is specifically in the language area and not also in arithmetic and science and it may include other language skills, such as spelling, penmanship, and speech. In support of Gallagher's argument, the word "dyslexia", as derived from the Greek word lexis, means speech rather than words, as implied by the Latin-Greek derivation, lexicon (Webster, 1961).

In 1954, Rabinovitch isolated three groups of poor readers with the common term "reading retardation": (1) the primary reading retardation group, endogenous or specific cases without brain damage: (2) the brain-damaged group; and (3) the secondary reading retardation group of children who read badly because of various exogenous factors such as inadequate teaching.

The pediatric neurologists, in 1963, decided on the syndrome "minimal brain dysfunction" to include among children with hyperactive behavior, inattention, and coordination and perceptual problems, those with a reading

disability. In 1967, educators introduced "learning disability" to refer to a specific retardation or disorder in one or more of the processes of speech, language, perception, behavior, reading, spelling, writing or arithmetic (Kirk, 1967). This term was made more official and "specific" with a definition provided by the United States Government in 1970 that read:

The term "children with specific learning disabilities" means those children who have a disorder in one or more of the basic psychological processes involved in understanding or using language, spoken or written, which disorder may manifest itself in imperfect ability to listen, speak, read, write, spell or do mathematical calculations. Such disorders include such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia. This term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, or mental retardation, or emotional disturbance, or of environmental disadvantage. (From Public Law 91-230).

The educators classified dyslexia among thirty-seven terms grouped under the diversified label of learning disabilities (Tarnopol, L., 1971). The importance of dyslexia as a specific entity was emphasized by the neurologists at their meeting of a Research Group on Developmental Dyslexia and World Illiteracy under the auspices of the World Federation of Neurology in 1968.

The educational perspective on dyslexia is different from that of the medical perspective (Lerner, 1976). While the educators seek a combination of factors in causation, the neurological approach is in search of a single

etiological factor. The National Advisory Committee on Dyslexia and Related Reading Disorders, set up in 1968 to investigate, clarify, and resolve these controversial issues, tended to side with the educational perspective. The committee was of the opinion that the term specific dyslexia, as distinct from learning disabilities in general, served no useful purpose.

CHAPTER III

THEORIES OF CAUSATION

A variety of causes for dyslexia has been suggested but the majority are presumptive and unproved. A chronological list of causes, the earliest source mentioned in the literature, and the date of the publication are shown in Table II. The earliest reference to a focal or localized brain lesion as the underlying pathology in a case of acquired dyslexia was that of Broadbent in 1872. A middle-aged adult who had suffered a slight stroke could not recognize printed or written words with the exception of his own surname, although he was able to write and to converse fairly well. At the time of his death, lesions in the region of the left angular and supramarginal cerebral gyri were found at autopsy. Dejerine, in 1892, reporting a similar case in an adult, placed the responsible lesion in the medial and inferior portions of the left occipital lobe of the brain.

Developmental Brain Anomalies

Anatomic studies of the brains of children with reading disability are rare (Drake, 1968), and none has shown a localized pathology similar to that reported in

Table II. Presumptive Causes of Dyslexia.

<u>Cause</u>	<u>Source</u>	<u>Date</u>
Focal brain lesion	Broadbent, W.	1872
Heredity	Rutherford, W.J.	1909
Impaired eye dominance	Dearborn, W.F.	1931
Incomplete cerebral dominance	Orton, S.T.	1937
Emotional	Robinson, H.M.	1947
Toxic (e.g. lead poisoning)	Thurston, D.L. et al	1955
Environmental	Vernon, M.D.	1957
Pregnancy and perinatal brain damage	Kawi, A.A. Pasamanick, B.	1958
Minimal brain dysfunction	Bax, M. and MacKeith, R.	1963
Delayed cerebral maturation	Critchley, M.	1964
Nutritional	Winick, M. and Rosso, P.	1969
Developmental brain anomalies	Galaburda, A.M. et al	1985

adults with acquired dyslexia. However, in a very recent report (Galaburda et al., 1985) of neuroanatomical findings in four young men with histories of developmental dyslexia, the brains showed nodular developmental anomalies of the cerebral cortex, termed "brain warts" by the authors, located mainly around the sylvian fissure and affecting predominantly the left hemisphere. Extrapolation from descriptions in adults would suggest a possible functional or structural abnormality most commonly located in the

angular gyrus of the hemisphere dominant for language.

Hermann and Norrie (1958) emphasized the association between congenital wordblindness and Gerstmann's syndrome, a disorder characterized by finger agnosia (inability to name fingers), disorientation for right and left, agraphia (handwriting inability), and acalculia (arithmetic inability) (Gerstmann, 1940). This syndrome was described in adult patients who had tumors or atrophic lesions involving the angular gyrus in the dominant cerebral hemisphere. It has also been found in children with learning disabilities and minimal brain dysfunction without accurate cerebral localization (Benson and Geschwind, 1970).

Some support for a structural cerebral defect as the basis for specific developmental dyslexia has been provided by a report of abnormalities in computerized tomography scans of five children with dyslexia (Galaburda et al., 1985). Functional deficits in the brain are supported by descriptions of electroencephalographic (EEG) abnormalities in children with dyslexia. Hughes found a variety of EEG dysrhythmias in 75 per cent of one group of 125 patients (1949) and in 36 per cent of a second group of 157 children with specific reading disabilities (1969). However, the abnormalities in the EEG's were often diffuse or bilateral, suggesting a more generalized cerebral dysfunction, and the localization of a specific lesion in the left angular gyrus

area of the brain was not supported by these electroencephalographic studies.

Hereditary Familial Factors

In 1909, Rutherford alluded to the case of a 10 year old girl who could not read as an excellent example of the effect of defective hereditary material in causing congenital dyslexia. Hallgren, in 1950, in a clinical and genetic study of 116 subjects with specific dyslexia and 160 cases of their siblings and parents, emphasized the role of hereditary, familial predisposition, and the predilection for boys.

Studies of twins (Table III), especially from Denmark, are most convincing of a familial tendency to dyslexia. Hallgren's six cases (1950) and Hermann and Norrie's 28 (1958) showed invariable concordance (i.e. both twins affected) in identical twins compared to a high degree of discordance (i.e. only one twin affected) in fraternal twins. A much larger study of 676 twin children by

Table III. Dyslexia in Twins

<u>Authors</u>	<u>Total Number</u> <u>of twin pairs</u>	<u>Monozygotic</u>		<u>Dizygotic</u>	
		<u>Concordant</u>	<u>Discordant</u>	<u>Conc.</u>	<u>Disc.</u>
Hallgren (1950)	6	3	0	1	2
Hermann & Norrie (1958)	28	7	0	6	15
Bakwin (1973)	62	26	5	9	2
Total	96	36(88%)	5	16(29%)	39

Bakwin, H. (1973) in the United States indicated that monozygotic (identical) twins shared the disability of dyslexia in a significantly higher proportion of the cases than did dizygotic (fraternal) twins. The total number of dyslexic twins from these studies and the incidence of concordance in identical and fraternal groups are shown in Table III.

Impaired Dominance

Although the earliest references to impaired dominance in dyslexics were concerned with left-eyedness and lack of ocular dominance (Dearborn, 1931), the principal interest in this factor of causation relates to cerebral dominance (Orton, 1937). Orton noted an unusual number of children with reading disability who showed preference for the right eye, left hand, and left foot, or other such crossed preference for the use of eye, hand and foot. He suggested that this physical finding might indicate an incomplete cerebral dominance or lateralization for language.

The notion of cerebral dominance owes its origin to the discovery that loss of speech (aphasia) almost always results from a lesion of the left hemisphere. This suggested a possible link with handedness, and the idea soon developed that both right-handedness and the lateralization of speech are due to an innate functional

pre-eminence of the left hemisphere (Broca, 1865). In left-handers, the position was thought to be reversed, aphasia resulting from a right-sided lesion.

Hughlings Jackson (1868) was the first to describe aphasia as a complication of left hemiplegia in a left-handed patient. This finding was not invariable, however, and subsequent studies have demonstrated that 70 to 75 per cent of left-handers have language represented in the left hemisphere, an observation counter to the rule of cross-brain control (Brown and Simonson, 1957).

Thus, cerebral dominance appears to be imperfectly related to eye, hand, or foot preference. It is not surprising that studies of children with mixed laterality (eye, hand, or foot preference) have failed to show a higher incidence of reading retardation than the general population (Belmont and Birch, 1965). A cause and effect relationship between mixed laterality and poor reading performance, as suggested by Orton, has not been confirmed. Although many children with dyslexia may have mixed laterality, this finding may be coincidental rather than causal in nature.

Environmental Factors

A constellation of multiple causative factors, emphasizing the influence of the environment, has been suggested by psychologists and educators (Robinson, 1947; Vernon, 1957). Robinson stressed the effects of maladjusted homes and emotional factors, while Vernon (1957) alluded to

inadequate education, changing teachers, and lapses of interest or lack of motivation.

Other possible environmental causes of dyslexia include toxic factors, such as lead poisoning (Thurston et al., 1955), and the effect of malnutrition during pregnancy and early infancy on the development of the brain (Winich and Rosso, 1969; Dodge et al., 1957). An allergic reaction in the child to food additives and preservatives has been proposed by Feingold (1975) as a cause of learning and behavior disorders, but controlled studies have failed to support this hypothesis, except in rare instances (Conners et al., 1976).

Prenatal and Perinatal Brain Damage and MBD

Children with language disabilities have been subjected to an increased frequency of complications during the pregnancy (prenatal) or delivery (perinatal) stages of development, according to Kawi and Pasamanick (1958). Infants who were small at birth were particularly at risk for brain damage, behavioral syndromes and neurological deficits such as cerebral palsy and minimal brain dysfunction (MBD). However, data correlating pathological findings with clinical syndromes of MBD are not available (Bax and MacKeith, 1963).

Studies that suggest an increased incidence of perinatal stresses in children with MBD were retrospective in design (Kawi and Pasamanick, 1958). Subsequent

longitudinal, prospective studies (Werner et al., 1967) have demonstrated that the home and social environments play a major role in determining school performance of children who have been subjected to adverse experiences during pregnancy and the perinatal periods. Follow-up studies of infants who suffered profound anoxia at birth have shown that compared to a control group, 80 per cent were performing equally well in school (Benaron et al., 1960). The authors concluded that even the severest forms of birth anoxia produced learning deficits in only a small proportion of affected infants. The theory that minimal brain injury due to anoxia or other complications of pregnancy and birth may result in developmental dyslexia is difficult to accept on the basis of evidence derived from controlled, prospective studies.

Delayed Cerebral Maturation

The concept of a "maturational lag" to explain dyslexia, alluded to by Eustis in 1947 and Vernon in 1957, was developed as the most likely theory of causation by Critchley in 1964. A maturational lag signifies a slow differentiation in cerebral anatomical structure, chemistry and function, and does not necessarily imply a structural defect in the brain (Bender, 1957). The delay in development could involve the nerve cell interconnections, the neurochemical transmitter substances (serotonin, acetylcholine) and the process of myelination.

The cause of this delayed maturation may be acquired,

due to injury or nutritional deficiency during pregnancy, or genetic factors may be invoked (Duane, 1974). The male preponderance in dyslexics (Hallgren, 1950) and the generally slower rate of maturation of male compared to female young 'are supportive of the genetic theory of maturational lag.

