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ABSTRACT

Described is the use of the Halstead-Reitan Neuropsychological Tests in the evaluation of children with learning disabilities. It is explained that these tests are based on a combined evaluation of four methods of inference: level of performance, ratio scores (measuring the discrepancy between overlearned and seldom practiced behavior to infer the presence of brain injury), pathognomonic signs (such as aphasia), and right versus left comparisons. Specific components considered include the category test, tactual performance test (measuring time, memory and localization), speech sound perception test, and tactile form recognition test. (CL)

The Neuropsychological Evaluation of Children with Learning Disabilities

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Children with the chief complaint of learning disabilities or failure to achieve in school are seen in the School Problems Clinic at the New England Medical Center Hospital for a comprehensive multi-disciplinary evaluation including intellectual, academic and neuropsychological testing and where indicated examinations by a neurologist, psychiatrist, clinical psychologist or speech pathologist. Specific recommendation regarding school programs, educational methods and materials are suggested. During this presentation, we will describe the purpose, use and composition of the neuropsychological test battery. We shall also illustrate a comprehensive School Problems Clinic evaluation with a video-tape of a neurological and developmental examination and the presentation and discussion of the neuropsychological, education and intelligence test results of twin eight year old boys.

In the clinical evaluation of children with learning disabilities, the neuropsychological battery may be used diagnostically to assess intellectual functioning, educational performance and to draw inferences concerning the condition of the brain. It may be used to make referrals to ancillary treatment services. There may be something in the pattern of test scores that suggests the presence of a neurological, emotional and/or speech, hearing or language problem. It may be necessary at that time to obtain additional information regarding the child's behavior or functioning to confirm the diagnostic impression made on the basis of the neuropsychological test battery. The neuropsychological test battery may also be used to follow the course of recovery in a child who has, for instance, suffered a closed head injury or central nervous system inflammatory disease. It is also of value in monitoring the functioning of children who are on medication

for the control of a seizure disorder or hyperactivity. For these reasons, the multi-disciplinary diagnostic team must work closely in order to achieve comprehensive educational, psychological and medical management.

There is still another category of children for whom the neuropsychological evaluation may provide insight. In light of present knowledge, they represent a research problem. Certain children do not seem to benefit from reading instruction. At least, their progress is torturously slow and painful. These children appear to be unable to learn reading and language related tasks of one variety whereas they can learn perceptuomotor and auditory tasks that are equally difficult. These are the children alleged to have developmental dyslexia. Theoretically, the issue is one of global versus selective impairment of abilities as a consequence of a brain lesion. An adult with a recent brain lesion may be impaired in only very specific behaviors. To wit, an aphasic adult may be able to repeat the statement "He is here.", and be totally unable to repeat the question "Is he here?" It is our contention, that among children with similar intellectual levels, alterations in learning capacities for specific tasks may result from discrete brain lesions. More specifically, developmental dyslexia may result from a lesion in the left cerebral hemisphere. A comprehensive neuropsychological evaluation may provide behavioral evidence of impairment of the left cerebral hemisphere and also provide an understanding of the class of behaviors that have been altered.

The evaluation model we are presenting is that outlined and developed by Halstead and Reitan. The rationale of their evaluation procedures is based on a conjoint evaluation of four methods of inference: level of performance, ratio scores, pathognomonic signs and right vs. left comparisons.

Level of performance: One of the consequences of brain injury is to lower level of performance for a wide variety of tasks. Children with verified brain lesions will typically score lower on a general intelligence test than a corresponding group of normal control children. In evaluating children suspected of having neurological impairments, one should employ tests that measure level of performance for verbal abilities, for visuo-spatial abilities, and for abstract reasoning abilities. These results for example may be used to judge global performance in school. They may be used to determine whether a child should be placed in a regular classroom where he competes with his peers in all spheres or in a smaller group where he can receive more individual instruction or in a substantially separate program.

A limitation in the use of a level of performance tests is that it is difficult to infer the presence of brain dysfunction from a low level of performance alone. Other factors may also lower the level of performance--cultural deprivation, familial retardation or even temporary anxiety. In the evaluation of the child with learning difficulties, level of performance tests are necessary, but caution should be exercised in drawing the inference of brain damage.

