DOCUMENT RESUME

ED 042 569 RE 002 819

AUTHOR Krippner, Stanley
TITLE Space, Time, and Dyslexia: Central Nervous System Factors in Reading Disability.
PUB DATE Dec 69
NOTE 57p.; Paper presented at a workshop on learning disabilities sponsored by Coney Island Hospital and held in Brooklyn, N.Y., in December, 1969

EDRS PRICE EDRS Price MF-$0.25 HC-$2.95
DESCRIPTORS *Clinical Diagnosis, *Diagnostic Tests, *Dyslexia, Lateral Dominance, Minimally Brain Injured, Neurological Defects, Neurologically Handicapped, Neurological Organization, *Reading Diagnosis, Remedial Programs

ABSTRACT

Developmental and post-traumatic dyslexia are discussed in terms of a dysfunction of the central nervous system resulting in reading disabilities. The relationship of reading to other language functions is considered, with emphasis on the temporal aspects of speech and reading. An interdisciplinary approach is held necessary for the diagnosis of dyslexics, and emphasis is placed on the idea that diagnosis should be made by a medical specialist operating in an interdisciplinary research facility. Diagnostic techniques for professional workers are listed, including 12 psycho-educational tests and/or batteries. Eleven tests and techniques are detailed for the remediation of learning disabilities in the classroom. Sixteen remedial approaches are discussed at some length. It is noted that the question of whether neurological organization can be changed to bring about a greater facility in mastering language skills remains a controversial issue. An extensive bibliography is attached. (WB)

SPACE, TIME, AND DYSLEXIA: CENTRAL NERVOUS SYSTEM FACTORS IN READING DISABILITY*

Stanley Krippner, Ph.D.
Maimonides Medical Center, Brooklyn, N. Y.

Human behavior occurs in a matrix of time and space. Space involves the dimensions of distance, area, and volume; time is often referred to as the "fourth dimension," a dimension which is inextricably bound to the other three. Millikan (1962) has noted that space and time "are not at bottom independent of each other" and in relativity theory every object is a four-dimensional structure traveling in the four-dimensional world of space-time (Einstein, 1956).

Space is generally thought of as the three-dimensional extension in which objects and events exist, occur, and have relative position and direction. Time is regarded as the measurable period during which an action, process, or condition exists, occurs, and continues. Both time and space are hypothetical constructs; as such, they are dependent upon human perception and human conceptualization for their definition and use.

Some cultures view time as linear, as evolving, as proceeding in direct temporal sequences which involve cause and effect relationships. Other cultures see time as cyclical, as repeating itself, as operating

---

*This paper was prepared for presentation at a workshop on learning disabilities sponsored by Coney Island Hospital and held in Brooklyn, N. Y., in December, 1969. The preparation of this paper was supported by a grant from the Society for Comparative Philosophy, Sausalito, Calif.

in a rhythm, the events of which are often acausal and synchronous. Scientific investigations indicate that both notions may have some validity; Darwin's theory of evolution supports the concept of linear time while Heisenberg's uncertainty principle, to some extent, negates it.

Space is perceived differently at different points in history and in different geographical locations. The fact that perspective and vista were introduced into Western painting only a few hundred years ago suggests a subtle change in culturally-influenced visual perception at that time. Certain primitive tribes, such as the Xingu Indians of Brazil, have never developed near-point binocularity (the ability to use both eyes in a coordinated way); the fact that their culture affords them few experiences which would encourage the coordination of the eyes leaves the natives inept when they attempt complex near-point work such as painting and drawing. This factor may account, in part, for the absence of a written language among the Xingu tribe.

Time and space are important concepts for the child to develop and to understand (Helms, 1967). However, in highly civilized as well as in primitive societies, many children have no interest in future events, no mastery of the difference between "up" and "down," no clear conceptualization of "past" as opposed to "present." Other children can not perceive their world in the three spatial dimensions (lacking, as they do, the perception of depth) and still others do not possess adequate left-to-right progression when reading a book (often because they have poor concepts of their "left" and "right" body parts). This failure to master the culture's temporal and spatial constructs adversely affects the child in many ways; it is an especially severe impediment in the development of language processes (Money, 1966).

Mastering Receptive and Expressive Language

The infant's development of language begins at the approximate age of nine months with what Lewis (1959) has called a "first understanding of words." This is receptive language in the form of listening. By the age of one year, most children have spoken their first word; this is the beginning of speech, a form of expressive language. Some writers feel that "inner language," which is egocentric rather than social in nature, precedes both listening and speaking. In the American culture, two other forms of language -- reading and writing -- are introduced when the child enters school. Children can often learn reading and writing skills at earlier ages, but controversy exists as to the wisdom of this practice.

Listening and reading are basically receptive in nature; in both, information filters into the organism for decoding and processing. Speaking and writing are basically expressive in nature as encoded data emerge from the organism in the form of spoken and written words. There can be combinations of both processes; for example, oral reading involves receptive as well as expressive functions.

Receptive language may be thought of as combining two phases: perception (the understanding of one's sensory experience as influenced by expectancy set, background, and personality) and conceptualization (the interpretation of one's perceptions so that sensory data can be utilized). Reading achievement tests that measure both word recognition and reading comprehension tap into perception in the former instance and conceptualization in the latter.

Perception consists of acuity (sensory keenness as demonstrated by the child with 20/20 sight), discrimination (as demonstrated by a child who can auditorially perceive that "pit" and "pet" are two different words), analysis (as when a pupil breaks a word into its component parts),

and synthesis (as when a pupil blends a number of sounds together to produce a whole word).

Conceptualization requires proficiency in attention (the ability to focus consciousness and to maintain awareness over a period of time), recall (the remembrance of what has been experienced), comparison (as when an incoming perception is matched with the individual's storehouse of past perceptions), and abstraction (as when an individual utilizes a word as a symbol for an object or an event, or when he makes the notation of a quality apart from a single object -- such as "whiteness").

Expressive language involves idea formation (the representation in the mind of ideas, thoughts, images, and symbols) and motor function (the direct issue of ideas, thoughts, images, and symbols in action utilizing the body musculature).

Idea formation consists of symbolization (as when a child puts a feeling, mood, or experience into phonemic or graphemic symbols), imagery (as when a pupil formulates a mental picture of some object that is not present), revisualization (as when an individual "re-sees" a word in the "mind's eye"), and reauditorization (as when someone "re-hears" a word in the "back of the mind"). Motor function involves construction (as when a pupil temporally arranges phonemic symbols in speech or spatially arranges graphemic symbols on paper) and control (the correct articulation and pronunciation of phonemic symbols; the legible and accurate writing of letters and words with regard for their size, slope, and other spatial characteristics).

Myklebust (1956) has spoken of "integrities for learning"; it is likely that a child's central nervous system (i.e., the brain and spinal cord) is the most important integrity for all four of the language processes

Another important integrity is the peripheral nervous system which consists of the cranial and spinal nerves; these nerves terminate in the receptor cells in man's sense organs. Four of man's fourteen senses are especially critical for language: sight, hearing, kinesthesia (the "feeling" sense which is dependent upon receptors in the muscles, tendons, and joints), and tactile pressure (with receptors in the skin). Less important for language are the other ten senses -- smell, taste, balance, pain, heat, cold, vibration, two-point discrimination, the visceral sense, and the sense of nearness.

While the peripheral nervous system is of crucial importance for listening and reading, the body's skeletal-muscular system is important for speaking and writing. The latter two language processes are expressive rather than receptive in nature and require properly functioning muscles for the child to articulate (with his tongue, vocal folds, etc.) and to write (with his fingers, wrists, etc.). The voluntary musculature of the skeletal system is striated muscle; although most striated muscle is concerned with expressive language, the eye muscles are utilized in reading which is a receptive activity.

The fourth integrity for language development is the child's autonomic nervous system which controls the involuntary smooth muscles of the gastrointestinal tract and cardiovascular system, as well as glandular secretions. The individual's body chemistry can also be affected by his diet, sleep habits, and cell permeability.

In addition, there are four integrities which arise from the interaction of organism and environment: emotional stability, social competence, cultural background, and educational experience. The other four integrities also reflect organism-environment interaction but to a lesser extent.

A child with a hypothyroid condition is likely to lack energy for the learning process and be too sluggish to do well academically. This reflects a disorder in the autonomic nervous system and in the child's biochemical integrity. A child suffering from acute anxiety due to psychosexual problems will not be able to concentrate adequately during classroom instruction; this indicates malfunctioning of the emotional integrity. A pupil who enters the first grade from a slum area might have no idea what the teacher means when she refers to "books," "pencils," and "paper." This child would be suffering from deficiencies in the cultural integrity. A pupil who has been the victim of large classes, poor teachers, inadequate materials, and a lack of individualized instruction would manifest problems in the educational integrity. An individual who can not work well with groups and who is not self-directive in his activities would lack mature development of the social integrity.

A pupil with eye disease or with structural defects of the eye would lack integrity of the peripheral nervous system. A crippled child would lack integrity in bodily musculature, while a brain-injured child would be suffering from a disorder in central nervous system integrity. There is a minimum level of wholeness, or integral development, needed in each of the eight factors which influence learning before the child can master speech, reading, listening, and writing.

Dyslexia: Developmental and Post-Traumatic

Learning disabilities stemming from central nervous system dysfunction may be divided into two general categories: post-traumatic and developmental. In the post-traumatic cases, a portion of the brain has

sustained physical injury; nerve cells have been destroyed, severed, or otherwise damaged. The traumatic event may have occurred prenatally (before birth), natally (during birth), or postnatally (after birth).

In the developmental cases, the child has not sustained central nervous system damage but still suffers from brain dysfunction. In these cases there are anomalies of growth and development, rather than insult to the brain. Various writers have studied children manifesting these problems; Hermann (1959) uses the phrase "congenital word blindness," Rabinovitch (1959) speaks of "disorganized neurological development," Bender (1957) writes of "maturational lag," and Olson (1949) writes of "developmental lag." Critchley (1964) has utilized the term "developmental dyslexia" to refer to those individuals whose reading difficulty is due to congenital factors and improper growth rather than to frank injury or insult to the brain.

Sometimes children may be suffering from dyslexia of both the developmental and post-traumatic types. In others, there is difficulty determining one from the other on the basis of electroencephalographic, neurological, and psychological tests. Nevertheless, both conditions can produce problems in reading as well as in other language functions.