If specific developmental dyslexia does represent a type of cerebral immaturity, it follows that the reading difficulty might eventually improve with age and physiologic maturation. Indeed, some retarded readers do show apparent improvement at adolescence, but many are afflicted into adult life despite special educational intervention (Drake, 1974). The exact nature and validity of the theory of maturational lag needs to be investigated further by longitudinal studies (Critchley, 1964).

CHAPTER IV

METHODS OF TREATMENT

The history of the teaching of reading is pertinent to a review of the various methods used in the remedial treatment of dyslexia. Indeed, some authorities (Orton, 1929; Matthews, 1966) have considered the "whole word" or "look-and-say" method of reading instruction, made popular in the nineteenth century, to be a cause of reading disability.

Ancient and Modern Reading Methods

Matthews, in his book, "Teaching to Read, Historically Considered" (1966), refers to the Greek alphabet dating back to a time before 429 B.C. and the requirement for Greek boys to master letters in a passage in Plato's Republic, written at least 350 B.C. Emphasis was placed first on learning the letters in their proper alphabetical order and, second, the syllables that developed naturally out of the phonetic structure of the Greek language. Whereas Greek is a syllable-oriented language, English is word oriented and has to be pronounced to determine the number of syllables.

To summarize Matthews' review of early English reading methods, Christian missionaries set up school in the seventh century A.D., and, based on the Roman invader's influence,

selected Latin letters to represent the English sounds and alphabet. Priests and monks were interested in reading, in translating parts of the Bible into English, and in giving instruction in reading. Their most distinguished pupil was King Alfred (849-99), but virtually nothing is known about how he or others were taught to read. In 1066, with the Norman invasion of England, a form of French took precedence over the English language and any enthusiasm for reading or translation in English was discouraged.

° In the fifteenth century, references to learning to read from the ABC appear, but more often the battledore-book or hornbook was employed. This device resembled a ping-pong paddle on one side of which was pasted a paper or parchment inscribed with the ABC's arranged in the form of a cross, syllables, and the Lord's prayer. The instructional paper was protected by a thin transparent sheet of horn, hence the name hornbook. Since the alphabet was printed in the form of a cross, the teacher often referred to the letters as the Christ-cross row or cross-row. If the child failed to learn how to write his name and to read, then his Christ-cross or Crisscross "mark" was accepted as his signature. If he advanced to a real book, he used a primer, from the Latin word meaning "first", thought to refer to the first canonical hour of the day in ecclesiastical use, and an indication of the close relationship between religion and the ability to read.

The method used by those who taught beginners to read in the sixteenth century was that employed by the Greeks and Romans; first the names of the letters, then letter sounds and syllables, and then the words. The teachers failed to realize that letters merely stand for speech sounds but some letters have two sounds. For example C is pronounced S in city and K in can. This led to confusion and the suggestion that the number of letters in the alphabet should be increased so that every sound in the language was represented by one letter and no letter should represent more than one sound. These proposals for a new alphabet and the efforts of the reformers, Sir Thomas Smith, John Hart and others, failed.

In sixteenth and seventeenth century England, efforts to teach children to read increased, but the ancient classical method of letters first, then syllables, and finally words, was continued. The alphabet was set to music, recited forwards and backwards, but teaching never departed from the traditional ABC approach.

In Germany, teachers of reading were having the same problems as those in England. Instead of trying to modify the alphabet they devised a new method of instruction. Ickelsarner and later, Gedike (1754-1803) introduced the method of learning the whole word first and then the letters, in an analytical and "natural" manner, in place of the synthetic traditional method of teaching the ABC's first

and the whole word last.

Jacotot (1790-1840), a French scholar and educator, following Gedike's experiments in having children begin to read with whole words, developed this method further and taught by reading the whole book to the pupils first and then by having them learn the words and finally the sounds, not names, of letters. The new method was called the Analytic-Synthetic Method and Normal-Words Method.

In the early nineteenth century, the new European method of reading instruction had reached the United States, and Gedike and Jacotot were both influential in changing the manner of teaching the alphabet. The laborious ABC's, a single letter at a time method, was discarded and the "letter-to-word" or "word-to-letter" method was substituted in connection with words having a definite meaning. This technique of teaching children their letters by means of words was referred to as the "new method" and later, the "word method" or the "word method and phonic method." It was endorsed enthusiastically by Horace Mann, the first Secretary of a State Board of Education, in Massachusetts, in 1837, though he and others appeared to be confused between the alphabet method of learning letters through words and a word method, now called the look-and-say method, or learning to read through saying the word as a whole.

Matthews distinguishes these methods by the expressions "words-to-letters" and "words-to-reading", but

in the mid-nineteenth century the terms "new" or "word" method had a variable meaning in the United States: it might refer to the words-to-letters method of teaching the alphabet or to the words-to-reading, look-and-say, method of reading instruction. The criticism of the conventional method of teaching by the ABC's led by Mann, in 1837, and his endorsement of the word method was slow to be accepted in the United States.

Rice, a medical practitioner in New York City in the late nineteenth century wrote a book, The Public School System of the United States, in 1893, in which he observed that the methods employed in Chicago varied in the different schools. In some Chicago public schools the pupils were taught by the word method, in others by the sentence method, and in still others by a variety of methods, including phonics and word building. The Cook County Normal School, Englewood, Illinois, under the direction of Colonel Francis Parker, was singled out as the most progressive and successful.

Francis Parker, the founder of the Francis Parker School on the Near North Side of Chicago, and John Dewey, at the University of Chicago Laboratory School, used the "word method" as one of the features of the "Progressive" System of Education that developed in American elementary schools in the early 1900's. Despite the enthusiasm of educators for their new methods of teaching, the illiteracy rate

remained high. Among American soldiers enlisted in World War I, 24.9 per cent proved unable to read or write, and during World War II approximately the same percentage of British servicemen were found to be similarly handicapped. In 1940, one third of high school students were incapable of mastering reading and writing well enough to profit from textbook instruction and Dr. William S. Gray (1885-1960), a reading expert, found that one half of the adult population in the United States was "functionally illiterate" (Matthews, 1966).

Milford M. Matthews, who served from 1919 until 1925 as principal of high schools in Alabama and became associated with the University of Chicago in 1926, wrote about the public excitement over reading at that time, and the decline of faith in Progressive Education that involved the new analytical look-and-say method of teaching to read. Because of the widespread dissatisfaction with the reading results, a number of "phonic systems" of teaching were introduced.

Dr. Leonard Bloomfield (1887-1949), a linguist at the University of Chicago, was convinced that the word method or look-and-say was not soundly based on either linguistic or psychological principles. He felt that the method prevailed because of the inability of educators to cope with the illogical nature of English spelling and confusion about the basic nature of reading. He compiled a linguistic system of

reading with lists of monosyllabic words in which there were no inconsistencies of spelling. For example, one group of words involving short a were arranged by initial consonants as bad, bag, ban, etc., and by final consonants, bat, cat, hat, etc. Reading exercises were interspersed among the word lists. Experimentation with the Bloomfield System was continued in the Catholic schools of Chicago for ten or twelve years, and linguistic systems have been used in the remediation of dyslexic children.

Another method of teaching reading to be used later for remedial reading instruction was the modified alphabet system. Phonetic shorthand, invented by Sir Isaac Pitman in 1837, and consisting of a phonetic alphabet composed of characters called phonotypes, was used to teach reading and writing in so-called "Phonetic Schools." From 1852 to 1860, an experiment involving eight hundred pupils was made with the new method of teaching to read in phonotype in schools of Waltham, Massachusetts. After seven or eight months they were able to read so well in the new alphabet that they shifted without difficulty to material printed in traditional orthography (Matthews, 1966).

The success of phonotypy inspired the production of competing modified alphabets and aroused public interest in England, so that a Spelling Reform bill was introduced in Parliament in 1949 and was passed in 1953. It authorized research with a view to reading and eliminating the

widespread inability of the children of Great Britain to read their own language. An alphabet was prepared for use in this research and was published in The Times of London, May 29, 1959. Sir James Pitman, grandson of Sir Isaac, was the author of this Initial Teaching Alphabet, often abbreviated i.t.a.

Teachers who favor a word-method approach to initial reading find that i.t.a. words never vary in form. Capitals have the same forms as lower case letters; they are merely larger in size. Those who prefer a synthetic phonic approach discover that every letter in the i.t.a. represents a single individual sound; there is no confusion of the g in get and gem and there are no silent letters such as k in knife and g in gnat. However, the i.t.a. is not a synthetic phonics approach to reading but rather a teaching medium to supplement other methods (Downing, 1966).

In summary, there are three ways of teaching to read. The first and oldest method is the synthetic, sometimes called the "phonic" system, in which the beginner is taught letters and their sounds.

The second method is the analytic, a modern system, known since the close of the eighteenth century, but in widespread practice about 1900. Called the new method in the 1830's and the 1840's, later it was termed the word method, and later still the look-and-say method. In this method a child is taught to memorize words as a whole.

The third method is both analytic and synthetic, a mixed method of whole words supplemented with phonics instruction, sometimes called "gradual phonics" or a "phonic word-method".

Experiments designed to find how a child may best be taught to read have demonstrated clearly and statistically that phonics methods, in which letters and sounds are taught initially and persistently, give results superior to those obtained by other approaches (Matthews, 1966). Even among children with I.Q.'s in the eighties and nineties, reading failures were uncommon if a phonics approach was used from the beginning.

The methods advocated in the instruction of dyslexic children are different from those employed in the child without this handicap, although many incorporate the synthetic or analytic techniques. A multisensory approach in which visual and auditory channels were supplemented with kinesthetic and tactile senses was one of the first methods to be introduced.

Methods of Treatment of Dyslexia

Several different methods of treatment of dyslexia have been proposed since Orton, in 1929, emphasized the advantages of a "multisensory" over the look-say approach and his pupil, Gillingham with her associate Stillman, in 1940, outlined their multisensory method, sometimes called the Orton-Gillingham method.

The advocates of the multisensory approach, Gillingham (1940), Fernald (1943), Lehtinen (1947), and Cruickshank (1961), focused on determining a single best method of teaching all dyslexic children. The alternative approach to reading remediation was to stress the development of those prerequisite reading skills that are deficient in the affected child, stressing that inherent dysfunctions must be corrected before any academic training is given. Advocates of this remediation method include Delacato (1963) who introduced a neurological organization theory and motor training technique, Frostig (1964) and Kephart (1971) who favored a perceptual-motor regimen, and Kirk and Kirk (1971) who developed the psycholinguistic training method.

A "phonics" or "decoding" approach which teaches the child to master the relationship between the sound and the letter symbol, was preferred by some authorities (Spalding, 1957) over the "look-and-say", whole-word method for use in all dyslexic children, whereas others (Johnson and Myklebust, 1967) proposed a two-pronged approach with emphasis on phonics or on whole-word, look-and-say methods depending on the individual child's learning strengths and weaknesses. This method which capitalizes on the child's strengths in visual or auditory processing was emphasized as early as 1912 in the remediation of a case of congenital word-blindness reported by Hinshelwood in a 13 year old boy. His visual memory was poor and auditory memory good. The

boy's reading instruction had been by the look-and-say method which Hinshelwood considered unsuitable in children with visual memory deficits. Individual instruction outside the classroom, many short rather than one long reading lesson, and the block letter tactile approach were also suggested by Hinshelwood.