Ratio scores: The concept of ratio scores to infer brain damage was first introduced by Babcock. In the evaluation of a brain injured patient, the question may arise as to whether there has been intellectual loss as a consequence of brain injury. Without a premorbid measure of intellectual functioning such an inference may be difficult to make. Judicious use of patterns of scores may make it possible not only to infer brain damage but also to reach estimates of premorbid level and amount of deterioration if any. The theory is that overlearned tasks and behaviors will be less susceptible to change than recently acquired or seldom

practiced skills. For an adult, a vocabulary test in his native language would measure an overlearned behavior. Reproducing a geometrical design with colored blocks might well represent a seldom practiced behavior. In theory, a wide discrepancy between a vocabulary score and a score on a block design test could not only be used to infer brain damage, but the former could be used to reach conclusions about premorbid level whereas the latter could be used to infer amount of deterioration.

Certain assumptions are present in the use of ratio scores that limit their usefulness. The assumption is present that the effect of brain damage is constant, regardless of type and site of lesion. A lesion of the left cerebral hemisphere will result in the same kind of deficit as a lesion in the right cerebral hemisphere. This is obviously untrue. With children there is the further assumption that the test that represents an overlearned behavior for an adult also represents an overlearned behavior for the child. This assumption is highly questionable. In addition, lesions that occur early in life may not have the same consequences as lesions that occur later in life. An adult who suffers an extensive lesion of the left cerebral hemisphere will probably lose the ability to speak and to read. A child suffering from a lesion principally confined to the left cerebral hemisphere that occurred prior to learning to speak and read may well develop effective language skills. In the evaluation of children, discrepancies between verbal tests on the one hand and motor and sensory tests on the other may be indicative of brain lesions. Discrepancies among verbal tests or between verbal and visuo-spatial tests probably have little diagnostic significance for brain dysfunction.

Pathognomonic signs: Certain behaviors or certain kinds of errors that may be present or absent are believed to be uniquely indicative of brain damage. Aphasia for example, is a pathognomonic sign. An aphasic error not only indicates a brain

lesion, it suggests with very high probability that the lesion is in the left cerebral hemisphere. Rotation on the Block Design Test is believed by many (though without foundation) to be a pathognomonic sign of brain damage. In the evaluation of adult patients, the use of pathognomonic signs may be of value. For the evaluation of children, pathognomonic signs should be used cautiously. For both adults and children, the use of pathognomonic signs will result in a high proportion of false negatives, i.e., patients who indeed have brain damage but who fail to show the sign. In addition, for children pathognomonic signs are age related. The errors that indicate brain damage in an older child may be perfectly normal when made by a younger child. A similar problem exists with respect to interpreting the tracings from an electroencephalogram. Nevertheless, judicious use of pathognomonic signs may be of value in determining presence of brain damage and on occasion site of lesion.

Right versus left comparisons: One of the most powerful tools for inferring brain damage is having the patient be his own control. Compare the adequacy of the right side of the body with the adequacy of the left side of the body. Cultural deprivation may lower the level of performance. Anxiety may lower the level of performance. However, neither of these factors will have a selective effect on one side of the body but not the other. Right versus left comparisons are based on the fact that lesions in the left cerebral hemisphere will impair the right side of the body. Lesions in the right cerebral hemisphere will impair the left side of the body. In the clinical neurological examination, extensive use is made of the principle of right versus left comparisons. It is comparatively recently, that psychologists have incorporated these techniques into their examination procedures. It is even more recent that such procedures have been used in the evaluation of children with learning disabilities.

Each of the foregoing methods of inference is of use in the neuropsychological evaluation of children. The advantage of the Halstead-Reitan battery of neuropsychological tests is that it permits the use of these methods either in isolation or simultaneously. The tests contain an internal set of checks and balances so the validity of an inference base on one of the four methods can be tested against a conclusion reached through another of the methods.