An individual whose brain dysfunction has resulted in a disorder of listening is said to be suffering from "receptive aphasia." If speech is affected, the problem is termed "expressive aphasia." "Dysgraphia" is a disorder of writing caused by brain dysfunction while "dyslexia" is a reading disability rooted in central nervous system defect. The receptive difficulties (receptive aphasia and dyslexia) are often referred to by the general term "agnosia," while the expressive difficulties (expressive aphasia and dysgraphia) are subsumed under the term "apraxia."

Phonemes, Graphemes, and Language

An understanding of the time-space milieu is essential to the understanding of language disabilities. Speaking and listening involve perceptual skills that deal with phonemes, morphemes, and other linguistic units that account for meaningful differences in oral language. These units occur in time rather than in space: the sentence "there dogs go" has a different meaning than "dogs go there" because the words occur in a different temporal sequence. When we say "you look at people," we mean something quite different than when we say "people look at you." The words are the same; what differs is their order in time.

A similar phenomenon occurs within words. The syllables "tur" and "pin," when joined together, may evoke the memory of Ben Turpin, the late American actor. The same syllables, arranged in a different time sequence as "Pinter," may bring to mind Harold Pinter, the English playwright. In some types of receptive aphasia, one's time sequence is juggled so that parts of words or parts of sentences are perceived in odd and incorrect sequences; thus, the basic meaning of the word or sentence is lost and communication fails.

Perceptual synthesis difficulties often relate to time sequence as when, on an auditory blending test or exercise, a child incorrectly blends "d-ĭ-s-c" ("disc") as "s-c-ĭ-d" ("skid"), or "p-r-ō" (pro") as "r-ō-p" ("rope"). In these instances, phonemes lend themselves to entirely different meanings depending upon their temporal ordering.

Time sequence is not the only factor involved in oral language disabilities; auditory acuity, auditory localization, auditory discrimination, auditory blending and closure, auditory recall, and re-auditorization are also important. However, these oral language skills

have their counterparts in written language skills (visual acuity, visual localization, visual discrimination, visual blending and closure, visual recall, revisualization) while temporal sequencing does not. Instead, the position in space of a letter, word, or phrase assumes major importance in written language.

The grapheme is the linguistic unit that makes a meaningful difference in written language. Although "pit," "quit," "bit," and "dit" are members of the same "word family," in each case the first letter becomes a grapheme which causes each word to assume a different meaning. The dyslexic child who suffers from spatial confusion might well perceive "p," "q," "b," and "d" in the same way. After all, a cup is still a cup whether the handle faces top right ( ), top left ( ), bottom right ( ), or bottom left ( ). The child who is "lost in space," insofar as written language is concerned, is in the same predicament as any one of us would be who found himself in a strange country where an upside down cup had an entirely different name and an entirely different use than a "right side up" cup.

The child with "literal dyslexia" has difficulty making proper space orientations with single letters and often confuses "p" and "q," "b" and "d," "M" and "W." He often is unable to read single letters and frequently reverses or rotates letters and letter combinations.*

The child with "verbal dyslexia" has trouble making proper space

---

*Nichols (1968) defines a reversal as a symmetrical 180 degree shift in position of a figure which moves through different planes as though hinged either vertically or horizontally to its original position or as though pivoted on the center vertical or horizontal axis. Rotations are angular changes in position within the same plane. Differentiation is necessary because remedial techniques should vary for the two conditions.

orientations with words and may read "was" as "saw" or "tops" as "spot." This child can usually read single letters correctly and may even be able to give the correct sounds for consonants and dipthongs (unlike the child with literal dyslexia). However, the pupil with verbal dyslexia has trouble identifying the word even when he can individually identify the component letters in the word; the defect in these cases is at a somewhat higher level of perceptual functioning (e.g., synthesis -- putting a number of letters together to form the whole word.

A child with "psycholexia" has conceptualization problems and may do poorly with word meanings, paragraph comprehension, abstractions, or generalizations. This pupil may be functioning adequately on the perceptual levels, but may do poorly on the levels that involve concept-formation. Spatial difficulties for this child may manifest themselves in a reluctance to play with dolls, model trains, and other toys which demand an association between larger scale, real-life objects and smaller scale, "make-believe" objects. In academic subjects, the psycholexic child may have difficulties in reading charts, graphs, maps, and other materials that are representational in nature. Answers to comprehension questions on tests are liable to be concrete and literal rather than abstract and imaginative.

A child's development of spatial knowledge proceeds from orientation on his body, through orientation for right and left on a person facing oneself, to orientation for right and left together with "going" and "coming" in one's daily behavior. In other words, the child must learn how to construct space regarding his own body and then project this knowledge outside of his body.

The mere presence of deficits in space orientation is not by itself

sufficient to cause reading disability; children with Turner's syndrome (a genetic disorder) were found by Alexander and Money (1961) to have poor directional orientation but adequate reading skills. The problems in space orientation typically displayed by dyslexic pupils are associated with disorders in the areas, circuits, and functions of the brain which mediate language.

Many theories have been introduced in an attempt to explain the neurological mechanisms which account for problems in space orientation among children with central nervous system dysfunctions. Costa (1962), for example, has stressed the failure of "set" among brain-injured individuals, a failure which distorts perceptions and delays the formation of accurate conceptualizations. Thomas (1962) has postulated a "supervisor" which controls output and whose work is impaired by brain dysfunction. Most specialists agree that youngsters with central nervous system handicaps differ from other children in quantitative rather than qualitative ways.

The identification of central nervous system factors in reading disability should lean heavily on medical diagnosis. Unfortunately, few medical schools include even one lecture on reading disability in their curricula, much less a course or a practicum on the diagnosis of language disorders. As a result, a bitter feud often rages between physicians (neurologists, pediatricians, ophthalmologists, psychiatrists, etc.) on the one hand and non-physicians (psychologists, reading specialists, optometrists, etc.) on the other concerning who is best able to diagnose and assist a dyslexic child. From a practical point of view, it is clear that interdisciplinary efforts are required because few professional people are able to evaluate the child's status in each

of the relevant integrities for learning.

Psychiatric, medical, and neurological examinations are useful from the standpoint of identification and are helpful when psychotherapy, surgery, or pharmacological treatment is advisable. A clinician or teacher, however, can not rely on a medical report for advice concerning remediation. Unfortunately, school psychologists often fail to give the teacher direction; a common complaint has been that a diagnostic study leaves the teacher as confused and helpless as before the testing was inaugurated. If these reports were task-oriented rather than stressing classification and etiology, the teacher and the pupil would both benefit.

These different schools of thought also are represented in current discussion on the clinical diagnosis of brain damage. The first point of view holds that psychological tests or behavior indices can be used to predict what a neuropsychiatric examination will conclude (Knights and Hinton, 1969). The medical statement, therefore, is taken as the criterion. Tests may be compared as to their value in predicting this medical diagnosis.

The second school of thought is critical of this approach, holding that psychological tests may tap different functions than medical examinations and may even differ among themselves. Wohlford and Flick (1969) suggest that the Bender Visual Motor Gestalt Test assesses parietal lobe functioning while the Memory-for-Designs Test assesses temporal lobe functioning. Reitan (1962) differentiates five types of brain dysfunction (independent variables), each of which may have differential effects on the performances (dependent variables) measured by psychological tests.

When Strauss and Lehtinen (1947) undertook to define the brain-injured child, they established four criteria: a history of trauma to

the brain (before, during, or after birth), neurological evidence, indicative evidence from psychological tests, and evidence that the child comes from a "normal" (i.e., non-retarded) family background. However, none of the four criteria have proved to be definitive. A child can display all of the symptomatology of brain injury without a history of cerebral trauma (as in developmental dyslexia rather than post-traumatic dyslexia). Complete neurological examinations, including electroencephalographic testing, often fail to provide positive evidence of injury and, according to Capobianco (1965) "perhaps equally often may discern an injury which is non-existent." Psychological test data are equally questionable diagnostically, although far more useful when it comes to planning a remedial problem. In addition, there are many children who are classified as mentally retarded, who come from a family in which there is a history of mental retardation, and who also have an undisputable history of trauma to the brain; thus, the categories of "brain injury" and "mental retardation" are not mutually exclusive.

For these reasons, and many others, several investigators have called for an abandonment of the classification of "brain injury." Capobianco (1965) states:

> The term "brain injury" has failed to serve any practical function. It is an etiological concept which offers little to the educator, psychologist, or other specialist who is interested in the behavioral symptomatology of the child with learning disabilities....Perhaps the new movement to establish special classes for children with similar learning disabilities may reduce some of the frustrations suffered by the diagnostician who no longer will find it necessary to "prove" that a "brain injury" exists.

A contrary position is offered by Thomas (1967) who feels that abandonment of the term will lead to a neglect of ways to improve neurological functioning. The possibility of successful treatment, to Thomas, makes a diagnosis of brain injury both necessary and useful.

Because of the difference of opinion surrounding the concept of "brain damage" (and, therefore, of "dyslexia" as well), many investigators prefer an operational definition of language and other learning problems. For example, Valett (1969:3) has defined a learning disability as "any specific difficulty in acquiring and using information or skills that are essential to problem solving," adding that "a significant learning disability exists when the individual's actual performance or achievement in any given ability is found to be far below his capacity or potential." Valett describes 53 basic learning abilities in six areas of psychoeducational growth and development: gross motor development (e.g., creeping), sensory-motor integration (e.g., balance), perceptual motor skills (e.g., visual-motor memory), language development (e.g., spelling), conceptual skills (e.g., arithmetic reasoning), and social skills (e.g., value judgments). Valett prescribes a variety of remedial procedures for the development of each of the 53 abilities as well as specific tests for their evaluation.

Schiffman (1962) stresses the importance of treating a child "once dyslexia...however it is defined...has been recognized." Adams (1969) agrees with those who suggest that the diagnostic evaluation of a dyslexic child be an operational description of the pupil's level of performance in various areas as well as an attempt to define the rate with which the identified disabilities can be modified. This approach to the problem avoids misleading and possibly harmful labelling of a child, while stressing ways in which the child's specific learning problems can be ameliorated.

Diagnostic Techniques for Professional Workers

In recent years, a number of psycho-educational tests have appeared

which show promise in the diagnosis and treatment of learning disabilities in general and of dyslexia in particular. When a trained professional worker administers these tests, he must remember that diagnosis is the first step in remediation. Therefore, the final diagnostic report must contain advice concerning the rehabilitation of the child and a description of the pupil's strengths as well as his weaknesses.