The use of colors for vowel sounds and whole words was introduced by Norrie (1960) and Gattegno (1962), and a linguistic approach, in which the emphasis in phonics is placed on the intonation of the word as a whole rather than the presentation of single letters and isolated phonemes, was devised by Fries (1962). Modified alphabet techniques, in which phonemes are represented by different characters and upper case letters are eliminated to reduce confusion, assured a regular correspondence between sound and symbol (Downing, 1965).

Technological innovations such as a talking typewriter developed by O.K. Moore (Johnson, 1969) and computer-assisted instruction (CAI) (Atkinson and Fletcher, 1972), combined the audio and visual presentation with coordinated tapes and film strips to teach reading. Reading laboratories, utilizing reading machines as well as conventional materials, permitted individual instruction in small carrels. Programmed reading materials were designed to be self-instructional and self-corrective, and reading systems employed a step-by-step process, providing materials

and directions to be used at varying rates to gain a specified reading skill. Other approaches to the remediation of dyslexia were psychological and medical, including the treatment with drugs and diet.

The plethora of reading approaches and reading materials suggests that the problem of dyslexia is heterogeneous, and no single method is likely to be successful in all cases. Research studies have indicated that the most important variables in successful reading programs is not the material, method, or approach, but rather the teacher who is interacting with the child (Lerner, 1976) and the so-called "Hawthorne effect" (Thomson, 1984). Anything which is new, involving additional attention given to subjects by enthusiastic teachers, would tend to result in an improved performance.

The Hawthorne effect was applied originally to improved workers' performance in an industrial center in Hawthorne, California, noted in response to a change in the environment lighting. It was discovered that when the lighting was improved, the performance of the workers went up. On closer examination, exactly the same effect of improved performance could be obtained when the lighting was decreased. The improved performance was not related to the lighting per se but rather to the fact that the environment was changed.

From this experience in industry, the term "Hawthorne

effect" was developed and applied also to the behavioral and educational fields. The term indicates that when the environment or experience is modified in a complex way, an indirect effect may be produced. In evaluating remedial methods for the treatment of dyslexia, this variable is highly relevant and difficult to control, particularly as many of the instructors are highly motivated and enthusiastic about the relative merits of their individual programs (Thomson, 1984).

Table IV lists various methods for the treatment of dyslexia with the references to the authors and the dates of their publications provided in a chronological order. The major advances in treatment of dyslexia have occurred in the past 45 years.

In the 1940's three multisensory methods, using visual, auditory, kinesthetic and tactile techniques, (VAKT), were developed, and the 1960's provided 18 new and diverse methods or approaches. Since 1970 the only additions to the therapeutic armamentarium for dyslexia have been in the fields of technology and neuropharmacology.

For the purpose of detailed description, the treatment methods may be grouped into six categories: 1) those that focus on a single so called "best method;" 2) treatments designed to remediate prerequisite reading readiness skills; 3) those that match the method to the individual pupil's learning strength and weakness; and 4-6) optometric and

Table IV. Methods of Treatment for Dyslexia.

Treatment Method	Author	Year
Multisensory (Phonetic-Kinesthetic)	Orton, S.T.	1937
Multisensory	Gillingham, A., and Stillman, B.	1940
Multisensory	Fernald, G.	1943
Multisensory	Strauss, E.W. and Lehtinen, L.	1947
Unified Phonics	Spalding, R.B.	1957
Psycholinguistic Training	Osgood C.E.	1957
Individualized Reading	Veatch, J.	1959
Synthetic Phonics with Colors	Norrie, E.	1960
Cruickshank's Multisensory	Cruickshank, W.M.	1961
Linguistic	Fries, C.C.	1962
Words in Color	Gattegno, C.	1962
Early Letter Emphasis	Barrett, T.C.	1963
Structural-Discovery	Stern, C.	1963
Language-Experience	Lee, D.M. and Van Allen, R.	1963
Neurological Organization	Delacato, C.	1963
Visual-Motor Training	Frostig, M.	1964
Modified Alphabet-i.t.a. (Initial Teaching Alphabet)	Pitman, J. Downing, J.	1959 1965
Color Phonics	Bannatyne, A.D.	1966
Neuropsychological	Johnson, D.J. and Myklebust, H.R.	1967
Neurological Impress	Heckelman, R.G. (Langford, et al.)	1969 (1974)
Distar	Englemann, S., and Bruner, E.C.	1969
Peabody Rebus	Woodcock, R.W., and Clark, C.R.	1969
Optometrics Visual	Mullins, J.B.	1969
Talking Typewriter (O.K. Moore)	Johnson, D.K.	1969
Behavior Modification	Wark, D.M.	1969
CAI (Computer Assisted Instruction)	Atkinson, R.C. and Fletcher, J.D.	1972
Medical - Drugs		
CNS Stimulants	Conners, C.K.	1972
Anticonvulsants	Fenelon, B. et al	1972
Anti-Motion Sickness	Levinson, H.N.	1980
-Megavitamins	Cott, A.	1972
-Additive-Free-Diet	Feingold, B.F.	1975
-Sucrose-Free-Diet	Gross, M.D.	1984
-Hypoallergenic Diet	Breneman, J.C.	1984

and medical (Table V).

1. The "One Best Method" Approach

This category includes some of the earliest programs of remediation involving multisensory approaches. These were developed on the premise that stimulation of visual, auditory, kinesthetic and tactile modalities of sensation would reinforce learning. They are often referred to as VAKT methods.

In learning a word in the VAKT techniques, the child (1) sees the word, (2) hears the teacher say the word, and (3) simultaneously says the word himself, traces it, and feels the muscle movement and touch sensation in his fingers (Lerner, 1976).

The Gillingham and Stillman method (1940) and the Fernald method (1943) are two approaches that emphasize the tactile and kinesthetic modalities. Both methods stress tracing, but whereas the Gillingham method uses the tracing technique to teach individual letters, the Fernald method presents the word as a total pattern to be traced as a whole word.

The Gillingham-Stillman Method. This method is based on the theoretical work of S. Orton (1937) and is often referred to as the Orton-Gillingham approach (Orton, J.L., 1966). The method stresses auditory discrimination abilities and phonics with supplementary use of kinesthetic and tactile sensations. When the child has covered the

Table V. Categories of Remedial Reading Methods.

<u>Category of Teaching Approach</u>	<u>Methods of Remedial Reading</u>
1. "One Best Method"	Multisensory Gillingham-Stillman Fernald Lehtinen Cruickshank Modified Alphabets i.t.a. Words in Color Rebus Distar Language-Experience Neurological Impress Individualized Reading Synthetic Phonics with Colors Linguistic Phonics Semantics
2. Prerequisite Reading Skills -Deficit Models	Kephart Perceptual Training Frostig-Horne Perceptual Training Doman-Delacato Neuro-Organization Psycholinguistic (ITPA)
3. Neuropsychological -Matching strengths and treatment of subtypes	Johnson and Myklebust Boder Mattis
4. Behavioral	Behavior Modification
5. Optometric	Visual, Laterality and Perceptual-Motor Training
6. Medical	Drugs, Megavitamins, and Diets

phonics program and has learned to read and write three-letter words, he is permitted to progress to sentences, stories, and independent reading. It is a highly structured approach requiring five lessons a week for a minimum of two years.

Critics of this approach (Gates, 1947; Dechant, 1970) have expressed concern about the rigidity of the teaching procedures, the tendency to belabor reading, and the lack of emphasis on comprehension. The importance of auditory word discrimination and phonics stressed this method precludes its application with dyslexic children who are dysphonetic (Boder, 1973) or weak in auditory perception (Johnson, 1978). While proponents of the Orton-Gillingham method consider it the best method for use with all dyslexic children, caution is suggested when considering this approach in children with deficits in auditory discrimination and sequencing abilities.

The Fernald Method. In the Fernald approach (1943), the process of remediation is in four stages: In stage I, the child is encouraged to select a word and then the multisensory approach is employed to facilitate learning. First, the word is written for the child with black crayon on firm paper. Then the child traces over the word with a finger and says the word out loud while tracing it. In order to increase the kinesthetic-tactile input, many teachers have the child write the word in clay with a stick and trace the indented letters with a finger. The words traced on paper are filed alphabetically in the child's "word box".

In stage II, the tactile component is discontinued and the child learns a new word by following the look-say-write

steps of stage I (VAK).

Stage III omits the kinesthetic component, requiring the child to learn new words by looking and saying them out loud. Finally, in stage IV, the child is able to recognize new words by their similarity to words that have been already learned.

Fernald based her approach to remediation by observation and work with Greek children who learned to read by finger-writing on a sand board. It has been referred to incorrectly as a kinesthetic approach when, in fact, it is multisensory, involving four modalities simultaneously (VAKT) (Hynd and Cohen, 1983). Fernald was also concerned with the emotional components of reading failure, emphasizing avoidance of emotionally laden situations and references to the child's specific problems and cultivating a positive attitude toward learning and a good self-image.

Advocates of the Fernald approach (Roberts and Coleman, 1958) stress the benefits of the kinesthetic-tactile input in children with visual-perceptual and visual-sequencing deficits (Boder's dyseidetic dyslexia group, 1973), and in those suffering from attention-deficit disorder characterized by hyperactivity, short attention span and distractibility (Ofman and Shaevitz, 1963; Harris, 1970). It was thought that the finger tracing functions as an attention-holding device that compels the child to attend to the task at hand, provided that the multisensory

stimulation does not overload the already over-aroused hyperactive child with dyslexia, thus increasing his distractibility (Johnson and Myklebust, 1967).

The Lehtinen Multisensory Method. Lehtinen based her methods of remedial education on Strauss's clinical and psychological findings in brain-injured children (1947). Such children are hyperactive, distractible, and abnormally reactive to the stimuli of their environment.

To achieve the environment she considers optimal, Lehtinen keeps the classroom group small, each child is seated at a distance from his neighbor, the room is devoid of all visually stimulating material, the windows covered, the teacher's dress plain and unornamented. She divests the child's materials of all but the barest essentials, even cutting away the borders of pictures and using covers over reading material to expose only a small area at a time (Myers and Hammill, 1969).

Having manipulated the situation to modify behavior, Lehtinen proceeds with teaching methods based on the child's disabilities. She believes the approach should be an attack on the organic disturbance rather than a psychotherapeutic approach to relieve emotional conflicts or an approach of stimulation intended to increase interest and motivation. She disagrees with the theory that a child should be developed in the areas of strength so that he can have a better sense of achievement. On the contrary she stresses

programs to develop the areas of weakness.

Lessons include motor activities - sorting, cutting, printing, or writing, and manipulating objects. For reading remediation, Lehtinen uses word and letter cards, letter puzzles, slotted covers to expose only one word or a sentence at a time. She considers reading to be primarily auditory, even when silent, and the beginning of phonetic instruction is entirely oral. Symbols are introduced only after the child can discriminate the sounds of letters and reproduce them in isolation.

When auditory discrimination has been achieved, the letter is presented as the visual symbol for the sound and is written down. A color is assigned to each vowel sound and an association between color and sound is taught. Lehtinen stresses an analytical rather than a global method of making a response to the whole word. The words are written on paper, letter by letter, using a stamping set or they are built from letter cards.

In conclusion, Lehtinen says that the teacher of brain injured children must be a therapist, must observe behavior, be cognizant of each child's personality and organic disturbances, devise preventative environmental controls, analyze the specific learning disabilities and prescribe appropriate remedial procedures.

