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Child Neuropsychology

An Introduction to Theory, Research, and Clinical Practice

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"A milestone in the development of the field of child clinical neuropsychology, the book is informative, significant, and of practical value to neuropsychologists and other specialists interested in brain-related disabilities in children. I would use this text heavily for any course I teach in neuropsychology." —*H. Gerry Taylor, Ph.D.*

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For Carolyne, Gerda, Karen, and Paulette

some of these instances, may be unable to benefit from the therapy simply because of a general inability to accommodate the relevant aspects of the therapeutic experiences into his/her cognitive schemata. Because of this situation, the determination of the child's general adaptational capacities would seem to be a *necessary* starting point in the remedial process.

It is quite difficult to define what is meant by the brain's adaptational capacities, especially when we are referring to the brain-impaired child. Although a simplistic definition would include a statement describing the brain's potential for structural and functional change, this does not reflect adequately the complexities involved in assessing a brain-impaired child's adaptational capacities. We will attempt to elucidate this concept by identifying some aspects of the neuropsychological profile which may reflect adaptational capacities.

Perhaps, the most obvious source of information that may serve to enhance the child-clinical neuropsychologist's understanding of the brain-impaired child's adaptational capacity is the child's summary scores (levels of performance) on complex heterogeneous measures. In this regard, the Full Scale IQ (usually derived from one of the Wechsler measures) and the child's level of performance on problem-solving measures (e.g., the Category Test) may be important. However, the use of this particular mode of approach by itself may prove to be misleading (see Chapter 5).

The absence of pathological signs in a child's neuropsychological test profile and good performances on both sides of the body for measures of motor, psychomotor, and tactile-perceptual abilities may, in some cases, be associated with good general adaptational capacities. However, as pointed out above (see Chapter 5), the absence of pathological signs does *not* indicate that the child's brain is completely intact.

The special assessment properties of other measures typically employed in the neuropsychological assessment, when viewed in terms of some version of one or more of the four interpretive strategies associated with neuropsychological assessment, can yield rather specific information concerning a brain-impaired child's adaptational capacities. Some of the more outstanding features of this aspect of determining a child's remedial needs and remediable capacities are described below (see Chapter 5 for a more complete discussion of this topic).

1. The ability of the brain to benefit from feedback. Performances on the Category Test and the Tactual Performance Test demand this capacity.

2. The ability of the child to develop specific adaptational strategies. A qualitative assessment of many neuropsychological test

performances can provide information regarding specific adaptational strategies. In this qualitative assessment, in particular, it is important to keep in mind the child's neuropsychological strengths and weaknesses and the child's general "stage" of intellectual development. Each of these factors should aid in rendering a decision regarding the significance of the child's adaptational strategy.

3. The performance of the child on tasks which require vigilance. Performances on the Seashore Rhythm Test and a comparison of level of performance on later and earlier tests of the Underlining Test can provide information concerning vigilance.

There is no doubt that information can be gleaned from sources other than the neuropsychological assessment regarding the child's general adaptational capacities. For example, when a child has sustained brain-impairment due to a traumatic head injury during childhood, selected aspects of that child's post-brain-injury educational history can provide some information regarding adaptational capacities. However, we have found that it is best to draw as much information as is possible from the neuropsychological assessment rather than relying on other sources of information which are less standardized and may be systematically contaminated (see Chapter 5).

The remedial significance of a brain-impaired child's general adaptational capacities (in the way that these capacities have been described here) cannot usually be determined until other variables relating to the child's remedial needs and remediable capacities have been considered. However, it would appear that there are some rather general principles pertaining to this issue which may apply in at least some circumstances.

1. The brain-impaired child who exhibits well-developed general adaptational capacities usually has a better prognosis than does the child who exhibits somewhat poorly developed general adaptational capacities.
2. The brain-impaired child who exhibits well-developed general adaptational capacities can usually benefit from a wider range of remedial approaches and techniques than can the child who exhibits somewhat poorly developed general adaptational capacities.
3. The brain-impaired child who exhibits well-developed general adaptational capacities on the one hand, and obvious, outstanding specific deficiencies in one or more areas of adaptive abilities (e.g., motor and psychomotor handicaps) on the other, may be particularly at risk for the development of secondary emotional handicaps if his/her remedial program is not designed in an appropriate fashion.