The Haeussermann Evaluation of Intellectual, Sensory, and Emotional Functioning (1958) is designed for the child between two and six years of age. This approach proceeds from higher levels of adaptive organization to lower ones, from abstract relations to concrete events. If the child does not succeed at a given level, the clinician proceeds to determine the perceptual, motivational, experimental, or intellectual reasons for that failure. The clinician also attempts to discover what adaptations can be made in the test item which would enable the child to succeed. As a result, the evaluation produces a descriptive and interpretive statement regarding the child's capacities, functioning abilities, and developmental potential. This statement can serve as a guide for rehabilitation, remediation, and training.*

The Myklebust Picture Story Language Test (Myklebust, 1965) is another measure which can be utilized by a specialist in language disorders. Applicable to all age levels, the test measures three aspects of language which are essential for effective communication: productivity (the length of the expression), syntax (the correctness of the expression), and the abstractness (or concreteness) of the ideation being expressed. Myklebust defines language as "symbol-making behavior" and notes that

---

*This rather lengthy, complex test is currently being adapted for wider use by Lillie Pope, Department of Psychiatry, Coney Island Hospital, Brooklyn, N. Y.

all communication is not in the form of language.

The Money Road Map Test of Direction Sense (Money, Alexander, and Walker, 1965) is a technique designed to measure the development of directional sense in children from the ages of 7 to 18. It tests the ability to orient oneself to right and left, toward and away from, and then to translate this orientation on to a two-dimensional plane.

The Minnesota Percepto-Diagnostic Test (Fuller and Laird, 1963) was devised by Fuller and Laird in an attempt to differentiate cases of reading disability in terms of etiology. Using terminology proposed by Rabinovitch (1959) the authors view "organic" cases as those in which the physiological capacity to read has been impaired by frank brain damage. In "primary" cases, the capacity to learn to read is impaired without specific evidence of brain injury; a disturbed pattern of neurological organization is felt to be the causal factor in this group. In "secondary" cases, the physiological capacity to learn to read is intact but is not utilized sufficiently due to emotional problems and unfavorable educational experiences. Krippner (1966) reported a successful project in which this test was used to separate post-traumatic dyslexics ("organic" cases) from developmental dyslexics ("secondary" cases).

The Predictive Index (De Hirsch, Jansky, and Langford, 1966) combines such well-known tests as the Bender Visuo-Motor Gestalt, the Wepman Auditory Discrimination Test, the Horst Reversals Test, and the Gates Word Matching Test, with such simple tasks as pencil use, story telling, word categorization, word recognition, and word production. When administered to kindergarten children, this index was found to be highly effective in predicting those who would fail in reading.

Jansky is currently developing a 20-minute screening test for teachers based on a factor analytic study of this battery which discovered the basic "clusters" of tests to be in the areas of verbal pattern matching, memory for sentences, quantitative language skills, visual-motor skills, and auditory skills.

The Gesell Behavior Tests (Ilg and Ames, 1965) were devised to measure school readiness and developmental status. They require the child to copy geometric forms, complete a picture of a man, discriminate between right and left, name animals, state a number of interest preferences, print his name and address, and differentiate among a number of visual forms. Supplementary are the observation of the child's teething, a visual examination, an evaluation of his reading ability, and the administration of the Lowenfield Mosaic Test and the Rorschach Technique.

The Reitan Battery (1962) has been developed for children between the ages of 9 and 14 years of age who are suspected of having central nervous system dysfunction. In one form of his battery, Reitan (1964) identified the following variables which should be identified in studies of central nervous system deficit affecting language functions:

1. Visual number agnosia.
2. Visual letter agnosia.
3. Visual word agnosia.
4. Auditory verbal agnosia.
5. Body agnosia.
6. Right-left disorientation.
7. Naming apraxia (anomia).
8. Spelling apraxia.
9. Writing apraxia (dysgraphia).

10. Calculation apraxia (acalculia).

11. Enunciatory apraxia (central dysarthria).

12. Constructional apraxia.

Reitan (1966) stresses that any diagnostic method which assumes that behavior will be affected by brain damage in a unitary, constant, invariable manner is inadequate and open to suspicion. Therefore, a battery is needed for the identification of central nervous system dysfunction; a single test is hardly adequate to measure this complex and subtle phenomenon.

The Halstead Category Test (Halstead, 1947) is a non-verbal measure of abstraction, concept formation, and reasoning ability. It consists of 208 photographic slides of geometric figures which are presented by means of projection equipment. The 208 items are arranged in seven subtests with successful solution dependent upon discovery of a principle which reveals each item to be a symbolic presentation of a number. This principle is consistent within each subtest but generally changes between all subtests. The correct principle must be discovered by trial and error and responses are made by depressing one of four numbered switches. Correct responses are rewarded by a chime, while incorrect responses elicit a buzzer. This test has been shown to be sensitive to the presence of brain damage, according to its authors.

The Temporal-Spatial Concept Scale (Hartigan and Fuller, 1965) explores the areas of laterality knowledge, space knowledge, temporal knowledge, and directional knowledge. The test items involve mostly verbal responses to the examiner's questions although a few items demand a written response (e.g., "Draw these figures upside down;" these letters and numbers are upside down and backward; write the correct letter or number"). A "developmental score" may be obtained by

totalling correct responses in all four areas.

The Perceptual Profile (Silver and Hagin, 1967) involves evaluation in four areas: reading level, intellectual level, educational opportunity, and neurological status. A number of measures are utilized, including the Jastak Wide Range Achievement Test (for oral reading and spelling), the Metropolitan Reading Test (for silent reading), a sample written composition, examination of the child's written work from school, the Wechsler Intelligence Scale for Children, the Bender Visual-Motor Gestalt, the Gottschaldt Embedded Figures Test and the Strauss-Werner Marble Board Test (to measure visual figure-background discrimination), the Bender Face-Hand Test and the Strauss-Werner Tactile Figure-Ground Test (to measure tactile skills), the Roswell-Chall Auditory Blending Test, the Wepman Auditory Discrimination Test, the Goodenough Draw-a-Man Test, a speech articulation survey, and (to measure sequencing ability) the Head Cloth Test and various tasks involving the ordering of months of the year, days of the week, objects, digits, words, and sentences. To measure cerebral dominance, the following procedure is used:

> The issue of cerebral dominance has been a confused and controversial one. Part of the difficulty stems from the confusion of peripheral dominance with central or cerebral dominance. The emphasis has been upon observing which hand is used for skilled activity, which eye for sighting, and which foot for kicking, and determining the lack of agreement in eye, hand, and foot preferences.... There is real question, however, whether these peripheral preferences are really indicative of cerebral dominance ....How can central dominance be effectively studied? Experimentally, injection of sodium amytol into each carotid artery (Penfield and Roberts, 1959), will suggest the dominant cerebral hemisphere for language. Direct stimulation of the brain in surgery has been utilized. Less drastic measures include the following:
>
> ...When the eyes are closed and the arms extended at shoulder level parallel to each other and to the floor, one arm will be higher than the other. In children with

> established dominance, the higher arm corresponds to that used for writing. In children with severe "specific reading disability," this arm may be opposite to that used for writing, or neither arm may be elevated....In a study of 100 third- and fourth-grade children in a suburban school, we were able to identify 34 of 41 children who were reading below their mental age and grade placement....We suggest that the elevated extremity is one which has the greater muscle tone and, hence, is an expression of cerebral dominance.... This does not mean that the cause of "specific reading disability" is indeed a lack of cerebral dominance, but it does suggest that a lack of cerebral dominance is an important part of the syndrome.

Silver and Hagin (1967) have followed up "specific reading disability"children with a similar test battery, finding that "basic perceptual problems tend to remain, and tell-tale evidence of the old reading disability persists."

The Illinois Test of Psycholinguistic Abilities (McCarthy and Kirk, 1968) includes 12 subtests that categorize language along three dimensions. Language ability is viewed as being of two levels of organization (meaningful and non-meaningful language), three processes of assimilation (reception, association, and expression), and two channels of communication (auditory-verbal and visual-motor). Channels of communication then refer to the manner in which a child recevies sensory information and how he responds to that information. As a result, many professional workers base remedial suggestions upon the findings of this measure although it remains highly controversial (Ryckman and Wiegerink, 1969).

The Doman-Delacato Developmental Profile (Doman, Delacato, and Doman, 1964) evaluates a child's neurological status by testing his competence in mobility, language, manual skills, vision, audition, and tactilism. The most controversial of the newer measures, this test lacks adequate standardization data but purportedly has demonstrated a high degree of effectiveness in charting the progress of remedial cases (LeWinn, et al., 1966). The test is individually administered and produces a "neurological age" for each child tested.

Diagnostic Techniques for the Classroom Teacher

In many parts of the country, a specialist is not available to diagnose a child. In these instances, a well-trained teacher can utilize a number of tests which have demonstrated their utility in the remediation of learning disabilities.

The Neurological Organization Evaluation Form (Delacato, 1966) is based on the studies done at the Institutes for the Achievement of Human Potential and concerns itself with four anatomical areas of the brain: medulla, pons, midbrain, and cortex. If the medulla or pons is damaged, it is not likely that the child would be capable of attending school; therefore, the test begins at the midbrain level.

Dysfunction of the midbrain is indicated if the pupil can not creep in cross pattern (with the right hand and left knee striking the floor at the same time and the left hand and right knee striking the floor simultaneously). Other tests of midbrain functioning involve eye tracking (of an object held by the pupil) and writing.

In testing cortex functioning, it is noted whether or not the pupil walks in cross pattern with the opposite hand and foot moving forward at the same time. Eye tracking (of an object held by the examiner) is also measured. Cortical hemispheric dominance is evaluated on the basis of handedness, footedness, eyedness, and posture.

Remedial programs are initiated at the lowest level of neurological development at which the child fails. Two films ("The Diagnosis of Speech and Reading Problems" and "The Treatment of Speech and Reading Problems") have been prepared to assist the teacher in this work. Careful teacher preparation is necessary for use of this form.