Some authorities have questioned the Strauss and Lehtinen theory that an excess of incoming stimuli causes

hyperactivity, reporting that hyperactivity may in fact be decreased with increased visual stimulation (Gardner et al., 1959). Frey (1960) tested Lehtinen's techniques in reading and found them helpful for Strauss syndrome children. It is emphasized that these methods were devised with a particular type of child in mind - the hyperactive, distractible, brain-injured child. Many of the behavioral controls and highly structured perceptual training procedures would not be applicable to children with developmental dyslexia uncomplicated by hyperactive behavior syndromes.

The Cruickshank Method. Cruickshank, in 1961, published "A Teaching Method for Brain-Injured and Hyperactive Children" that was a modification of Strauss and Lehtinen's concepts and was based on an attempt to correct the disability.

The principles for a favorable teaching environment were listed as follows: 1) The reduction of unessential visual and auditory stimuli; 2) the reduction of environmental space; 3) a highly structured program; and 4) instructional materials with a high stimulus value, involving use of color. Reading is taught last because the other subjects, visual discrimination, auditory training, motor training, and writing, are thought of as prerequisites to the ability to read.

The Kirk principles (1966) with regard to reading readiness were incorporated by Cruickshank: 1) A mental age

of six years or more; 2) adequate language development; 3) memory for sentences and ideas; 4) visual memory and visual discrimination; 5) auditory memory and auditory discrimination; 6) correct enunciation and pronunciation; 7) motor ability; 8) visual maturity; and 9) motivation.

The teacher begins with visual motor training for hand preference, then the matching of letters, and finally whole words. At the same time, auditory perception training is introduced, proceeding to phonics, the learning of consonants and vowels, and then word families, sight words, color words, and words needed to follow simple directions.

Cruickshank felt that the organized multidisciplinary approach was most conducive to achievement, both academically and socially. Like that of Lehtinen, the method is probably suited only to the brain-injured child (Meyer and Hammill, 1969).

Modified Alphabets. The Initial Teaching Alphabet (i.t.a.) is the best known of the modified alphabets developed to simplify initial reading instruction (Downing, 1965). The i.t.a. consists of 44 characters, each representing a different phoneme. Phonemes in the conventional alphabet such as sh, ch, th, that have no letters of their own in traditional orthography, are given symbols while certain letters, for example, q and x, have been eliminated because they have sounds represented by other letters. Upper case letters are also eliminated. The

transition from i.t.a. to t.o. (traditional orthography) is planned after one year of instruction.

In the Words in Color (Gattegno, 1962) alphabet method, a single phoneme sound is represented by one color regardless of its spelling. A child learns the sound of the color "white" as a short "a", whether the spelling is a, au, or ai as in pat, laugh, or plaid. The short "u" as in up is yellow, and short "i" as in if is pink, and so forth.

The Rebus modified alphabet substitutes a picture or symbol for a printed word. In the Peabody Rebus Reading Program (Woodcock and Clark, 1969) for example, "be" is represented by a picture of a bumblebee and "in" is a black dot contained within a square.

In the Distar Reading System (Englemann and Bruner, 1969), symbol-action games and blending and rhyming tasks are used to teach skills such as right-left orientation and phonics, respectively.

Language-Experience Approach. The language-experience method correlates the development of reading skills with the ability to listen, speak, and write (Lee and Allen, 1963). The child tells a story, the teacher writes it down, and the child then reads it out loud. This approach is creative, motivating and dependent on the visual memory for words.

The Neurological Impress Method. This is a system of unison reading by the student and the instructor at a rapid pace (Heckelman 1969; Langford et al. 1974). The student

uses a finger to follow the words as they are read. The theory is that the feedback from the reader's voice simultaneous with the voice of the instructor establishes a new learning process.

Individualized Reading. With this method, each child in the classroom selects material of a personal interest and level and reads from books that are suited to individual needs and skills (Veatch, 1959). The method builds the child's enthusiasm and a positive attitude toward reading.

Synthetic Phonics With Colors. Norrie (1960) devised a "composition box" containing letters on blocks arranged phonetically. Vowels are printed in red, voiced consonants in green, and unvoiced letters in black. The child forms words and sentences from the letter blocks and copies them in a book after all mistakes have been corrected. Working with the composition box is reported to relieve the monotony of reading drills.

The Linguistic Approach. This is a decoding process differing from the phonics method in that the letters and sound equivalents are not present in isolation to be blended into whole words but the letters are embedded in words with regular spelling patterns so that the learner can make generalizations about the minimal contrast elements (Fries, 1962).

For example, words that use a consonant-vowel-consonant (CVC) pattern are presented as whole words, and

children are expected to learn the code by making generalizations through minimal contrasts of sounds in the words selected as follows: can, Nan, van; fan, Dan, pan.

These carefully selected, regularly spelled words are then strung together to make sentences (Bloomfield and Barnhart, 1963; Lerner, 1976): Nan can fan Dan; Can Dan Fan Nan?; Dan can fan Nan.

The linguistic approach emphasizes phonology, or the sound system of the English language, while the semantics or meaning of words are not stressed (Lerner, 1976).

Phonics Methods. Phonic systems, developed to overcome the inconsistent relationship between the letter and its sound equivalent in the English language, are featured as the initial approach to reading in Basal Reading Programs such as Basic Reading (J.B. Lipincott) and New Phonics Skill texts (Charles E. Merrill).

Advocates of the phonics or "decoding" approach consider printed English to be difficult for many children to decipher. The letter "a", for example, has a different sound in each of the following monosyllabic words: at, Jane, ball, was, saw, are. The long "i" sound is spelled differently in the words I, eye, tie, high, buy, sky, and rye. Examples of first grade sight words with irregular spelling patterns and their phonic spellings in parentheses are as follows: of (uv), was (wuz), is (iz), said (sed), and one (wun).

Critics of the phonics systems presented as a single "best method" for reading remediation point out that children with deficits in auditory discrimination are likely to have difficulty in learning through decoding approaches (Lerner, 1976).

2. Teaching Prerequisite Reading Skills.

The treatment methods within this category focus on the remediation of prerequisite reading readiness skills that are lacking in the individual child. Advocates of these approaches include Kephart (1960, 1971), Frostig (1964), and Delacato (1963).

The Kephart Perceptual Training Approach. Kephart and other perceptual motor theorists, like Frostig, based their training programs on the assumptions that visual-motor abilities are essential to cognitive development and academic success and the inadequate development of perceptual motor skills, if uncorrected by training, will prevent the child from effectively participating in reading instruction and other educational programs.

Kephart's three crucial perceptual skills to be mastered by the child as prerequisites to reading are form perception, spatial discrimination, and ocular control. If the child fails to develop these skills, he will be unable to make proper perceptual-motor matches of his environment, and, as a result, he will develop faulty intersensory integration abilities and concept formations (Kephart,

1971).

According to some critics of this method (Hynd and Cohen, 1983), the research evidence strongly questions the usefulness of the Kephart approach as a standard remedial reading technique in the schools. Not only has this approach been found ineffective in the remediation of reading disabilities and in the enhancement of reading skills, it has not even been demonstrated effective in the development of the perceptual-motor performance for which it was originally intended.

The Frostig-Horne Perceptual Training Approach.

Marianne Frostig (Frostig and Horne, 1964) maintains that adequate perceptual functioning in young children is an important foundation on which later school success is dependent. She believes that visual perceptual problems will be most apparent in the learning-to-read process.

Eye-hand coordination, figure-ground, form constancy, position in space, and spatial relations are visual perception skills measured in the Frostig Developmental Test of Visual Perception and contained in worksheets of the Frostig Developmental Program in Visual Perception.

Examination of studies that evaluated the effects of the Frostig-Horne program on reading skill development failed to demonstrate a consistent beneficial effect (Hammill et al., 1974). The authors concluded that the use of the Frostig-Horne program as a supplement to traditional

readiness activities or as a method for facilitating the mastery of reading or remediating dyslexia does not appear to be warranted.

The Doman-Delacato Neurological Organization Approach.

According to the Doman-Delacato theory (Delacato, 1963) neurological development must proceed in a sequential fashion if a child is to attain normal psychomotor and linguistic skills. It proposed that ontogenetic neural development recapitulates the phylogenetic development of the human nervous system and develops in a rostral or upward fashion from the spinal cord to the medulla, the pons, midbrain, and finally, the cortex of the brain.

Delacato postulated that the attainment of lateralized cerebral dominance was the highest form of neurological development, and that mixed laterality (e.g. left-footed, right-handed, and left-eyed) is evidence of poor neurological organization. At the cortical level, neurological organization is evaluated by observing whether the child walks with good balance, smoothly and rhythmically, and in a cross-pattern manner (i.e. extending the right arm with the left leg). At the midbrain level, the Delacato evaluation involves smooth and rhythmic cross-pattern creeping and smooth eye-movement while visually tracking an object. Finally, at the level of the pons, a right-side dominance is thought to be correlated with the tendency to sleep on the abdomen with the head turned to the

left and the left arm and leg flexed. The left dominant child is said to sleep in the exact opposite position.

Children with reading problems are tested until the lowest level of incomplete neurological organization is determined. Treatment is based on the training of those activities incompletely developed, beginning with the lower-order and proceeding to the higher-order or level of organization. The child is assisted in performance of the creeping and crawling techniques if necessary by passive manipulation of the limbs by a therapist or trained parent. The goal of treatment is to provide the child with the opportunity for an uninterrupted development of complete neurological organization and to promote the attainment of lateralized cerebral dominance.

The Doman-Delacato approach to remediation of reading and learning problems has been criticized both from the theoretical and experimental standpoints (Hynd and Cohen, 1983). The results of research studies (Glass and Robbins, 1967) have seriously questioned the validity of this treatment approach in the remediation of reading disabilities or other learning disorders.

The Psycholinguistic Approach. Psycholinguistics is the study of the psychological functions and interactions involved in communication (Hammill and Larsen, 1974). According to Hammill and Larsen, psycholinguistic training is based on the assumption that discrete elements of the

language behavior are identifiable and measurable and may be remediated if defective so that learning may be improved.

The Illinois Test of Psycholinguistic Abilities (ITPA), a diagnostic battery designed by Kirk, McCarthy, and Kirk (1968), is composed of 12 subtests that measure the specific communication functions required in major academic areas. The ITPA model of remediation, developed by Kirk and Kirk (1971) and used widely in public schools as a remedial program for reading disabled children, assumes that a deficit in a given subtest of the ITPA should be corrected as a prerequisite to reading instruction.

A comprehensive review of several studies that evaluated the effectiveness of psycholinguistic training methods has demonstrated that the ITPA subtests fail to adequately correlate with the achievement scores in reading, spelling, and arithmetic and that the effectiveness of the ITPA training program for reading remediation has not been conclusively demonstrated (Hammill and Larsen, 1974). In the opinion of Hynd and Cohen (1983), based on their review of the research data available, the psycholinguistic approach to the remediation of dyslexia is unwarranted.

All techniques based on deficit remediation may be doomed to failure since they are based on training or retraining of damaged or dysfunctional areas of the brain (Hartlage, 1981). Other explanations proposed by Hartlage for the lack of validation of the deficit models of

remediation are the failure to recognize and treat distinct subgroups of dyslexic children among a heterogeneous diagnostic group, and the emotional stress, poor self-concept, and negative attitudes toward reading and school in general that develop as a result of the emphasis on weaknesses rather than strengths in learning. Alternatives to the deficit remediation methods are those that determine each child's intact areas of neurological functioning and match cognitive neuropsychological strengths with a teaching strategy designed to exploit these strengths (Category 3).