The Halstead-Reitan tests measure a wide variety of behaviors and abilities. These include nonverbal concept formation, the ability to shift set, psychomotor problem solving behavior, motor speed, and simple tactile perceptual ability. The battery described here includes the Wechsler Intelligence Scale for Children (Revised), the category test, a modified trail making test, an aphasia screening test and various tests of psychomotor, motor and sensory or perceptual functions.

Category Test: The Category Test is a measure of abstract concept formation. It requires the subject to abstract and apply principles from serially presented visual stimuli. The test at the intermediate level includes one hundred and sixty-eight presentations divided into 6 subtests. Each subtest is organized around a single principle, and the task of the subject is to discover this organizing principle.

Slides are individually presented on a screen and at the base of the screen is an answer panel which contains four levers numbered one through four. For each picture that appears on the screen, the subject presses one of the four buttons. If his answer is correct, a bell rings; if it is wrong, a buzzer sounds. Only one response is allowed for each item. On the first item in any group, the subject can only guess with regard to the right answer, but as he progresses through the items in the group the occurrence of the bell or buzzer

with each response indicates whether the guesses are correct or incorrect. The test procedure permits the subject to discover the principle underlying the set of items.

Tactual Performance Test (Time, Memory and Localization Components): The Tactual Performance Test utilizes a modification of the Seguin Goddard Form Board. The subject is required, while blindfolded, to place six blocks of different size and shape into corresponding holes on the form board. The subject performs the task first with his preferred hand, then with his nonpreferred hand and finally with both hands. The time recorded for each trial provides the comparison. The adequacy of performance of the two hands and the time score for all three trials is an indication of the adequacy of performance from the standpoint of level. After the third trial has been completed, the board and blocks are put away and the blindfold removed. The subject is then asked to draw a diagram of the board, the shape of the blocks and, as well as he can, locate them in their correct position. The test yields three scores--a score for total time, a score corresponding to the number of blocks correctly drawn from memory and a third score for the number of blocks correctly localized in the subject's drawing.

This test measures the patient's problem-solving ability in a novel situation and requires him to adapt kinesthetic and sensory cues in a problem-solving situation which would ordinarily be coordinated by vision.

Rhythm Test: The Rhythm Test is a modification of the Seashore Test of Musical Talent. The subject is required to differentiate between thirty pairs of rhythmic beats which are sometimes the same and sometimes different. The test appears to require alertness, sustained attention to the task and the ability to distinguish between rhythmic sequences.

Speech Sound Perception Test: The Speech Sound Perception Test consists of sixty spoken nonsense words which are variants of the "EE" sound presented in multiple choice form. The test is played from a tape recorder with the intensity of sound adjusted to meet the subject's preference. For younger adolescents the answer form has 3 alternatives. The subject's task is to underline the letter combination which corresponds to the spoken syllable. The test requires the patient to maintain attention for sixty items, to distinguish between similar auditory stimuli and to recognize the relation between the visual letter combination and its auditory counterpart.

Finger Oscillation Test: This test is a measure of finger tapping speed. Measurements are obtained from a Veeder Root Counter. The subject is given five consecutive 10-second trials and is told for each trial to tap as fast as he can. Measurements are obtained for the preferred hand and then the nonpreferred hand. A score is recorded for each hand and the score is the average of the five 10-second trials. Performance on this test is probably dependent upon motor speed.

Aphasia Screening Test: Reitan modified the Halstead-Wepman Aphasia Screening Test so that it would be suitable for younger adolescents and children. The test is designed to sample a large number of language and related behaviors in order to provide a survey of possible aphasia and related deficits. The test requires the subject to name common objects, spell, identify individual numbers and letters, read, write, calculate, enunciate, understand spoken language, identify body parts, and differentiate between right and left. Measures are also obtained of the patient's ability to reproduce simple geometric forms.

Trail Making Test: The Trail Making Test consists of parts A and B. Part A is a series of twenty-five circles randomly distributed over a white sheet of paper and numbered from 1-25. The subject is required to connect the circles with a pencil as quickly as possible beginning with number 1 and proceeding in sequence

to the end. Part B consists of twenty-five circles, each of which is identified either by a number or a letter of the alphabet. The patient is required to connect the circles in sequence alternating between numbers and letters. Thus, he goes from 1 to A, 2 to B, 3 to C and so on until he gets to the end. Timed scores are obtained separately for part A and part B. The test appears to require visual scanning as well as the ability to shift set in integrating numerical and alphabetical sequences.