The Perceptual Forms Test (Manus, et al., 1963) is part of a perceptual training program devised for beginning school children (Spache, 1963). Either individually or in groups, the request is made to copy

a number of geometric forms. In individual testing, a small booklet is used; for group testing, large posters are utilized. The forms include a circle, a cross, a square, a triangle, a divided rectangle, a horizontal diamond, and a vertical diamond. The teacher is told that the odds are six to one that a child (in the five to seven age group) who scores below the cut-off point on this test will do poorly in school.

The Pate-Webb First Grade Screening Test (Pate and Webb, 1966) is designed to identify children who will not make sufficient progress during their first year of school to be ready for the second grade. It involves learning problems based on intellectual deficiency and emotional disturbance as well as central nervous system dysfunction.

The School Readiness Survey for Preschool and Kindergarten Children (Jordan and Massey, 1967) was designed to furnish information to the parent about the readiness of his child for school. The information is obtained by having the child's parent administer the test as much as six months prior to the child's entering kindergarten in order to allow the parent adequate time to assist the child in developing necessary skills. The survey contains a general school readiness checklist and seven scorable sections: number concepts, discrimination of form, color naming, symbol matching, speaking vocabulary, listening vocabulary, and general information.

Obviously, the survey may also be administered by a teacher. However, the simplicity of the measure makes it possible for a parent to use it; some schools distribute copies of the surveys to parents during kindergarten pre-registration or P.T.A. meetings; follow-up meetings are held to instruct parents in ways that they can help their children to progress in areas of deficiency noted on the survey.

The Valett Developmental Survey of Basic Learning Abilities (Valett,

1966) was compiled for the evaluation of children between the ages of two and seven. The Survey can be used as a whole or in separate parts, as required. It contains tasks in the areas of motor integration and physical development, tactile discrimination, auditory skills, visual-motor coordination, visual skills, language development and verbal fluency, and conceptual development. The survey must be administered individually and requires a number of toys and other materials which must be purchased by the examiner in a school supply store. The entire test generally requires an hour or more for administration; it is not a screening test but a tool for clinicians who are developing a special remedial program with a learning disability child.

The Evanston Early Identification Scale (Landsman and Dillard, 1967) was constructed to screen out those children between the ages of five years, zero months and six years, three months who can be expected to have difficulty in school. The test may be administered either individually or in a group; it involves having the child draw the figure of a person. This figure is scored by the teacher through the use of a 10-item scale. Except in extreme cases, mental ability and socio-economic status are not supposed to significantly influence the test results. Children falling into the "high risk" category on this test should be referred for remedial help.

The Simkov Perceptual Organization Inventory (Simonson and Kovacevich, 1963) purports to be closely related to a child's neural organization. As a diagnostic instrument, which can be administered on a group basis, it obtains a perceptual-motor age as well as a "problem index." The manual contains remedial suggestions for treating the problems which are noted by this test.

Slingerland's Screening Tests for Identifying Children with Specific

Language Disability (Slingerland, 1944, 1969) were designed to locate dyslexic children in the lower grades. Simple reading, spelling, copying, auditory-perceptual, and visual-perceptual tasks are presented to children, either individually or in groups.

The Frostig Developmental Test of Visual Perception (Frostig, Lefever, and Whittlesey, 1964) diagnoses operational problems in vision. The five areas tested are eye-hand coordination, figure-ground perception, perception of form constancy, perception of position in space, and perception of spatial relationships.

The Purdue Perceptual-Motor Survey (Roach and Kephart, 1966) allows the teacher to observe a broad spectrum of behavior and to evaluate it properly. The authors of this survey, Roach and Kephart, have stated that the main purpose of the device "is to provide the teacher with a tool which can be used to identify those children who do not possess perceptual-motor abilities necessary for acquiring academic skills by the usual instructional methods." The tasks required of the child involve generalized movement, reflex activities, movement patterns, laterality, perceptual-motor matching, directional knowledge, and concept formation.

The Meeting Street School Test for Learning Disorders (Denhoff, 1964, 1969) was designed for teacher administration; a manual and films are available. A 15-minute version of the device is suggested for screening purposes and a 40-minute diagnostic version is recommended for the identification of perceptual and motor difficulties associated with neurologically-based learning problems.

No teacher should make a diagnosis of dyslexia on the basis of any of these tests. In fact, it is doubtful whether the diagnosis of dyslexia should be made by anyone but a medical specialist operating in

an interdisciplinary research facility. All too often, a teacher links the term "dyslexic" with the notion of a hopeless condition, abandoning her attempt to assist the pupil.

Patterns of Remediation

For many years, there was a dearth of ideas in regard to remediation for dyslexic children. The approaches of Itard, Seguin, and Montessori,* were ignored; the contributions of Orton (1937), Fernald (1943), Gillingham (1966), and Strauss and Lehtinen (1947) were overlooked. At the present time, however, the situation is reversed and a number of methods are competing with each other for attention.

The Valett Approach (1968, 1969) to the "programming" of learning disabilities includes three stages: planning, implementation, and

---

*Despite the fact that Montessori began her work at the turn of the century, the first Montessori school in America was not opened until 1958. The first piece of controlled research was reported recently by Argy (1965). At the beginning of a two-year program, Argy assigned Montessori teachers to 40 brain-injured pre-school children while another 31 children received a more orthodox and traditional educational approach to neurological impairment. The walls of the two classrooms contained similar materials but the shelves contained vastly different items. In the control classroom, the shelves were filled with the standard educational books, toys, and puzzles which have been generally used with brain-damaged children. The experimental classroom contained those materials recommended by Montessori: pots and pans, a button frame, a lacing shoe, colored tablets, sound boxes, bells, a touch board, language cards, metal insets, rods, bead units, a movable alphabet, sandpaper letters, and jigsaw maps. The Gesell tests and other measures were used to determine educational attainment and developmental changes in ambulation, manual skills, and speech. The sample was divided in terms of age and intelligence. At the conclusion of the study, the improvement was significantly greater in the Montessori classes than in the control classes. Children in the Montessori classes made significant improvement in educational attainment, manual skills, and speech (but not in ambulation); other children only made significant improvement in educational attainment and even that was not as marked as it was for the Montessori group.

remediation. The planning stage includes development of an operational rationale; for example, Valett (1969:3) defines a learning disability as "any specific difficulty in acquiring and using information or skills that are essential to problem solving." In the implementation stage, the child is evaluated by the teacher or clinician who will eventually take charge of the third stage, remediation. However, the third stage also includes the organization of school services and parent involvement.

Valett's remedial approach stresses prescriptive programming (which builds upon the child's strengths to increase his self-confidence, gradually moving into his specific areas of weakness) and behavior modification which is based on the finding that children can be taught appropriate responses through conditioning procedures that reinforce or reward the desired behavior. Valett (1969:202-204) lists the basic principles of behavior modification as applied to children with learning disabilities:

1. Readiness: A child will learn when he has the interest and the desire to learn and when he recognizes purpose and meaning in the task at hand. The programming of learning disabilities should begin by determining strengths and interests, and by utilizing both intrinsic and extrinsic motivation. For example, one disabled learner's readiness to learn was stimulated by teacher exploration of his curiosity about horses. He was motivated to complete his assigned learning tasks through an extrinsic reward system culminating in weekly horseback riding privileges.
2. Effect: Pupils should be programmed with educational tasks that are appropriate for their developmental and achievement levels and that have a high probability of success. For example, to obtain one boy's cooperation in learning to read, he was programmed with

material on an achievement level that assured him a good chance of accomplishment.

3. Cue Discrimination: Learning tasks should be programmed in small structured units, systematically proceeding from material that has been successfully accomplished to the next level of difficult task. For example, one girl's body coordination and balance gradually improved through the use of sequential exercises with the balance beam and jump rope.

4. Immediate Reinforcement: Upon successful accomplishment of new learning tasks, children should be rewarded with verbal reinforcement (e.g., praise, exclamations), physical contact (e.g., a pat on the back, hugging), social privileges (e.g., field trips, special in-school roles), tokens (e.g., colored stars, chips, or tickets that can be turned in for a prize when a sufficient number has been accumulated), or primary rewards (e.g., food, money). For example, one girl was taught how to speak by placing a piece of M & M candy in her mouth every time she correctly named an object presented to her.

5. Intermittent Reinforcement: Once the child has learned the task, he should continue to be rewarded. However, evaluation and reward can now be given upon completion of several tasks or at the end of an assignment period. For example, one boy's arithmetic work was evaluated and awards were given only once a day instead of following each item as before.

6. Social Reinforcement: The pupil's peer group is a powerful source of reinforcement for behavior modification. Sometimes a bonus reward can be given to the class as a whole when one or two pupils make a significant improvement. For example, one class was given fruit and candy by the members of that class who had completed a

difficult learning task that week.

7. Negative Reinforcement: Occasionally, a child should be deprived of a privilege for not doing a required task. Negative reinforcement must be used with caution since emotional behavior is easily conditioned in an undesirable way by traumatic association. For example, one boy was restricted to his home for the weekend because he had failed to carry out the chores his parents assigned him during the week.

8. Feedback and Repetition: Repeated success and varied reinforcement experiences should be provided before moving pupils to significantly more difficult material. Children should be involved in evaluating their own performance and in the correction of their mistakes. For example, one pupil was rewarded with 20 bonus tokens for correcting his spelling errors.

9. Transfer and Generalization: The teacher should provide opportunities for skills already learned to be used in varied and related situations. The child should be helped to analyze the new situation and to apply relevant skills. For example, one boy transferred his new word attack skills learned from practice on simple materials to direct use with the regular classroom readers under the tutoring of his special teacher.

10. Extinction: Do not reward or pay attention to behavior that you do not want to be learned. Inappropriate behavior is extinguished ("unlearned") through non-reinforcement. For example, one girl's mother paid no attention to her when she acted out her frustration in temper tantrums. After awhile, the tantrums lessened and then disappeared altogether.

11. Insight and Understanding: The pupil must be led to understand

what is desired or expected in the learning situation and how this new knowledge may be used in problem solving. Hopefully, the child will become aware of the change in his system of knowledge and will know how to apply this new insight. For example, one boy was taught to role-play the logical consequences of various social behavior patterns. As a result, his personal behavior toward others improved considerably.

Valett (1969:139) recommends that special education programs be organized around the teaching of specific developmental tasks in the areas of basic learning abilities. Teachers and clinicians should carefully define the abilities that they will try to improve; they should design sequential task levels for programming purposes. Valett (1969:139-140) concludes, "It is especially important that all persons working in the program have a positive commitment to a philosophy of growth and human development that stresses the primary role of special education in helping the handicapped child to reach his potential.