3. Matching Learning Strengths and Teaching Method

This matching method, sometimes termed the neuropsychological approach to reading remediation, is favored by Johnson and Myklebust (1967), Boder (1971) and Mattis (1981).

The first step in this approach involves the assessment of the child's cognitive neurological abilities by employing a psychological battery of tests appropriate for the child's age. The Reitan-Indiana Battery is suggested for the 5-to 8-year old range, the Halstead Battery for the 9-to 14-year-old range, and the Lerria-Nebraska Battery for children in the 8- to 12-year-old range (Hynd and Cohen, 1983). The Wechsler tests of Intelligence (WPPSI or WISC-R) and the Wide Range Achievement Test (WRAT) are administered along with the neuropsychological test batteries. The second step in the neuropsychological

approach is to match the child's cognitive strengths with a remedial reading method directed toward these abilities.

Johnson and Myklebust (1967) recognize two main subtypes of dyslexia, "visual dyslexia" and "auditory dyslexia". For children with visual dyslexia, who have a central nervous system dysfunction that impairs visual discrimination and memory for words, the Gillingham and Stillman (1940) synthetic phonics method is recommended whereas the auditory dyslexic group of children, who have difficulties with auditory discrimination and phonetic analysis, are thought to respond best to a whole word or look-and-say method of reading remediation.

Boder (1971) has described a "dysphonetic" subtype of dyslexic children with an inability to develop phonetic skills, and a "dyseidetic" group with a primary deficit in the ability to perceive whole words visually as gestalts. Those with a combination, dysphonetic-dyseidetic, disability are referred to as "alexia."

The dysphonetic dyslexic children with strengths in visual perception are matched with a whole word method of reading remediation, whereas the dyseidetic group with intact auditory perception are taught phonetically. In the alexic group, a remedial approach with emphasis on the tactile-kinesthetic sensory channels is recommended.

The response to these teaching methods and prognosis varies with the type of dyslexia. According to Boder's

observations, the dysphonetic child will approach normal proficiency in contextual reading since he can acquire a sight vocabulary at grade level but he will not develop word-analysis skills and his spelling tends to be poor. The dyseidetic child spells relatively well but reads slowly, does not achieve a sight vocabulary commensurate with grade level, and the prognosis for reading is not as good as that of the dysphonetic subtype. For those children with deficiencies in both visual and auditory perception, the alexic group, the prognosis is guarded, none of them having achieved proficiency in reading at the high school level.

Mattis (1981) has also advocated a variety of neuropsychological methods for the remediation of three subtypes of dyslexia. In one group, termed the "language-disorder syndrome", manifested by anomia and deficits in verbal learning, the acquisition of a look-say vocabulary is difficult and a teaching method using letter-sound associations and synthetic phonics is advised. A second "articulation and graphomotor dyscoordination" group is deficient in phonetic word-attack skills and should be responsive to a whole-word, look-say approach. The third subgroup identified by Mattis, the "visuospatial-perceptual disorder" group, is first taught letter recognition, by having the child describe and draw letters, as a prelude to a phonetic program of reading remediation.

Although the neuropsychological approach to the

remediation of dyslexic children appears to be theoretically sound (Hartlage and Reynolds, 1981), the validation of this method remains to be accomplished (Hynd and Cohen, 1983). One variable in the use of the neuropsychological approach involves motivational improvement and confidence building, a factor that is difficult to assess and one that may be linked to socioeconomic status (Miller, 1977), an additional variable to be considered in the evaluation of remediation methods.

Dyslexic children often come to the remedial setting after several years of frustration due to poor academic success in the regular classroom. The child's self concept will be poor, and he may have behavior problems with attention-deficit disorder and hyperactivity. As a result, a reconditioning period is often used prior to the introduction program, during which appropriate classroom behavior and self-concept development are emphasized. In order to accomplish these goals as well as to maintain motivation in reading, behavior modification methods are employed (Hynd and Cohen, 1983; O'Leary and O'Leary, 1976).

4. Behavior Modification Approach.

Specified, observable, and measurable behavioral objectives are set, and the environmental stimuli are then structured to modify the child's behavior and attain the desired objective. Wark (1969) experimented with a behavior-modification technique for teaching reading skills

and found it of value in the phonics approach and improvement of oral reading. Willis et al. (1972) reported the beneficial effects of immediate rewards with colored plastic chips and their exchange for toys on remedial reading progress, employing students as the tutors or "behavioral engineers." Langford and Johnson (1974) described a method of behavior modification for teaching children with severe reading problems in which each word correctly pronounced has a dot placed over it by the tutor. The number of dots is totaled, points are given and later exchanged for some tangible reward, for example, candy, field trips, etc. Accuracy, not rate of reading, is stressed.

In the behavior modification method, a reinforcement is found that will accelerate a child's rate or accuracy of performance on a given task. When performance is accurate, the reinforcer is increased and when an error is made the reinforcer is decreased. The importance of an objective record of the child's performance or behavior is stressed, and a graph or chart is used to record daily observations and scores.

Reinforcers can be tangible rewards such as candy or toys, a token to be exchanged later for a privilege or outing, or simply a word of praise or sign of approval from the teacher or parent. The appropriate reinforcer is the one that interests and motivates the individual child to

improve his performance (Lerner, 1976). Some commercial materials such as the Distar reading system (Engelmann and Bruner, 1969) incorporate elements of the behavioral approach.

5. Optometric Training Methods.

Optometric training programs for the remediation of dyslexia and learning disabilities use a wide variety of techniques based on visual exercises (Goldberg and Arnott, 1970), the neurological organizational training program of Doman and Delacato (1966), and the Kephart perceptual-motor training programs (1971).

In 1879, Emile Javal, a French oculist, published a paper on the psychology of reading in which he pointed out that as one reads the eyes do not sweep smoothly along the line of print but advance by "jumps" or "fixes" (Matthews, 1966). Unfortunately, the use of this finding in teaching to read by eye-movement training failed to demonstrate any lasting benefit (Mullins, 1969; American Academy of Pediatrics, 1984).

The American Academy of Pediatrics, in conjunction with the American Association for Pediatric Ophthalmology and Strabismus and the American Academy of Ophthalmology, issued a policy statement (1984) regarding the optometric training methods proposed for the remediation of dyslexia and learning disabilities which read in part as follows:

No known scientific evidence supports claims for

improving the academic abilities of dyslexic or learning disabled children with treatments based on (a) visual training, including muscle exercises, ocular pursuit or tracking exercises, or glasses (with or without bifocals or prisms); or (b) neurologic organizational training (laterality training, balance board, perceptual training).

6. Medical Treatments.

Central nervous system stimulants, anticonvulsants, and anti-motion sickness drugs have been advocated in the management of children with dyslexia and other learning problems. Megavitamins and additive-free diets have also been proposed.

The stimulant drugs, Ritalin, Cylert, and Dexedrine, may improve reading performance in a hyperactive child by modifying behavior, reducing distractibility and impulsiveness, and increasing the span of attention. In a multi-clinic trial of Cylert in a total of 413 children with hyperactive behavior syndromes, the reading grade score, as measured by the Wide-Range Achievement Test (WRAT), showed a 0.45 mean gain after nine weeks of treatment with the drug compared to a mean gain score of only 0.17 in the placebo-treated group. The difference was statistically significant (Conners, 1972).

Conners (1973) has cautioned that drugs by themselves do not teach anything. The child still needs continued

attention to educational inputs. In dyslexic children who are hyperactive, the stimulant medications may be of benefit but only as an adjunct to educational methods. A report of the effectiveness of coffee, a stimulant beverage, in the treatment of hyperactivity, was not confirmed by controlled studies.

Anticonvulsant drugs are indicated in the treatment of an interesting but rare syndrome called "reading epilepsy" (Bickford and co-workers, 1956). Patients with minor epileptic seizures have been described whose attacks are precipitated by reading. The "absence" seizures and associated interruptions in the fluency of reading may be controlled by antiepileptic drug treatment. Nitrazepam (Mogadon), an anticonvulsant-sedative drug, tested for its effects on perceptual difficulties of dyslexic children, was found to improve their ability to respond to flashes of light by pressing a switch. The effect of the drug on reading scores was not determined (Fenelon and Wortley, 1973).

Anti-motion sickness medications, Antivert and Dramamine, for the treatment of dyslexia, have been proposed on the basis of a theory that a cerebellar-vestibular dysfunction and resultant dysmetria is the underlying cause (Levinson, 1980). Although some children with dyslexia have been found to have symptoms and signs of vestibular dysfunction, the claims of benefit from anti-motion sickness

drugs have not been validated (Hynd and Cohen, 1983).

Megavitamin therapy used in the practice of orthomolecular psychiatry consists of large doses, considerably greater than the recommended daily allowance, of the B vitamins, especially nicotinamide, vitamin C, and various minerals. Cott (1972) reported that this treatment was effective in children with learning disabilities, but others have concluded that megavitamins are ineffective in the management of attention deficit disorders and should not be used because of their potential liver toxicity (Haslam and co-workers, 1984).

Among dietary therapies proposed for the treatment of learning and behavior disorders, the additive-free diet of Feingold (1975) received the greatest following and publicity in the lay press but little support from the scientific community. The claim that food additives, salicylates and coloring agents were a major cause of hyperactivity and learning disabilities, when tested by double-blind controlled studies and additive-containing challenge foods, was not supported to the extent publicized by Feingold.

The evidence suggests that perhaps 10 per cent of hyperactive children react adversely to food additives and may be benefitted by the additive-free diet. Children of preschool age seem to be more susceptible than school-age children (Wurtman and Wurtman, 1979). The influence of food

additives and an additive-free diet on dyslexic children without hyperactivity has not been evaluated.

Another diet-related theory of the cause of learning and behavior disorders suggests that many children are reactive to the ingestion of sugar-containing foods, responding with hyperactivity and lack of concentration. Consumer groups, including parent advocates of the Feingold diet, have expressed concern that sugar intake induces hyperactivity by leading to hypoglycemia (low blood sugar) with associated alterations in cognitive abilities (Rumsey and Rapoport, 1983).

The results of a controlled study in 50 hyperkinetic children, whose mothers had volunteered that they "knew" or were "sure" that their hyperactivity and general behavior were much worse, when they had eaten foods containing sugar (sucrose) showed no differences in behavior after ingestion of a large challenge dose of sucrose compared with saccharin (Gross, 1984). The author concluded that hypersensitivity to sucrose may lead to adverse behavior, but this reaction appears to be an uncommon condition. No specific studies of the effects of sugar in dyslexic children are available.

Allergists have theorized that disturbances of behavior may be caused by allergies to foods in certain individuals born with an inherited tendency to foreign protein sensitivity (Breneman, 1984). The foods most commonly implicated are milk, eggs, orange, wheat and corn.

The affected children are described as "nervous" and their school work is poor because of distractibility and memory impairment. Removal of the offending foods by a trial of an elimination diet is the treatment advocated. A recent study that linked dyslexia and associated brain malformations to immune diseases including allergies lends support to this theory and the need for further trials of antigen-free diets in therapy (Galaburda et al., 1985).