Sensory Perceptual Disturbances: Measures of sensory-perceptual intactness for tactile, visual and auditory stimuli are obtained under conditions of double simultaneous stimulation. For tactile stimuli, for example, each hand is first touched separately in order to determine that the subject is able to respond accurately to the hand touched. Following unilateral stimulation, bilateral simultaneous stimulation is interspersed. The normal response is for the subject to respond with the following alternatives: right hand, left hand, or both hands. A patient with a lateralized cerebral lesion will sometimes fail to perceive the stimulus applied to the hand contralateral to the lesion under conditions of simultaneous stimulation even though he was able to perceive the stimulus under conditions of unilateral stimulation. Corresponding procedures are followed for visual and auditory stimuli.

Tactile Finger Recognition: Inability to identify the fingers on the basis of tactile stimulation alone is one manifestation of finger agnosia. The patient's hand is shielded from his view and the fingers are touched in a random order. There are four trials for each finger on each hand, yielding a total of twenty trials per hand. The score is recorded as the number of errors for each hand.

Fingertip Number Writing Perception Test: Numbers are written on the tips of the fingers and the patient is required to identify solely on the basis of tactile

information which number is being written. Again, there is a total of four trials for each finger on each hand. The score is the number of errors for each hand.

Tactile Form Recognition Test: In this test the subject must identify through touch alone common geometrical shapes, (cross, square, triangle and circle). The subject's hand is shielded from his view, and one of the objects is placed in the hand. With the other hand, the subject points to a standard set of stimulus figures that are visually exposed and identifies the given object. Measures are obtained for both the right and left hand. An additional procedure requires that the patient identify by touch pennies, nickels and dimes. Each hand is tested separately and the test also requires recognition of coins placed in each hand simultaneously.

An analysis of the requirements for each of the foregoing tests indicates the diversity of the procedures through which it is possible to infer cerebral damage. The tests permit scores for level of performance on tasks covering a wide range of psychological functions, from higher level cognitive skills, such as concept formation, to very basic, simple tactile-perceptual skills. Methods are given for eliciting pathognomonic signs, for deriving differential scores, and for comparing the two sides of the body. The cross-body comparisons include measurements of motor function as well as sensory integrity. Each method of inference used to supplement and complement the others constitutes not only a powerful diagnostic tool, but also a research procedure for increasing understanding of brain-behavior relations.

The Halstead-Reitan tests provide a tool for investigating, at the most restrictive level, behavioral deficits that may be associated with learning disorders. At a more inferential level, they provide instruments that can be used to make statements about the condition of the brain. In both areas, more research needs

to be done. If, as hypothesized here, dyslexia results from a neurological lesion or has an organic basis, then the relation of dyslexia to other language disturbances also needs to be explained. Is dyslexia one form of a general language impairment, or does it represent a discrete entity? Understanding the relation between early acquired lesions of the brain and the inability to read will not only extend our knowledge of brain behavior relationships, but also it may lead to more effective programs of early intervention.

From the practical side, the Halstead-Reitan tests provide a tool for making effective clinical judgements pertaining to the disposition of a given patient. When relevant, they can be of help in the differential diagnosis of emotional versus organic etiology. They can be of use in explaining the kinds of ability impairments that a child might have in addition to the problem of reading. Impairment in reading does not exist in isolation. It occurs in a framework of a host of complex, debilitating problems. The results of a comprehensive and effective neuropsychological evaluation can be of material value in the decision making process pertaining to the total psychological, educational and medical management of the learning disabled child.

The foregoing is a summary and synopsis of the symposium on the neuropsychological evaluation of learning disabled children. The symposium will also include a demonstration of the Halstead-Reitan tests, a presentation of illustrative cases, a video tape showing of the developmental and a neurological evaluation of 8 year old twins and a discussion of the results of their neuropsychological and educational evaluation.