The Intersensory Reading Method (Pollack, 1967a) follows the principle that visual responses become more stabilized when related information is made available through the auditory and kinesthetic approaches integrated with a motor component. The method is aimed toward beginning readers and features a sequential series of 48 integrated lessons of programmed material designed for remedial readers who have inadequate phonic and linguistic skills. It contains a vocabulary of 403 words which are phonically controlled and organized into linguistic spelling patterns. Separate writing workbooks (Pollack, 1967b) are also available which provide instruction in manuscript writing in consonance with the phonic spelling lessons in the reading workbook.

The Intersensory Reading Method was based on research studies which indicate that the development of integrative organization of the senses leads to more effective control of cognitive behavior (e.g., Birch and Belmont, 1965). The kinesthetic approach is applied in the form of tracing and manuscript writing and spelling, while the motor component consists of the building of words with letter squares. The pupil advances in a step-by-step sequence from the learning of simple phonemes to more complex phonic elements. The vocabulary employed in the workbooks employs linguistic spelling patterns as units, thus facilitating visual and auditory discrimination and retention of word-images through structure based on generalization.

The method typically includes a program of gross motor activities (e.g., balancing, hopping, skipping, cross-patterned creeping, cross-patterned walking). This program of motor activities is based on the premise that the basis of perception is motoric in nature and that the efficiency of the higher thought processes can be no better than the basic body awareness in space which a child develops through movement.

In addition, the method typically is combined with a system of conditioning techniques in an attempt to modify various types of maladaptive behavior. Initially, a maladaptive aspect of each child's behavior is identified; then, the child is motivated toward change, following which a reward is instituted to reinforce his attempts at behavior change. With each successful reinforcement, the child's confidence in his own powers grows, his self-image improves, and his ability to change his own behavior stimulates a chain of events which propels the child toward other forms of more adaptive behavior.

The AEIOU & Y Method of Reading (Tien, 1967) is based on the memorization of a set of these phonic tables which attempt to help the

child develop pattern recognition which Tien feels to be "The central concept in learning, thinking, and behavior." The first table combines each of the major single letter consonant sounds with A, E, I, O, U, and Y. The second table combines the double letter consonant sounds (e.g., TH, SL) with the vowels. The third table combines the triple letter constant sounds (e.g., PHR, SPR) with the vowels. The disabled reader looks at the tables, says the syllable and reproduces them on a worksheet, thus mastering the basic patterns of written English.

The Neurological-Impress Method (Heckelman, 1969) is a system of unison reading whereby the student and the clinician read aloud, simultaneously, at a rapid rate. The disabled reader is placed slightly to the front of the clinician with the student and the clinician holding the book jointly. As the student and clinician read the material in unison, the voice of the clinician is directed into the ear of the student at close range. In most instances the clinician has one hand free and is able to use his finger as a locater. He slides his finger along the line following the words that are being spoken. The finger must be at the location of the spoken word. At no time does the clinician attempt to teach sounds of the words or word recognition. The clinician always comments positively as to the success of the child; he permits the child to volunteer information about the story but refrains from asking direct questions. Heckelman (1969) describes the technique as one based on "feedback:"

> I remembered reading somewhere in the psychological literature that in speech problems stuttering would stop if the sound of the voice was fed back simultaneously into the stutterer's ears. It, therefore, seemed logical that this or a similar process of feedback could be imitated in a reading situation and that it might effect a neurological change. A new learning process could be established, and the older, defective learning process might be suppressed. I

> further hypothesized that perhaps this need not be the reader's own voice, but that it could be the voice of someone else reading the same material at the same time.

A study (Heckleman, 1969) utilizing this method with 24 children produced statistically significant results amounting to 1.9 grade levels of improvement in reading following 7 to 25 hours of instruction.

The Frostig Materials (Frostig and Horne, 1964) are based on the assumption that faulty visual perception and poor visual-motor coordination is a frequent causative factor in learning disability. The remedial materials consist primarily of dittoed sheets; a test is available (Frostig, Lefever, and Whittlesey, 1964) and is advised as a precursor of the materials so that children can be correctly assigned to the exercises they most critically need. In some instances, the remedial program must start with activities which develop bodily awareness because many reading skills depend ultimately upon accurate body image and knowledge of the body parts.

The Stimulation of Deficit Perceptual Areas approach has been utilized to increase reading efficiency by Silver, Hagin, and Hersch (1967). It was postulated that a total remedial program would include teaching at three levels: an accuracy level to develop accuracy of perception within a given sense modality, an intermodal level to relate two or more perceptual modalities, and a verbal level to insure the transfer of perceptual abilities to language skills. At the accuracy level, for example, the following perceptual techniques were available for use, depending on the deficit areas of a child:

1. Visual modality
    a. forms (simple, asymmetric, matrix-like, complex, letters, review)

b. spatial orientation (orientation lockplate, square puzzles, Pythagoras puzzle)

c. visual figure-background (patterns, single letters, letter sequences)

2. Auditory modality

a. code patterns

b. sequencing (alphabet, telephone game, xylophone game, pictures, song chains)

c. sound discrimination (initial sounds, final sounds)

d. word discrimination

e. rhyming (discriminating rhymes, picture strips, supplying rhymes, review games)

3. Tactile modality

a. texture discrimination

b. size discrimination

c. form discrimination (tactile templates, sandpaper forms, smooth forms, sandpaper letters)

d. tactile dot forms

4. Kinesthetic modality

a. directionality board

b. tracing movements

c. tracing forms

d. rhythmic writing

5. Body image

a. finger number game

b. hand puzzle

c. rope trick

d. mirror portraits

In the visual modality, the first task is to teach the perception of form. These forms start with the relatively simple circle, square, rectangle, triangle, and diamond, then proceed to asymmetric forms, to matrix-like forms, and finally to complex forms which are adjacent and overlapping. Accuracy is taught through the process of visual recognition, copying, and recall. Each step in the sequence must be mastered at three correct performances during three consecutive weeks before the next step is taken. If there is difficulty at any stage, cues are used -- still within the same modality (e.g., if the child can not visually match simple geometric forms, color cues are introduced to assist the matching process). At the copying stage, point-to-point cues on incomplete forms are given; the cues are gradually reduced as the child develops mastery of the task.

Spatial orientation and visual figure-background perception is stressed through the use of Pythagoras puzzles. The materials for this technique are plastic or wooden pieces distributed commercially, consisting of seven geometric forms that include four triangles of various sizes, a parallelogram, and a square. These are to be put together to make various geometric forms which have been prepared. Two drawings are made for each form, one showing the elements of the design, the other showing the figure in outline only. Here again, the sequence of recognition, copying, and recall is repeated.

In the auditory modality, the recognition and recall of patterns is taught through the use of a Morse Code signal set. The clinician begins by demonstrating the long and short tones until the child is able to differentiate them accurately. It is important that the clinician screen his hand from view so that the child's response is to auditory cues only and not to the visual perception of the clinician's hand

movements. The sequences consist of various combinations of long and short tones. For the recognition stage, the clinician taps out the sequences in pairs so that the child can learn to discriminate between similar and different patterns. For the recall stage, the clinician taps out the pattern and the child reproduces it on the signal set.

An example of these techniques in operation is given by Silver, Hagin, and Hersh (1967) in the case of "J.," a second grader diagnosed as having a "specific reading disability:"

> Perceptual study showed deficits in every modality. His productions of the Bender Gestalt Test were disorganized. He could not draw straight horizontal or vertical lines, much less diagonals; his reproductions of the sinusoidinal curves were scallops. Visual figure-background problems were seen on the Marble-board Test in his difficulty with diagonals and his inability to build interlocking figures. Even the use of brightly colored marbles did not enable him to detach figure and background. J's drawings also illustrated this problem. For example, in his figure drawings he was impelled to draw not only the figure but the furnishing of the room -- desk, chairs, even the objects on the desk, figure-background interference was seen in the tactile modality also. In the auditory area, he had difficulty in discriminating differences and similarities of words presented orally, making 11 errors in 40 presentations....He managed to identify right and left on himself by using a ring as a cue. Handwriting, in which he used his right hand in the "crooked arm" fashion of some left-handers, was illegible. He sometimes "forgot" the directions for forming letters. It was noted that he used both right and left hands for a number of the tasks.
>
> ...In the visual modality, emphasis was placed upon accurate perception of form and orientation of figures in space. In the auditory modality, activities dealt with the problem of sequencing and the discrimination and matching of initial and final sounds in words. Tactile activities included discrimination of textures, sizes, and forms. Kinesthetic activities...included the use of the directionality board, the tracing of movements in media such as clay, and rhythmic writing on the chalk-board.
>
> At the end of six months his oral reading score was found to have accelerated 2.5 grade points, to a score of 4.0; his spelling score increased .9, to 2.9; his

> reading comprehension increased 1.2 grade points, to 3.9....The above findings suggest that perceptual maturation can be effected by specific stimulation and that it is accompanied by improved educational achievement.

The Cruickshank Teaching Method for Brain-Injured Children (Cruickshank, 1961) emphasizes "filling the gaps" within each of the child's successive stages of development. If a child can not distinguish a square from a triangle, he will not be able to tell "H" from "A." If a picture of a swing and a picture of a table look the same to him, he can not see the difference between "W" and "M." If he can not stack plates, if he does not know what size tablet will best fit on his desk, he needs help in organizing spatial relationships for in reading he may confuse "said" and "sand," "the" and "then," "you" and "yes." Cruickshank's method attempts to overcome the brain-injured child's tendency to perseverate (continue an action past the appropriate time for completion), to be distractible and hyperactive, to display motor disinhibition, to perceive and respond in terms of segments rather than wholes, to confuse a figure with its background, and to lack an understanding of body image.

The Miller Symbol-Accentuation Method (Miller and Miller, 1962) attempts to diminish the discrepancy between the word and the object or activity it stands for. For example, when the word "HOT" is taught, it is printed in red with streamers of heat radiating from it. The word "PIG" has curled ends on all letters, the word "FALL" is collapsing in the middle, "CANDY" is peppermint-striped, "WALK" has feet on the bottom of each letter, and "SAD" has turned-down mouth and eyes on the letter "A." For extremely difficult words, the child proceeds from "body accentuation" (e.g., lifting a cup while saying the word "cup"), to "picture accentuation" (seeing a picture of a cup which is formed

from the letters "c-u-p"), to "symbol accentuation" (which shows the letters more clearly while still maintaining a resemblance to a cup), to the symbol itself ("CUP" without accentuation). The method was significantly more successful than traditional techniques (using non-accentuated symbols) in a research study involving mentally retarded and brain-injured non-readers.