CHAPTER V

DISCUSSION

The diversity of definitions, causes, and methods of treatment described in this thesis on dyslexia emphasizes the heterogeneous nature of the condition and the confusion among experts regarding the optimal approaches to its management. Agreement on the limiting characteristics of the definitions has to be obtained if valid estimates of its prevalence are to be made and if teachers, psychologists, and neurologists, and those responsible for the diagnosis and educational programs are to communicate meaningfully with each other.

Early workers in dyslexia carefully distinguished between specific reading disability and reading failure attributable to more general factors, such as mental retardation, educational and cultural deprivation, visual or hearing defects, and emotional and behavior disorders, that might explain the reading disability. More recently, authorities such as the World Federation of Neurology, have formulated definitions that emphasize the unique and specific nature of dyslexia as a clinical entity of constitutional or developmental origin. These definitions are based on the exclusion of inadequate classroom

experience, subnormal intelligence, and sociocultural deprivation.

Criticisms of some presently accepted definitions have alluded to the ambiguity of the restrictive terms such as "conventional instruction" and "adequate intelligence" (Rutter, 1978). The extreme variability of schools requires assurance that a child has received exposure to competent reading instruction before he is labelled dyslexic. If adequate intelligence is interpreted as an I.Q. of 90 or above, then children with I.Q.'s less than 90 not considered dyslexic would exclude from the definition many intellectually subnormal children who read at a level significantly lower than their mental age. This criterion would also ignore the possibility that the impaired intellectual development of the child may itself be the consequence of the reading disability.

The restriction, "despite adequate sociocultural opportunity," does not take into account immigrant children from Spanish, Polish or other foreign language speaking families who may be proficient in the vocabulary of their native country but are deficient in the English language, a deterrent to reading achievement in the schools of the United States. The reference to "intact senses" excludes children who are hard of hearing or visually handicapped, and yet, a moderate to mild sensory loss has little if any effect on the ability to read, provided that the handicap is

recognized and dealt with appropriately. Perceptual defects, important in the mechanism of dyslexia and related to brain or central dysfunctions, must be distinguished from peripheral visual and auditory sensory handicaps (Eisenberg, 1978).

In their concern to ensure for the purpose of research that specific developmental dyslexia or specific reading disability was not confused with reading failure, professional and scientific workers have used exclusionary criteria in their definitions that may deny a large number of children the benefits of remedial reading instruction. In a modified definition that may meet both research and practical needs, Eisenberg (Eisenberg, 1978) has proposed that:

Specific developmental dyslexia should be diagnosed when individually administered reading and intelligence tests given by competent examiners reveal a severe performance deficit (greater than two standard errors of prediction) between the obtained reading level and that expected on the basis of age and intelligence in a child who has received reading instruction in his native language in kind and amount ordinarily sufficient for his peers.

This definition makes no assumption of homogeneity in the causes and mechanisms of reading disabilities. In studies of the clinical features and remedial programs in

dyslexic children, results will need to be reported separately for those with and without additional handicaps, in order to permit the identification of specific syndromes within the heterogenous group and to make comparisons of the response to treatment. Factors in the causation of dyslexia uncovered by future research should allow more specific definitions and more precise methods of remediation.

The search for these more precisely defined syndromes is exemplified by the differentiation of the "visual" and "auditory" dyslexics made by Johnson and Myklebust (1967), the "dysphonetic" and "dyseidetic" groups of Boder (1971), and the "language-disorder," "graphomotor dyscoordination," and "visuo-spatial-perceptual disorder" groups of Mattis (1981). These classifications have obvious implications for the choice of remedial teaching programs and might lead to a better understanding of causation of dyslexia.

To investigate causation, it will be necessary to relate these various dyslexic syndromes to the neurological status of the child, as assessed by the prenatal, birth, and early childhood developmental histories, familial and genetic factors, and the results of special tests. The localization of specific lesions in the brain of some children with dyslexia has been determined by the use of the computerized tomography scan and the electroencephalogram, and a suspected neurological basis for specific developmental dyslexia has been confirmed by

neuropathological studies in isolated cases.

If the syndrome of dyslexia viewed as a heterogeneous entity with multiple etiologies is accepted, then each subgroup of dyslexia will require a unique treatment approach. Methods based on the child's neurologically intact functional systems are now favored over those directed toward dysfunctional abilities. The so-called neuropsychological approaches to remediation seem to offer the best likelihood of success but the research literature is, at present, scant and limited to case-study material.

In order to validate these theories and methods of treatment, large-scale, longitudinal studies will be necessary, employing subjects grouped according to the precise criteria accepted in the definition of each subtype of dyslexia. The nature of the treatment must be described in detail and carried out by professionals who are adequately trained so that replication of the approach is possible (Benton and Pearl, 1978; Hynd and Cohen, 1983).

Finally, in the voluminous literature on treatment, research in prevention of dyslexia has received little attention and few confirmations of those theories suggested. The theory of left-handedness and mixed dominance in the causation of dyslexia prompted methods to facilitate the development of strong laterality with the object of preventing dyslexia. The modern view is that poorly developed laterality and reading defects are both due to an

underlying brain malformation (Galaburda et al. 1985) or cerebral maturational lag (Zangwill, 1962), and training toward fixed laterality is an unlikely preventive treatment for dyslexia. The Delacato method of neurological reorganization to promote the attainment of lateralized cerebral dominance has been discredited as a valid treatment or preventive approach to reading disabilities or other form of learning disorder.

Some approaches to teaching of reading have been blamed for the development of reading difficulties, and, for example, the avoidance of the look-and-say approach is suggested in the prevention of dyslexia (Mathews, 1966). The early recognition of a child's perceptual strengths and weaknesses and the introduction of the appropriate neuropsychological approach in initial reading instruction should offer a successful preventive measure. An alert teacher who can diagnose the early signs of dyslexia is the key to the success of the preventive method. The sooner the services of a reading specialist are obtained, the better the likelihood of a favorable outcome (Frostig and Maslow, 1973).

Preventive measures directed toward a neurological cause such as cerebral malformation involve basic research in the mechanisms underlying cerebral reorganization during fetal life (Galaburda et al., 1985). These authors suggest that diseases of the immune system may cause malformations

of the cerebral cortex, and the male predominance of dyslexia involves hormonal effects in utero that may enhance the immune anomalies. Greater knowledge of the exact mechanisms of factors concerned with early cerebral maturation may offer new avenues of prevention and treatment of specific developmental dyslexia and related learning disabilities.

Historically, many definitions and various theories of causation and methods of treatment for dyslexia have been proposed since Berlin first coined this term in 1887 and Hinshelwood developed the concept of congenital word-blindness in the late nineteenth and early twentieth centuries. Specialists in a number of different disciplines have approached the problem, each from their own viewpoint and area of training. A single specific cause, if such is the answer to the problem, has eluded extensive research for almost a century. Despite considerable advancement in the understanding of dyslexia, a general consensus on definition, cause, and remediation methods has not been reached.

REFERENCES

- American Academy of Pediatrics. Committee on Children with Disabilities, Statement on Learning Disabilities, Dyslexia, and Vision. Pediatrics, 74: 150, 1984.
- American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, ed. 3. Washington, D.C., 1980.
- Atkinson, R.C., and Fletcher, J.D.: Teaching children to read with computers. Reading Teacher, 25: 319, 1972.
- Bakwin, H.: Reading disability in twins. Dev Med Child Neurol, 15: 184, 1973.
- Bannatyne, A.D.: The aetiology of dyslexia. Slow Learn Child, 13: 20, 1966.
- Barrett, T.C.: Visual discrimination tasks as predictors of first grade reading achievement. Reading Teacher, 18: 276, 1965.
- Bax, M., and MacKeith, R. (Eds.): Minimal Cerebral Dysfunction, London, National Spastics Society and William Heinemann Medical Books Ltd, 1963.
- Belmont, L., and Birch, H.G.: Lateral dominance, lateral awareness, and reading disability. Child Dev, 36: 57, 1965.
- Benaron, H.B.W., Tucker, B.E., Andrews, J.P., Boshes, B., Cohen, J., Fromen, E., and Yacorzynski, G.K.: Effect of anoxia during labor and immediately after birth on the subsequent development of the child. Amer J Obstet Gynecol, 80: 1129, 1960.
- Bender, L.: Specific reading disability as a maturational lag. Bull Orton Soc, 7: 9, 1957.
- Benson, D.F., and Geschwind, N.: Developmental Gerstmann syndrome. Neurology, 20: 293, 1970.
- Benton, A.L, and Joynt, R.J.: Early descriptions of aphasia. AMA Arch Neurol, 3: 205, 1960.

- Benton, A.L.: Dyslexia in relation to form perception and directional sense. In Money, J. (Ed.): Reading Disability. Progress and Research Needs in Dyslexia. Baltimore, The Johns Hopkins Press, 1962.
- Benton, A.L. and Pearl, D.: Dyslexia. An Appraisal of Current Knowledge. New York, Oxford Univ Press, 1978.
- Berlin, R.: Eine besondere Art der Wortblindheit (Dyslexia). Wiesbaden, 1887 (Critchley, 1964).
- Bickford, R.G., Whelan, J.L., Klass, D.W., and Corbin, K.B.: Reading epilepsy: clinical and electroencephalographic studies of a new syndrome. Trans Amer Neurol Ass, 1956, pp. 100-102.
- Bloomfield, L. and Barnhard, C.L.: Let's Read, Part I. Bronxville, N.Y., C.L. Barnhart, 1963.
- Boder, E.: Developmental dyslexia: Prevailing diagnostic concepts and a new diagnostic approach. In Myklebust, H. (Ed.), Progress in Learning Disabilities. New York, Grune and Stratton, Inc., 1971.
- Boder, E.: Developmental dyslexia. Prevailing concepts and a new diagnostic approach. Bull Orton Soc, 23: 106, 1973.
- Breneman, J.C.: Basics of Food Allergy, 2nd Ed. Springfield, Charles C. Thomas, 1984.
- Broadbent, W.: Cerebral mechanisms of speech and thought. Trans Roy Med Chir Soc, 55: 145, 1872.
- Broca, P.: Sur la faculté du langage articulé. Bulletin de la Société d'Anthropologie, 6: 493, 1865.
- Brown, J.R., and Simonson, J.: A clinical study of 100 aphasic patients. 1. Observations on lateralization and localization of lesions. Neurology (Minneap.), 7: 777, 1957.
- Brown, J.R., Darley, F.L., and Gomez, M.R.: Disorders of communication. Ped Clin N Amer, 14:725, 1967.
- Burt, C.: The Backward Child, 3rd ed., London, Univ. London Press, 1950.
- Clairborne, J.H.: Types of congenital symbol amblyopia. JAMA, 47: 1813, 1906.
- Claparede: Bradylexie bei einem sonst normalen Kinde, XI

- Meeting Swiss Neurol Soc May 13 and 14, 1916, Abs Neur Ztbl, 36: 572, 1917 (Critchley, 1964).
- Clark, R.W.: Einstein. The Life and Times. New York, The World Publishing Company, 1971.
- Clements, S.D.: Minimal Brain Dysfunction in Children. United States Public Health Services Publications 1415 and 2015, 1966, 1969.
- Conners, C.K.: The syndrome of minimal brain dysfunction: Psychological aspects. Ped Clin N Amer, 14:749, 1967.
- Conners, C.K.: What parents need to know about stimulant drugs and special education. J Learn Disabil, 6: 349, 1973.
- Conners, C.K.: (Ed.): Clinical Use of Stimulant Drugs in Children. Proceedings of a symposium held at Key Biscayne, Florida, 5-8 March 1972. Amsterdam, Excerpta Medica, 1974.
- Connors, C.K., Goyette, C., Southwick, D.A., Lees, J.M., and Andrulonis, P.A.: Food additives and hyperkinesia: A controlled double-blind experiment. Pediatrics, 58: 154, 1976.
- Cott, A.: Megavitamins: The orthomolecular approach to behavioral disorders and learning disabilities. Acad Ther, 7: 245, 1972.
- Critchley, M.: Inborn reading disorders of central origin. Trans Ophthalmol Soc UK, 81: 459, 1961.
- Critchley, M.: Developmental Dyslexia. London, William Heinemann Medical Books Ltd., 1964.
- Cruickshank, W.M.: A Teaching Method for Brain Injured and Hyperactive Children. Syracuse, N.Y., Syracuse University Press, 1961.
- Cruickshank, W.M.: The Brain Injured Child in Home, School and Community. Syracuse, N.Y., Syracuse University Press, 1967.
- Darley, F.L., Brown, J.R., and Gomez, M.R.: Disorders of communication. Ped Clin N Amer, 14:725, 1967.
- David, O., Clark, J., and Voeller, K.: Lead and hyperactivity. Lancet, 2: 900, 1972.
- Dearborn, W.F.: Ocular and manual dominance in dyslexia.

- Psychol Bull, 28: 704, 1931.
- Dechant, E.V.: Improving the Teaching of Reading. Englewood Cliffs, Prentice-Hall, 1970.
- Dejerine, J.: Contribution a l'étude anatomo-pathologique et clinique des différents variétés de cécité verbale, Comp rend scean soc biol, 4: 61, 1892 (Critchley, 1964).
- Delacato, C.H.: The Diagnosis and Treatment of Speech and Reading Problems. Springfield, Ill., Charles C. Thomas, 1963.
- Delacato, C.H.: Neurological Organization and Reading. Springfield, Ill., Charles C. Thomas, 1966.
- Dodge, P.R., Prensky, A.L., and Feigin, R.D.: Nutrition and the Developing Nervous System. Saint Louis, C.V. Mosby Company, 1975.
- Downing, J.: The i.t.a. reading experiment. Chicago, Scott, Foresman, 1965.
- Downing, J. The initial teaching alphabet. In Downing, J. (Ed.) The First International Reading Symposium. New York, Day, 1966.
- Drake, W.E.: Clinical and pathological findings in a child with a developmental learning disability. J Learn Disabil, 1: 486, 1968.
- Dreikurs, R.: Emotional predispositions to reading difficulties. Arch Pediatr, 71: 339, 1954).
- Duane, D.D.: A neurologic overview of specific language disability for the non-neurologist. Bull Orton Soc, 24: 22, 1974.
- Early to Read. Initial Teaching Alphabet Publications, Inc., Pitman Publishing Corp., 1967.
- Eisenberg, L.: Definitions of dyslexia: Their consequences for research and policy. In Benton, A.L., and Pearl, D.: (Eds.) Dyslexia. An Appraisal of Current Knowledge. New York, Oxford University Press, 1978.
- Englemann, S., and Brunner, E.C.: Distar Reading I and II: An Instructional System. Chicago, Science Research Association, 1969.
- Engler, B.: Uber analphabetia partialis: (kongenitale Wortblindheit) Monat Psych Neur, 42: 119, 1917.

- Evans, M.M.: Dyslexia. An Annotated Bibliography. Westport, Conn., Greenwood Press, 1982.
- Eustis, R.S.: The primary etiology of the specific language disabilities. J Pediatr, 31: 448, 1947.
- Eustis, R.S.: Specific reading disability. High incidence of ambidexterity, left-handedness, and speech defects in child and family. N Engl J Med, 237: 243, 1947.
- Feingold, B.F.: Why Your Child is Hyperactive. New York, Random House, 1975.
- Fenelon, B., Holland, J.T., and Johnson, C.: Spatial organization of the EEG in children with reading disabilities: a study using nitrazepam. Cortex, 8: 444, 1972.
- Fenelon, B., and Wortley, S.: Effect of auxiliary acoustic stimulation on two-flash fusion thresholds of reading disabled children: a study using nitrazepam. Percept Mot Skills, 36: 443, 1973.
- Fernald, G.M.: Remedial Techniques in Basic School Subjects. New York, McGraw-Hill, 1943.
- Foerster, R.: A propos de la pathologie de la lecture et de l'écriture (cécité verbale congénitale chez un débile). Rév neur, 12: 200, 1904.
- Frey, R.M.: Reading behavior of brain injured and non-brain injured children of average and retarded mental development. Unpublished doctoral dissertation. University of Illinois, 1960.
- Fries, C.C.: Linguistics and Reading. New York, Holt, Rinehart and Winston, 1962.
- Frostig, M., and Horne, D.: The Frostig program for the development of visual perception. Chicago, Follett Publishing Co., 1964.
- Frostig, M. and Maslow, P.: Learning Problems in the Classroom: Prevention and Remediation. New York, Grune and Stratton, 1973.
- Galaburda, M.A., Sherman, G.F., Rosen, G.D., Aboitiz, F., and Geschwind, N.: Developmental dyslexia: Four consecutive patients with cortical anomalies. Ann Neurol, 18: 222, 1985.
- Galaburda, A.M., Signoret, J.L., and Ronthal, M.: Left

- posterior angiomatous anomaly and developmental dyslexia: report of five cases. Neurology (Cleveland), 35 Suppl: 198, 1985.
- Gallagher, J.R.: Specific language disability: cause of scholastic failure. N Engl J Med, 242: 436, 1950.
- Gallagher, J.R.: Specific language disability (Dyslexia). Clin Proc Children's Hospital, Boston, 16: 1, 1960.
- Gardner, W.I., Cromwell, R.L., and Foshee, J.G.: Studies in activity level. II Visual. American J Ment Deficiency, 63: 1028, 1959.
- Gates, A.I.: The Improvement of Reading. (3rd ed.) New York, MacMillan, 1947.
- Gattegno, C.: Words in Color. Chicago, Learning Materials, 1962.
- Gerstmann, J.: Syndrome of finger agnosia, disorientation for right and left, agraphia and acalculia. Arch Neurol Psychiat, 44: 393, 1940.
- Gillingham, A., and Stillman, B.: Remedial Training for Children with Specific Language Disability in Reading, Spelling and Penmanship. (Reprinted 1966), Camb. Mass., The Educator's Publishing Service, Inc., 1956 (Also, New York, Sackett and Wilhelms, 1940).
- Glass, G.V., and Robbins, M.P.: A critique of experiments on the role of neurological organization in reading performance. Reading Research Quarterly, 3: 5, 1967.
- Goertzel, V., and Goertzel, M.G.: Cradles of Eminence. Boston, Little, Brown, 1962.
- Goldberg, H., and Arnott, W.: Ocular motility in learning disabilities. J Learn Disabil, 3: 160, 1970.
- Gross, M.D.: Effect of sucrose on hyperkinetic children. Pediatrics, 74: 876, 1984.
- Guthrie, J.T.: Principles of instruction: A critique of Johnson's "Remedial approaches to dyslexia". In Benton, A.L., and Pearl, D. (Eds.) Dyslexia: An Appraisal of Current Knowledge. New York, Oxford University Press, 1978.
- Hallgren, B.: Specific dyslexia (congenital word blindness): a clinical and genetic study. Acta Psychiatr Neurol Suppl, 65: 1, 1950.

- Hammill, D., Goodman, L., and Wiederholt, J.L.: Visual-motor processes: Can we train them? The Reading Teacher, 27: 470, 1974.
- Hammill, D.D., and Larsen, S.C.: The effectiveness of psycholinguistic training. Exceptional Children, 41: 5, 1974.
- Harris, A.: How to Increase Reading Ability (5th ed.) New York, David McKay, 1970.
- Hartlage, L.C.: Neuropsychological assessment techniques. In Reynolds, C.R., and Gutkin, T.B. (Eds.), The Handbook of School Psychology. New York, John Wiley, 1981.
- Haslam, R.H.A., Dalby, J.T., and Rademaker, A.W.: Effects of megavitamin therapy on children with attention deficit disorders. Pediatrics, 74: 103, 1984.
- Heckelman, R.G.: A neurological impress method of remedial reading instruction. Acad Ther, 4: 277, 1969.
- Hermann, K., and Norrie, E.: Is congenital word-blindness a hereditary type of Gerstmann syndrome? Psychiat Neurol, 136: 59, 1958.
- Hinshelwood, J.: Word-blindness and visual memory. Lancet, 1: 1564, 1895.
- Hinshelwood, J.: Congenital word-blindness. Lancet, 1: 1506, 1900.
- Hinshelwood, J.: The treatment of word-blindness, acquired and congenital. Br Med J, 2: 1033, 1912.
- Hinshelwood, J.: Congenital Word-Blindness. London, Lewis, 1917.
- Holland, P.: The Historie of the World, Commonly Called the Natural Historie of C. Plinius Secundus, London, 1601.
- Hughes, J.R., Leander, R., and Ketchum, G.: Electroencephalographic study of specific reading disabilities. Electroencephalogr Clin Neurophysiol, 1: 377, 1949.
- Hughes, J.R., and Park, G.E.: Electro-clinical correlations in dyslexic children. Electroencephalogr Clin Neurophysiol, 26: 119, 1969.
- Hynd, G., and Cohen, M.: Dyslexia. Neuropsychological Theory, Research, and Clinical Differentiations. New

York, Grune and Stratton, 1983.

Jackson, J.H.: Defect of intellectual expression (aphasia) with left hemiplegia. Lancet, 1: 475, 1868.

Johnson, D.J.: Remedial approaches to dyslexia. In Benton, A.L., and Pearl, D. (Eds.) Dyslexia: An Appraisal of Current Knowledge. New York, Oxford University Press, 1978.

Johnson D.J., and Myklebust, H.: Learning Disabilities. New York, Grune and Stratton, 1967.

Johnson, D.K.: The O.K. Moore typewriter procedure. In Binter, A.R., et al (Eds.) Readings on Reading, Scranton, Pa., International Textbook, 1969.

Josephson, M.: Thomas A. Edison: A Biography. New York, McGraw-Hill Book Co., Inc., 1959.

Kawi, A.A., and Pasamanick, B.: Association of factors of pregnancy with reading disorders in childhood. JAMA, 166: 1420, 1958.

Kephart, N.C.: The Slow Learner in the Classroom. Columbus, Merrill, 1960, 1971.

Kerr, J.: School hygiene, in its mental, moral and physical aspects. Howard Medal Prize Essay, J Roy Statist Soc, 60: 613, 1897.

Kirk, S.A.: The diagnosis and remediation of psycholinguistic disabilities. Urbana, University of Illinois Press, 1966.

Kirk, S.: The ITPA: its origins and implications. In Helmuth, J. (Ed.). Learning Disorders Vol. 3., Seattle, Special Child Publications, 1967.

Kirk, S.A., McCarthy, J.J. and Kirk, W.D.: Examiner's Manual: Illinois Test of Psycholinguistic Abilities (rev. ed.) Urbana, Illinois : University of Illinois Press, 1968.