The Stuart Neurophysiological Approach (Stuart, 1963) is designed for children with neurologically-based language disabilities. The main focus of this method is on the integrated use of multiple-sensory devices and methods. Imagery, movement, and speech are combined with the activation of vision, hearing, and touch.

The McGlannan School (Ellingson and Cass, 1966) offers a full ungraded curriculum for dyslexic children. The school's diagnosticians find spatial problems among the many manifestations of dyslexia:

> It is common, for instance, for the dyslexic child to have imperfect directional sense -- to confuse left and right and up and down. As a result he is likely to reverse letters and words, or syllables within words: "b" becomes "d," "p" becomes "q;" and "sorrow" as "sowro;" and numbers may be similarly reversed with "42" substituted for "24." Up and down confusion leads him to write "M" for "W," and "d" for "p." All children, up to about age six, have difficulties of this kind, but the dyslexic child's reversals are far more numerous and persist much longer.

The school's basic approach is to determine the child's strengths and weaknesses, basing specific teaching methods on these findings. Visual and auditory approaches -- those most directly affected by space and time problems -- are supplemented by other methods, such as tactile-kinesthetic techniques. The pupil becomes increasingly familiar with the symbols that he finds so elusive; he feels them, traces them, arranges them in various sequences, and associates their shapes and sounds with familiar objects. Starting with simple geometric forms and

directionality training, the pupil works through to the letters of the alphabet and finally to complete words.

Subject matter is introduced in ways appropriate to the dyslexic pupils' condition. History, for example, is built upon "time lines" which are presented visually. When a dyslexic child looks at a map of the continents, it may appear to be an incomprehensible design. For geography, therefore, he traces the continents, colors them, cuts them out, and pastes them on a styrofoam globe. Only in this way is he able to see that Africa is larger than Australia and that England has a jagged coastline while Florida's is smooth. Concrete experiences help him to understand abstract concepts in other phases of the curriculum as well.

The Hudson Workbooks (1965) are designed for the primary grade pupil who lacks adequate time and space constructs. The When? workbook utilizes pictures, bodily exercises, and pencil-paper activities to develop such concepts as "now," "then," "before," "after," "soon," "often," "seldom," "never," "yesterday," "today," "tomorrow," etc. The Where? workbook attempts the same thing for such concepts as "up," "down," "on," "in," "over," "under," "around," "behind," "out," "here," "there," etc.

The Glen Haven Achievement Center for Children bases its remedial programs on the work of Kephart (1960) who has focused his investigations on the child who lacks readiness skills for reading. Kephart's suggestions for remediation involve the teaching of such pre-readiness skills as eye-hand coordination. Even eye-hand coordination, according to Kephart, must be preceded by the attainment of lateral dominance, directional knowledge, smooth eye movements, manual dexterity, and the ability to halt an action at will (Dunsing and Kephart, 1965).

Ideally, these abilities should be mastered at home; Radler and

Kephart (1960) have described procedures which parents can follow to foster their child's sensory-motor development. These procedures include play activities ("Angels-in-the-Snow," rhythm tapping, etc.) as well as utilization of such devices as walking rails, balance boards, and trampolines.

> The early, simple games of the child are intended to develop his sense organs and his motor system. The child experiments with these things, looks at them, feels them from all angles, smells them, and taps them to produce sound. Such games can be called games of experience. By the manipulation of things and of his own body in relation to things, he is perfecting the sensory-motor process and is learning to match sensory data to motor data (Kephart, 1960).

If a child reaches school without having mastered the basic pre-readiness skills, Kephart has designed a number of activities which teachers can inaugurate in the classroom. For example, the "Duck Walk" and the "Rabbit Hop" teach the child sensory-motor patterns which strengthen the body image. Drawing "lazy eights" and other simple figures on the blackboard assists the acquisition of directional knowledge, cross-movement, and the ability to reproduce a pattern. Peg-board lessons, matchstick forms, and ball-and-string games provide for the precise ocular control which Kephart purports is necessary for reading competence.

Kephart has noted that a child must be able to differentiate dimensions in space before he can identify directions along those dimensions. The child's awareness of verticality precedes his awareness of "up" and "down" which, in turn, precedes the concepts of "above" and "below." In much the same way, the awareness of laterality precedes the awareness of "right" and "left." When he procedes from laterality to

lateral directionality, he runs into the problem of the "midline;" as an object crosses in front of a young child, it will at first appear to be approaching him and then, at the midline, will suddenly appear to be going away from him. If the child can not master this directional translation at the midline, he will live in a bizarre and confused space world with his directional relationships shifting capriciously from side to side.

> The older child in the reading situation who has persistent problems with rotations and reversals, and who in some cases literally can not distinguish a "b" from a "d," is still struggling with the directionality problem. In working with such a child, it is well to establish just how thorough has been his solution of the more basic laterality problem. Directionality must rest upon a sound and stable motor awareness....This explains the need for a heavy emphasis upon hand-eye tasks during the learning of directionality (Dunsing and Kephart, 1965).

The Boder Procedure enables teachers to diagnose patterns of dyslexia through observation of reading and spelling performance. It begins with a word recognition inventory (e.g., Black, 1968); Schiffman, 1962) which contains a "flash" section and an "untimed" section. When taking the test, the child first looks at each word for one second; if he identifies it correctly, he continues down the list (i.e., "flash"). If he misreads the word or cannot read it at all, he is asked to study the word for as long as he wishes and then make another attempt to read the word (e.g., "untimed"). The words correctly identified in the "flash" section are regarded as his "sight vocabulary" while those identified during the "untimed" section represent his "word attack vocabulary" -- his ability to use word attack skills (e.g., analysis and synthesis). All other words represent the child's "unknown" vocabulary.

Following the administration of the word recognition test, the

pupil is asked to write 10 words from his "sight vocabulary" and 10 from his "unknown vocabulary." Inspection of the first list reveals his ability to revisualize while inspection of the second list indicates the child's proficiency in the utilization of phonic and/or linguistic methods while spelling.

Finally, the child is administered an informal reading survey (e.g., Krippner and Snyder, 1968). This determines whether the child's ability to read is improved in context; it also evaluates his reading recall and comprehension. On the basis of the pupil's performance, Boder places him in one of three groups:

> Group One Children have reading-spelling patterns which reflect a deficit in symbol-sound integration and an inability to develop phonic and/or linguistic skills. They can revisualize but can not reauditorize adequately. They tend to read words better in context than separately. They tend to guess a word from the first letter or from context. The "sight vocabulary" is larger than the vocabulary utilizing word attack skills. They can spell only those words in their "sight vocabulary" which they can revisualize. The misspelled words contain gross errors indicating virtually no ability to "sound out" a word (e.g., "sopy" for "stop"). Words are often substituted -- both in reading and spelling -- which are related conceptually but not perceptually (e.g., "house" for "cottage"). Remediation should consist of enlarging the "sight vocabulary" by stressing whole-word recognition techniques, reinforced by tactile-kinesthetic clues and supplemented by remedial phonics and/or linguistics for both reading and spelling. In this way the child's strengths are utilized while his weaknesses are gradually corrected. His deficiencies in reauditorization will handicap his spelling progress; thus, he should be taught to spell phonetically so that his work will at least be intelligible, even if it is not completely accurate.
>
> Group Two children read laboriously, as if they are seeing each word for the first time. Just as the Group One children have trouble learning what the letters sound like, Group Two children have difficulty learning what they look like. These children have poor revisualization skills but are not handicapped in their ability to reauditorize. Therefore, they often can recite the alphabet without recognizing many of the letters in print. They "sound out"

words as they read them and their "word attack vocabulary" may be more extensive than their "sight vocabulary. Non-phonetic words in their limited sight vocabulary are often written incorrectly while perfectly phonetic words are often written correctly, even if they appear in the "word attack vocabulary" or the "unknown vocabulary." Even when the words are misspelled, they are usually intelligible (e.g., "sed" for "said," "bisnis" for "business"). Reading material in context does not seem to significantly boost their level of reading ability. In remediation, tactile-kinesthetic methods should be used to teach knowledge of letters. Once the letters are mastered, a combination approach stressing phonics or linguistics (e.g., Orton, 1937) may be utilized. These children usually learn readily through phonics or linguistics because they have no basic difficulty with reauditorization. However, the tactile-kinesthetic approach is helpful in bringing about mastery of whole words -- a difficult task in view of the revisualization deficiency.

Group Three children can not read either "by sight" (as can those in Group One) or "by ear" (as can those in Group Two). Deficits in revisualization and in reauditorization produce spelling patterns that are often unintelligible. Spatial difficulties are more prominent among children in this group; reversals (e.g., "b" for "d"), rotations (e.g., "M" for "W"), and configuration errors (e.g., "h" for "n," "v" for "y") are frequently encountered. Emotional reactions are often noted among these children; many of them will demonstrate a sense of defeat or a phobic withdrawal from reading. The initial remedial approach for learning letters and whole words would be tactile-kinesthetic (e.g., Fernald, 1943). When letters and a small sight vocabulary are mastered, remedial phonics or linguistics can be introduced, supplemented by additional tactile-kinesthetic methods. Spelling improvement will be extremely slow but should begin with whole-word techniques utilizing tactile-kinesthetic reinforcement.*

Boder divided a clinic sample of dyslexic children into these three groupings, finding that Group One was the most common classification, Group Three the second most common, and Group Two the least frequent. She concluded that dyslexic children form "a heterogeneous group"

---

*The efficacy of the tactile-kinesthetic approach has been demonstrated in a research study reported by Turner, 1968).

demanding individual attention and treatment.

The Barsch-Perceptual-Motor Curriculum (Barsch, 1967, 1968) presents a specialized approach to achieving optimal learning efficiency for the pre-school, elementary, secondary, and special class child with an emphasis upon techniques for the classroom teacher and the parent. Barsch's approach stresses the relationship between physical movement and conceptual development.

The Programs to Accelerate School Success (McKee, et al., 1964) are based upon the work of Getman (1962) who specifies six basic developmental processes: general movement (e.g., creeping), special movement (e.g., manipulative skills), eye movement, communication, visualization, and visual-perceptual organization (e.g., reading).

Getman (1962) has stated that parents can assist their children in attaining proficiency in each process. Among the activities suggested are stomach rolls, balloon tossing, ocular pursuit, sound identification, identification of objects, and the counting of objects from left to right. These procedures were employed in a 15-week study of four first grade classes; the experimental group's gains in reading comprehension were significantly greater than those of the control group (McKee, et al., 1964).

Neurological Organization (Delacato, 1963) is fostered by the treatment procedures advocated by the Institutes for the Achievement of Human Potential (IAHP). Feeling that learning disability is often a manifestation of abnormal function of the central nervous system, IAHP rehabilitationists direct their treatment to the brain itself, through either surgical or non-surgical techniques. The latter techniques fall into five categories: supplying discrete units of information to the brain for storage, programming the brain, eliciting immediate responses

from the brain, permitting the brain to respond to previous programming, providing an improved physiological environment in which the brain may function. Examples of the techniques would include sensory stimulation (using tuning forks, flashlights, "sniff jars," etc.), superimposing movement patterns on the organism, providing sensory inputs that demand motor responses, encouraging certain types of crawling and creeping activities, and reducing liquid intake in an attempt to prevent over-accumulation of cerebrospinal fluid. Several studies have demonstrated the effectiveness of the IAHP approach (Delacato, 1966, Tremonti, 1968-9); in several additional studies, the IAHP techniques did not produce significant differences (Robbins, 1956; O'Donnell and Eisenson, 1969). Two differing accounts of the approach have been prepared by LeWinn (1966) and by Robbins and Glass (1969).

Conclusion

Dyslexia -- which can best be described as reading disability resulting from central nervous system dysfunction -- is not a simple entity since there is considerable variability in the degree and nature of the impairment. However, dyslexic children typically demonstrate a spatial confusion most obvious in the child's inability to consistently differentiate between reverse language symbols ("b" and "d," "was" and "saw"). In addition, they ignore the details within words, basing word recognition on insufficient cues (the word's initial letter, the word's length, etc.). Dyslexics also demonstrate difficulty in learning the associations between phonemes and graphemes -- between letter sounds (particularly multisound vowels) and letter symbols. Other learning problems exist but vary, depending on the type of dyslexia from which the child is suffering (Cole and Kraft, 1964).

An interdisciplinary approach is needed for the diagnosis of dyslexics and several new tests show promise in helping teachers and tutors individualize educational procedures for dyslexics.

Remediation may be inaugurated on a number of levels.

1. The pupil's dyslexic condition may be ignored and the child regarded as "stupid" or "lazy," thus incapable of benefiting from special assistance.

2. The child's condition may be misdiagnosed. Many dyslexic children are mistakenly identified as emotionally disturbed. In some instances, counseling and psychotherapy may be inaugurated. After a long period of treatment, the dyslexic child will still demonstrate reading difficulties (the special attention is not always in vain; the dyslexic child sometimes becomes a "well-adjusted non-reader").

3. The child's problem may be correctly diagnosed but remediation may consist of a repetition of classroom procedures -- or letting the child "read on his own level" with no provision made for his special instructional needs.

4. The child may be recognized as dyslexic and educational adaptations made. Bryant's suggestions (1965) which emphasize special instructional techniques but which omit neurological training, or others like them may be followed:

> Each discrimination or association problem that causes repeated errors in material even below the child's reading level should be worked with by itself until the difficulty is overcome. The simplest and most basic discriminations should be established first. Each new word should be taught by some procedure involving writing the word or filling in missing letters so that attention is directed to details within the word. In addition, it is essential to provide discrimination training between each new word and words of similar shape. Confusion in left and right reversals of letters requires distributed kinesthetic practice and discrimination training with materials of gradually increasing

> difficulty....The steps in increasing the complexity of the task should be so small that he is never allowed to make a mistake because a few errors can disrupt a great deal of previous learning and re-institute confusion.

5. Many remedial approaches attempt to ameliorate the child's educational, emotional, and cultural status; very few are concerned with the nervous system and the body musculature. The most controversial workers in this field emphasize motility, perceptual-motor coordination, and neurological training in an attempt to alter the child's physiology.

Most of the prominent writers in the field doubt that these training procedures can change the child's physiology. Wepman (1964) has stated that the "argument that function or exercise will produce neurological psychological growth has had few adherents over the years." Spache (1964) also has expressed his doubts that externally-directed treatments can induce internal structural changes in the brain.

Proponents of programs that are directed toward improvement in neurological organization point to the research of Klosovskii (1963) who rotated cats on a turntable and, after examining their brains, noted that their neurological growth was significantly greater than those in a control group. Further, Bennett and his associates (1964) found that rats given enriched experiences developed greater weight and thickness of cortical tissue as well as increased chemical activity of the brain, when compared with a control group. These investigators concluded that the anatomical and chemical dimensions of the brain are characterized by "plasticity." As a result, they are responsive to environmental manipulation.

The implications of these data are clear. If neurological organization can be altered, the child's perceptual-motor weaknesses should be

strengthened (through training procedures) while remedial reading is geared toward his strengths. Therefore, a child with poor visual skills and excellent auditory skills might learn how to read through phonic and linguistic approaches while visual training and neurological organization activities are instituted which -- in the future -- will help him to master "sight" approaches to reading.

Another widely held assumption was placed in question by a research project reported by the National Committee for Research in Neurological Disorders in 1962. Generations of medical students have been taught that nerves of the central nervous system will never regrow once they are severed. However, an experiment with cats demonstrated that severed nerves will regenerate for distances up to a quarter of an inch when assisted by a thin wall of filter material called millipore. The millipore sheath guides and supports the growth of the regenerating nerve cells so that they will meet and join. Furthermore, the tiny holes in millipore permit food materials from the blood to sustain the re-budding cells. At the present time it is not known whether these findings will apply to human subjects.

The wealth of research studies and remedial projects underway should encourage clinicians and educators who work with dyslexic children. It is hoped that professional jealousies will evaporate and that inter-disciplinary efforts will be made toward identifying and rehabilitating pupils with central nervous system dysfunctions.

Summary

Dyslexic children suffer from brain dysfunctions brought about by physical injury or disease (post-traumatic dyslexia) or by genetic or

maturational factors (developmental dyslexia). Whereas time distortions affect youngsters with aphasia (speech and listening problems brought about by central nervous system dysfunction), the inability to structure space afflicts children with dyslexia and dysgraphia. The prompt and accurate diagnosis of these children should be viewed as the first step in remediation and should be interdisciplinary in nature. The most controversial issue in remediation is whether or not a child's neurological organization can be changed so as to bring about a greater facility in mastering language skills.

References

Adams, R. B. "Dyslexia: A Discussion of its Definition," Journal of Learning Disabilities, II (1969), pp. 616-633.

Alexander, D., and J. Money, "Reading Disability and the Problem of Direction Sense," Reading Teacher, XX (1967), pp. 404-409.

Argy, W. P., "Montessori Versus Orthodox: A Study to Determine the Relative Improvement of the Preschool Child with Brain Damage Trained by One of the Two Methods," Rehabilitation Literature, XXVI (1965), pp. 294-304.

Barsch, R. H., A Perceptual-Motor Curriculum (Seattle: Special Child Publications, 1967).

Barsch, R. H., Enriching Perception and Cognition. (Seattle: Special Child Publications, 1968).

Bender, L., "Specific Reading Disability as a Maturational Lag," Bulletin of the Orton Society, VII (1957), pp. 9-18.

Bennett, E. L., et al., "Chemical and Anatomical Plasticity of the Brain," Science, CXLVI (October 30, 1964),pp. 610-619.

Birch, H. G., and L. Belmont. "Auditory-Visual Integration in Normal and Retarded Readers," American Journal of Orthopsychiatry, XXXIV (1969), pp. 45-52.

Black, M. H., Informal Word Recognition Inventory for the Pre-Primer Through Sixth Grade Levels (Los Angeles: Elementary Reading Office, Los Angeles Public Schools, 1968).

Boder, E., "Developmental Dyslexia: A Diagnostic Screening Procedure Based on Three Characteristic Patterns of Reading and Spelling." In Claremont Reading Conference, 32nd Yearbook (Claremont, Calif.: Claremont University Center, 1968), pp. 173-187.

Bryant, N. D., "Characteristics of Dyslexia and Their Remedial Implications," Exceptional Children, XXXIV (1965), pp. 195-199.

Capobianco, R. J., "Diagnostic Methods Used with Learning Disability Cases," Exceptional Children, XXXI (1965), pp. 188-193.

Cole, M., and M. B. Kraft, "Specific Learning Disability," Cortex, I (1964), pp. 302-313.

Costa, L. D., "Visual Reaction Time of Patients with Cerebral Disease as a Function of Length and Constancy of Preparatory Interval," Perceptual and Motor Skills, XIV (1962), pp. 391-397.

Critchley, M., Developmental Dyslexia (London: Heinemann, 1964).

Cruickshank, W. M., et al., A Teaching Method for Brain Injured and Hyperactive Children (Binghamton, N. Y.: Syracuse Univ. Press, 1961).

De Hirsch, K., J. J. Jansky, and W. S. Langford, Predicting Reading Failure (New York: Harper and Row, 1966).

Delacato, C. H., Neurological Organization in the Classroom and Neurological Organization Evaluation Form (Chicago: Systems for Education, 1966).

Delacato, C. H., Neurological Organization and Reading (Springfield, Ill.: Charles C Thomas, 1966).

Delacato, C. H., The Diagnosis and Treatment of Speech and Reading Problems (Springfield, Ill.: Charles C Thomas, 1963).

Denhoff, E., "Correlates Between Neurological Dysfunction and School Learning Failure," a paper presented at the annual meeting, American Academy of Pediatrics, New York City, 1964.

Denhoff, E., et al., Meeting Street School Screening Test. (Providence: Crippled Children and Adults of Rhode Island, 1969).

Doman, G. J., C. H. Delacato, and R. J. Doman, The Doman-Delacato Developmental Profile (Philadelphia: The Institutes for the Achievement of Human Potential, 1964).

Dunsing, J. D., and N. C. Kephart, "Motor Generalizations in Space and Time," in Learning Disorders, Volume I, edited by Jerome Hellmuth (Seattle: Special Child Publications, 1965), pp. 77-121.