Kirk, S.A. and Kirk, W.D.: Psycholinguistic Learning Disabilities: Diagnosis and Remediation. Urbana, Illinois, University of Illinois Press, 1971.

Kittler, F.J., and Baldwin, D.G.: The role of allergic factors in the child with minimal brain dysfunction. Ann Allergy, 28: 203, 1970.

- Kussmaul, A.: Word-deafness. Word-blindness. In Ziemssen, H., and Buck, A.H. (Eds.) Diseases of the Nervous System, and Disturbances of Speech. Encyclopaedia of the Practice of Medicine, vol. 14. New York, William Wood, 1877.
- Langford, K., and Johnson, T.D.: Behavior modification and beginning reading. Acad Ther, 10: 53, 1974.
- Langford, K., Slade, K., and Barnett, A.: An explanation of impress techniques in remedial reading. Acad Ther, 9: 309, 1974.
- Lee, D.M., and Van Allen, R.: Learning to Read Through Experience (2nd ed.) New York, Appleton-Century-Crofts, 1963.
- Lerner, J.W.: Children with Learning Disabilities, (2nd ed.) Boston, Houghton Mifflin, 1976.
- Levinson, H.N.: A Solution to the Riddle Dyslexia. New York, Springer-Verlag, 1980.
- Matthews, M.M.: Teaching to Read. Historically Considered. Chicago, University of Chicago Press, 1966.
- Mattis, S.: Dyslexia syndromes in children: Toward the development of syndrome-specific treatment programs. In Pirozzolo, F.J., and Witrock, M.C. (Eds.), Neuropsychological and Cognitive Process in Reading. New York, Academic Press, 1981.
- Miller, S.I.: An Introduction to the Sociology of Education. Cambridge, Mass., Schenkman Publishing Company, Inc., 1977.
- Monroe, M., and Backus, B.: Remedial Reading: A Monograph in Character Education. Boston, Houghton Mifflin, 1937.
- Morgan, W.P.: A case of congenital word-blindness. Brit Med J, 2: 1378, 1896.
- Mullins, J.B.: A rationale for visual training. J Am Optom Assoc, 40: 139, 1969.
- Myers, P.I., and Hammill, D.D.: Methods for Learning Disorders. New York, John Wiley and Sons, Inc., 1969.
- National Advisory Committee on Dyslexia and Related Disorders. Report to the Secretary of the Department of Health, Education, and Welfare, August 1969.

- Nettleship, E.: Cases of congenital word-blindness (inability to learn to read). Ophthalmic Rev, 20: 61, 1901.
- Nichamin, S.J.: Reading disorders in children. JAMA, 207: 2438, 1969.
- Norrie, E.: Wordblindness in Denmark: its neurological and educational aspects. Indep Sch Bull Ser 59-60: 8, 1960 (Evans, 1982).
- Nutrition Symposium. Mom's diet:Key to child's growth; neonatal retardation tied to fetal malnourishment. Med World News, 14: 28-29, 33-36, 1973.
- Ofman, W., and Shaevitz, M.: The kinesthetic method in remedial reading. The Journal of Experimental Education, 31: 317, 1963.
- O'Leary, S.G., and O'Leary, K.D.: Behavior modification in the schools. In Leitenberg, H. (Ed.) Handbook of Behavior Modification and Behavior Therapy. Englewood Cliffs, Prentice-Hall, 1976.
- Orton, J.L.: The Orton story. Bull Orton Soc, 7:5, 1957.
- Orton, S.T.: Specific reading disability-strephosymbolia. JAMA, 90: 1095, 1928.
- Orton, S.T.: The "sight reading" method of teaching reading as a source of reading disability. J Educ Psychol, 20: 135, 1929.
- Orton, S.T.: Reading, Writing, and Speech Problems in children: A Presentation of Certain Types of Disorders in the Development of the Language Faculty. New York, W.W. Norton and Comp., 1937.
- Osgood, C.E.: Motivational dynamics of language behavior. In Jones, M.(Ed.). Nebraska Symposium on Motivation. Lincoln, University of Nebraska Press, 1957.
- Park, G.E.: The etiology of reading disabilities: An historical perspective. J Learn Disabil, 1: 318, 1968.
- Park, G.E. and Linden, J.D.: The etiology of reading disabilities: an historical perspective. J Learn Disabil, 1: 318, 1968.
- Peabody Rebus Reading Program. Circle Pines, Minn., American Guidance Services, Inc., 1969.

- Pearson, G.H.J.: Survey of learning difficulties in children. Psychoanal Study Child, 7: 322, 1952.
- Peters, A.: Uber kongenitale wortblindheit. Munch Med Woch, 55: 1116 and 1239, 1908 (Critchley, 1964).
- Pitman, J.: Initial teaching alphabet. The Times of London, May 29, 1959 (Matthews, 1966).
- Rabinovitch, R.D., Drew, A.L., DeJong, R.N., Ingram, W., and Wittey, L.: A research approach to reading retardation. Res Publ Ass Nerv Ment Dis, 34: 363, 1954.
- Roberts, R.W., and Coleman, J.C.: An investigation of the role of visual and kinesthetic factors in reading failure. J Educ Res, 51: 445, 1958.
- Robinson, H.M.: Causes of reading failure. Education, 67: 422, 1947.
- Rockefeller, N.A.: Don't accept anyone's verdict that you are lazy, stupid or retarded. TV Guide, 24: 12, 1976.
- Rumsey, J.M., and Rapoport, J.L.: Assessing behavioral and cognitive effects of diet in pediatric populations. In Wurtman, R.J. and Wurtman, J.J. (Eds.) Nutrition and the Brain, Vol. 6. New York, Raven Press, 1983.
- Rutherford, W.J.: The aetiology of congenital word-blindness; with an example. Br J Child Dis, 6: 484, 1909.
- Rutter, M.: Prevalence and types of dyslexia. In Benton, A.L., and Pearl, D. (Eds.) Dyslexia. An Appraisal of Current Knowledge. New York, Oxford University Press, 1978.
- Schain, R.J.: Neurology of Childhood Learning Disorders. Baltimore, The Williams and Wilkins Co. 1972.
- Schapringer, A.: Congenital word-blindness in pupils of the public schools. Paper presented at the meeting of the Ophthalmological Section of the New York Academy of Medicine. February 19, 1906 (Evans, 1982).
- Schmidt, J.: De oblivione lectionis ex apoplexia salva scriptione. Miscellanea curiosa medico-phsica Academiae naturae curiosorum, 4: 195, 1676 (Benton and Joynt, 1960).
- Skydsgaard, H.B.: Den Konstitutionelle Dyslexi Orblindhed, Copenhagen, Busch, 1942.

- Silver, A.A., and Hagin, R.: Specific reading disability: Delineation of the syndrome and relationship to cerebral dominance. Compreh Psych, 1: 126, 1960 .
- Spalding, R.B., and Spalding, W.T.: The writing road to reading. New York, Morrow, 1957.
- Spring, C., Greenberg, L., Scott, J., et al: Reading time and effect of Ritalin on children with learning problems. Percept Mot Skills, 36: 75, 1973.
- Stern, C.: Children Discover Reading. Syracuse, N.Y., Singer, 1963.
- Strauss, E.W., and Lehtinen, L.: Psychopathology and Education of the Brain-Injured Child. New York, Grune and Stratton, 1947.
- Tarnopol, L.: Introduction to neurogenic learning disorders. In Tarnopol, L. (Ed.) Learning Disorders in Children; Diagnosis, Medication, Education. Boston, Little, Brown, 1971.
- Tarnopol, L., and Tarnopol, M. (Eds.) Reading Disabilities; An International Perspective. Baltimore, University Park Press, 1976.
- Thompson, L.J.: Reading Disability: Developmental Dyslexia. Springfield, Charles C. Thomas, 1966.
- Thompson, L.J.: Language disabilities in men of eminence. Bull Orton Soc, XIX, 1969.
- Thomson, M.E.: Developmental Dyslexia: Its Nature, Assessment and Remediation. Baltimore, Edward Arnold, 1984.
- Thurston, D.L., Middelkamp, J.N. and Mason, E.: The late effects of lead poisoning. J Pediatr, 47: 413, 1955.
- Variot, G., and Lecomte, J.: Un cas de typhlolexie congénitale (cécité congénitale verbale), Gaz Hop, 79: 1479, 1906.
- Veatch, J.: Individualize Your Reading Program, New York, Putnam, 1959.
- Vernon, M.D.: Backwardness in Reading: a Study of its Nature and Origin. Cambridge, England, Cambridge University Press, 1957.
- Waites, L.: Definition of dyslexia. Can Med Assoc J, 99:

37, 1968.

Walter, K.: Beitrag zum problem der angeborenen schreib-
lese-schwache (kongenitale wortblindheit), Nervenarzt,
25: 146, 1954.

Wark, D.M.: Case studies in behavior modification. In
Schick, G., and May, M. (Eds.) The Psychology of Reading
Behavior. Milwaukee, National Reading Conference, 1969.

Webster's Seventh New Collegiate Dictionary, Springfield,
Mass, G & C Merriam, 1961.

Wender, P.H.: Some speculations concerning a possible
biochemical basis of minimal brain dysfunction. An NY
Acad Sci, 205: 1973.

Werner, E., Simonian, K., Bierman, J.M., and French, F.E.:
Cumulative effect of perinatal complications and deprived
environment on physical, intellectual and social
development of preschool children. Pediatrics, 39: 490,
1967.

Wernicke, O.: Congenital word-blindness. Editorial Review.
Ophthalmic Rev, 23: 19, 1904.

Willis, J., Morris, B., and Crowder, J.: A remedial reading
technique for disabled readers that employs students as
behavioral engineers. Psychol Sch, 9: 67, 1972.

Winick, M., and Rosso, P.: The effect of severe early
malnutrition on cellular growth of human brain. Pediatr
Res, 3: 181, 1969.

Witmer, L.: A case of chronic bad spelling - amnesia
visualis verbalis, due to arrest of post-natal
development. Psychol Clin, 1: 53, 1907.

Witty, P.A., and Kopal, D.: Factors associated with the
etiology of reading disability. J Educ Res, 29: 449,
1936.

Woodcock, R.W., and Clark, C.R.: Peabody Rebus Reading
Program. Circle Pines, Minn, American Guidance Service,
1969.

World Federation of Neurology Definition. In Waites, L.
Definition of dyslexia. Can Med Assoc J, 99: 37, 1968.

Wurtman, R.J., and Wurtman, J.J. (Eds.) Nutrition and the
Brain, Vol. 4. New York, Raven Press, 1979.

Zangwill, O.L.: Dyslexia in relation to cerebral dominance,
In Money, J. (Ed.) Reading Disability. Progress and
Research Needs in Dyslexia. Baltimore, The Johns Hopkins
Press, 1962.

APPROVAL SHEET

The thesis submitted by Nancy Millichap
has been read and approved by the following committee:

Dr. Steven I. Miller, Director
Chairperson, Foundations of Education

Rev. Dr. Walter P. Krolikowski, S.J.
Professor, Foundations

The final copies have been examined by the director of the
thesis and the signature which appears below verifies the
fact that any necessary changes have been incorporated and
that the thesis is now given final approval by the Committee
with reference to content and form.

The thesis is therefore accepted in partial fulfillment of
the requirements for the degree of Master of Arts in
Foundations.

December 3, 1985
Date

Steven I. Miller
Director's Signature