Einstein, A., The Meaning of Relativity, Fifth Edition (Princeton: Univ. Press, 1956).

Ellingson, C., and J. Cass, "Teaching the Dyslexic Child," Saturday Review (April 16, 1966).

Fernald, G., Remedial Techniques in Basic School Subjects (New York: McGraw-Hill, 1943).

Frostig, M., and D. Horne. The Frostig Program for the Development of Visual Perception (Chicago: Follett, 1964).

Frostig, M., W. Lefever, and J. R. B. Whittlesey, Developmental Test of Visual Perception (Palo Alto, Calif.: Consulting Psychologists Press, 1964).

Fuller, G. B., and J. T. Laird, "The Minnesota Percepto-Diagnostic Test," Journal of Clinical Psychology, Monograph Supplement (1963).

Gillingham, A., and B. W. Stillman, Remedial Training for Children with Specific Difficulty in Reading, Spelling, and Penmanship. (Cambridge: Educators Publishing Service, 1966).

Getman, G. N., How to Develop Your Child's Intelligence (LuVerne, Minn.: Research Press, 1962).

Haeussermann, E., Developmental Potential of Preschool Children (New York: Grune and Stratton, 1958).

Halstead, W. C., Brain and Intelligence: A Quantitative Study of the Frontal Lobes (Chicago: University of Chicago Press, 1947).

Hartigan, P. R., and G. B. Fuller. "The Temporal-Spatial Concept Scale." Revised Edition (Mimeographed, 1965).

Heckelman, R. G. "A Neurological-Impress Method of Remedial-Reading Instruction," Academic Therapy, IV (1969), pp. 277-283.

Helms, H. B., "Time and Space," Academic Therapy Quarterly, II (1967), pp. 197-199.

Hermann, K., Reading Disability (Copenhagen: Munksgaard, 1959).

Hudson, M. W., When? and Where? (Phoenix, N. Y.: Frank E. Richards, 1965).

Ilg, F. L., and L. B. Ames, School Readiness: Behavior Tests Used at the Gesell Institute (New York: Harper and Row, 1965).

Jordan, F. L., and J. Massey, School Readiness Survey for Preschool and Kindergarten Children (Palo Alto, Calif.: Consulting Psychologists Press, 1967).

Kephart, N. C., The Slow Learner in the Classroom (Columbus: Charles E. Merrill, 1960).

Klosovskii, B. N., Development of the Brain and Its Disturbance by Harmful Factors (Oxford, England: Pergamon Press, 1963).

Knights, R. M., and G. C. Hinton, "Minimal Brain Dysfunction: Clinical and Psychological Test Characteristics," Academic Therapy, IV (1969), pp. 265-273.

Krippner, S., "Diagnostic and Remedial Use of the Minnesota Percepto-Diagnostic Test in a Reading Clinic," Psychology in the Schools, III (1966), pp. 171-175.

Krippner, S., and M. S. Snyder, The Krippner-Snyder Informal Reading Survey (Brooklyn: Paramount Press, 1968).

Landsman, M., and H. Dillard, Evanston Early Identification Scale (Chicago: Follett, 1967).

LeWinn, E. B. Human Neurological Organization. (Springfield, Ill.: Charles C Thomas, 1969).

LeWinn, E. B., et al., "Neurological Organization: The Basis for Learning," in Learning Disorders, Volume II, edited by S. Hellmuth (Seattle: Special Child Publications, 1966), pp. 51-93.

Lewis, M. M., How Children Learn to Speak, (New York: Basic Books, 1959).

McCarthy, J. J., and S. A. Kirk, Illinois Test of Psycholinguistic Abilities (Urbana, Ill.: Institute for Research on Exceptional Children, 1968).

McKee, G. W., et al., The Physiology of Readiness (Minneapolis: Programs to Accelerate School Success, 1964).

Manus, L., et al., Perceptual Forms and Incomplete Copy Forms: Teacher's Test Manual (Winter Haven, Fla.: Star Press, 1963).

Miller, A., and E. E. Miller. "Symbol Accentuation: A Method of Teaching Reading to Brain-Injured and Retarded Children," a paper presented at the annual meeting, American Psychological Association, St. Louis, 1962.

Millikan, R. A. "Time," in Time and Its Mysteries, edited by the James Arthur Foundation (New York: Collier Books, 1962), pp. 15-27.

Money, J., A. Alexander, and H. T. Walker, Jr., Road-Map Test of Direction Sense (Baltimore: Johns Hopkins, 1965).

Money, J., "Space-Form Deficit," in The Disabled Reader: Education of the Dyslexic Child, edited by J. Money (Baltimore: Johns Hopkins, 1966), pp. 263-276.

Myklebust, H. R., Development and Disorders of Written Language, Volume I, Picture Story Language Test (New York: Grune and Stratton, 1965).

Myklebust, H. R., "Language Disorders in Children," Exceptional Children, XXIII (1956), pp. 163-166.

Nichols, L. M., "Rotation or Reversed?" Exceptional Children, XXXV (1968), pp. 760-761.

O'Donnell, P. A., and J. Eisenson, "Delacato Training for Reading Achievement and Visual-Motor Integration," Journal of Learning Disabilities, II (1969), pp. 441-450.

Olson, W. C., Child Development (Boston: D. C. Heath, 1949).

Orton, S., Reading, Writing, and Speech Problems in Children (New York: W. W. Norton, 1937).

Pate, J. E., and W. W. Webb, First Grade Screening Test (Circle Pines, Minn.: American Guidance Service, 1966).

Penfield, W., and L. Roberts. Speech and Brain Mechanisms, Princeton, N. J.: Princeton University Press, 1959.

Pollack, C. My Own Reading Book (Brooklyn: Book-Lab, 1967a).

Pollack, C. My Own Writing Book (Brooklyn: Book-Lab, 1967b).

Rabinovitch, R., "Reading and Learning Disabilities," in American Handbook of Psychiatry, edited by Silvano Arieti (New York: Basic Books, 1959), pp. 857-8 9.

Radler, D. H., and N. C. Kephart, Success Through Play (New York: Harper and Row, 1960).

Reitan, R. M. "Psychological Deficit," Annual Review of Psychology, XXXIII (1962), pp. 414-444.

Reitan, R. M. "Relationships Between Neurological and Psychological Variables and Their Implications for Reading Instruction." In Meeting Individual Differences in Reading, e ited by H. A. Robinson (Chicago: University of Chicago Press, 1964), pp. 100-110.

Reitan, R. M. "The Needs of Teachers for Specialized Information in the Area of Neuropsychology." In The Teacher of Brain Injured Children, edited by W. Cruickshank (Syracuse, N. Y.: Syracuse University Press, 1966), pp. 223-243.

Roach, E. G., and N. C. Kephart, The Purdue Perceptual-Motor Survey (Columbus: Charles E. Merrill, 1966).

Robbins, M. P., "A Study of the Validity of Delacato's Theory of Neurological Organization," Exceptional Children, XXXII (1966), pp. 517-523.

Robbins, M. P., and G. G. Glass. "The Doman-Delacato Rationale: A Critical Analysis," Educational Therapy, Volume II, edited by J. Helmuth (Seattle: Special Child Publications, 1969) pp. 321-378.

Ryckman, D. B., and R. Wiegerink, "The Factors of the Illinois Test of Psycholinguistic Abilities: A Comparison of 18 Factor Analyses," Exceptional Children XXXVI (1969), pp. 107-113.

Schiffman, G. B., "Dyslexia as an Educational Phenomenon: Its Recognition and Treatment." In Reading Disability, Progress and Research Needs in Dyslexia, edited by J. Money (Baltimore, Johns Hopkins Press, 1962), pp. 45-60.

Silver, A. A., and R. A. Hagin, "Specific Reading Disability: An Approach to Diagnosis and Treatment," Journal of Special Education, I (1967), pp. 109-118.

Silver, A. A., R. A. Hagin, and M. F. Hersh, "Reading Disability: Teaching Through Stimulation of Deficit Perceptual Areas," American Journal of Orthopsychiatry, XXXVII (1967), pp. 744-752.

Simonson, J., and G. Kovacevich, Simkov Perceptual Organization Inventory (Medina, O.: Anthoff, 1963).

Slingerland, B. H., "Early Identification of Preschool Children Who Might Fail," Academic Therapy, IV (1969), pp. 245-252.

Slingerland, B. H., Screening Tests for Identifying Children with Specific Language Disability, Grades 1-4 (Cambridge, Mass.: Education Publishing Services, 1944).

Spache, G. D., "Another Approach to Language Problems," Reading Teacher, XVII (1964), pp. 409-410.

Spache, G. D., et al., Procedure Manual, Template Procedure (Winter Haven, Fla.: Star Press, 1963).

Strauss, A. A., and L. E. Lehtinen, Psychopathology and Education of the Brain-Injured Child (New York: Grune and Stratton, 1947).

Stuart, M. F., Neurophysiological Insights Into Teaching (Palo Alto, Cal.: Pacific Books, 1963).

Thomas, E. W., "The Validity of Brain Injury as a Diagnosis," Human Potential, I (1967), pp. 9-16.

Thomas, H. B. G., "The 'Supervisor' -- A Hypothetical Mental Function Impaired by Brain Damage," Journal of Mental Science, CVIII (1962), pp. 328-346.

Tien, H. C., "The AEIOU & Y Method of Reading: Theory and Technique," Journal of Special Education, I (1967), pp. 223-240.

Tremonti, J. B. "Neurological Organization and Reading Disability in College-Age Students," Academic Therapy, IV (1968-69), pp. 18-21.

Turner, P., Unpublished Doctoral Dissertation, Kent State University, Kent, Ohio, 1968.

Valett, R. E. Programming Learning Disabilities (Palo Alto, Calif.: Fearon, 1969).

Valett, R. E. The Remediation of Learning Disabilities (Palo Alto, Calif.: Fearon, 1967).

Valett, R. E. Valett Developmental Survey of Basic Learning Abilities, Manual, Palo Alto, Calif.: Consulting Psychologists Press, 1966.

Wepman, J. M., "On Claims and Evidence," Contemporary Psychology, IX (1964), pp. 351-352.

Wohlford, P., and G. L. Flick, "Sex-of-Rater in Clinical Diagnosis of Organic Brain Damage Using the Bender-Gestalt and Memory-for-Designs Test," Perceptual and Motor Skills, XXIX (1969), pp. 107-114.

END

12-16-70