TABLE 7-1
Tests included in neuropsychological test battery

Tactile-Perceptual
1. Reitan-Kløve Tactile-Perceptual and Tactile-Forms Recognition Test
a. Tactile Imperception and Suppression
b. Finger Agnosia
c. Fingertip Number-Writing Perception (9-15 yr)
Fingertip Symbol-Writing Recognition (5-8 yr)
d. Coin Recognition (9-15 yr)
Tactile-Forms Recognition (5-8 yr)
Visual-Perceptual
1. Reitan-Kløve Visual-Perceptual Tests
2. Target Test (TAR)
3. Constructional Dyspraxia Items, Halstead-Wepman Aphasia Screening Test
4. WISC Picture Completion, Picture Arrangement, Block Design, Object Assembly subtests
5. Trail Making Test for Children, Part A (TRA; 9-15 yr)
6. Color Form Test (5-8 yr)
7. Progressive Figures Test (PF; 5-8 yr)
8. Individual Performance Test (5-8 yr)
a. Matching Figures
b. Star Drawing
c. Matching V's
d. Concentric Squares Drawing
Auditory-Perceptual and Language Related
1. Reitan-Kløve Auditory-Perceptual Test
2. Seashore Rhythm Test
3. Speech-Sounds Perception Test (SSP)
4. Auditory Closure Test (AC; Kass, 1964)
5. Sentence Memory Test (SM; Benton, 1965)
6. Verbal Fluency Test (VF)
7. Peabody Picture Vocabulary Test (PPVT; Dunn, 1965)
8. Aphasoid Items, Aphasia Screening Test
9. WISC Information, Comprehension, Similarities, Vocabulary, Digit Span subtests
Problem Solving, Concept Formation, Reasoning
1. Halstead Category Test (CAT)
2. WISC Arithmetic subtest
3. Matching Pictures Test (MP; 5-8 yr)
Motor and Psychomotor
1. Reitan-Kløve Lateral Dominance Examination
2. Dynamometer
3. Finger Tapping Test
4. Foot Tapping Test
5. Kløve-Matthews Motor Steadiness Battery
a. Maze Coordination Test
b. Static Steadiness Test
c. Grooved Pegboard Test

TABLE 7-1 (*continued*)

Other
1. Underlining Test (UL; Doehring, 1968; Rourke & Orr, 1977)
2. WISC Coding subtest
3. Tactual Performance Test (TPTD-TPTN-TPTB)
4. Trail Making Test for Children, Part B (TRB; 9-15 yr)

Note. Unless otherwise indicated, these measures are described in Reitan and Davison (1974) or Wechsler (1949).

should be borne in mind that this type of neuropsychological examination is designed to allow for a "blind" assessment strategy. As noted above, the tests are administered by psychometrists and the interpretation of the results of the examination does not typically involve reference to the clinical history or direct observation of the child's behavior. While we have attempted to adhere rigorously to this policy in our clinical practice, this does not imply that clinical information is not useful. Indeed, the clinical history and observation of the child may, and often do, provide important insights regarding the child's condition. As the reader will soon recognize, the "blind" nature of our assessment procedure is not always obvious in the case presentations. For reasons of style and coherency, it was often necessary to present information that was not available to us at the time of assessment. In any case, the reader may wish to attempt a "blind" evaluation of the test results prior to examining the accompanying narrative.

The presentation of test scores posed several difficulties, since the test battery produced in excess of 100 measures in addition to direct observations of behavior by the psychometrist(s). Although we wished to present as many data as possible, the limitations of space forced us to recognize that excessive data could produce more confusion than clarity. In order to simplify (but not distort) the presentations, we chose to provide data in graphic and tabular form, accompanied by brief narratives describing additional test results not included in the graphs or tables.

In each case, we have presented in tabular form the Wechsler Intelligence Scale for Children (WISC; Wechsler, 1949) Verbal IQ, Performance IQ, and Full Scale IQ, including the subtest scaled scores. Grade-equivalent scores for the Wide Range Achievement Test (Jastak & Jastak, 1965) and Peabody Picture Vocabulary Test (Dunn, 1965) IQ and Mental Age scores are also presented. The raw data for other neuropsychological tests were converted to age-based normalized *T* scores ($M = 50$; $SD = 10$), and these data were used to construct histograms. This procedure obviated the need to provide

In general, she exhibited a cheerful demeanor and she was pleasant, friendly, and cooperative. She seemed to put forth good effort on most of the tasks presented to her, and it was felt that the test results obtained constituted a fairly reliable and valid reflection of her adaptive abilities.

Formal testing revealed very marked motor control difficulties. Seriously deficient levels of performance were obtained on tests for grip strength, motor speed, static, kinetic, and resting steadiness, and tests for speeded eye-hand coordination. These motor control difficulties were clearly reflected in the quality of her printed and cursive letter formations and in her drawings of various geometric forms (see Figure 7-9b). She tended to exert considerable pencil pressure and proceeded very slowly, as if sacrificing speed for accuracy.

Administration of the WISC yielded a Full Scale IQ in the Borderline range, with somewhat better overall performance on the Verbal portion of the test as compared with the Performance section of the test. Examination of the Verbal subtest scaled scores revealed a relatively "flat" pattern, except for the Comprehension subtest which was well below chronological age expectancy (scaled score = 4). Subtest scaled scores on the Performance section of the test were somewhat variable, ranging from lows of 4 on the Object Assembly subtest and 5 on the Picture Arrangement subtest to a high of 9 on the Picture Completion subtest (see Figure 7-9a).

She exhibited a number of deficient performances on several tasks designed to evaluate her ability to process visual-perceptual and visual-spatial information. For example, the Target Test (requiring her to recall and reproduce simple visual-spatial patterns) yielded a mildly impaired score. However, her performance on this test was somewhat inconsistent; that is, she tended to incur errors on some relatively simple items followed by correct responses to more complex items presented later in the test. Her graphic reproductions of simple geometric forms and her drawing of a complex key contained rather obvious visual-spatial distortions (see Figure 7-9b). A series of tests requiring her to underline various types of verbal and nonverbal stimuli as quickly as possible (Underlining Test) was problematic for her. However, it was interesting to note that she performed in a fairly normal manner on several subtests involving, in one case, a fairly complex geometric configuration and, in another case, a sequence of simple geometric figures. Thus, it was important to be cautious in interpreting her performance on tests designed to tap visual-perceptual and visual-spatial abilities, since it appeared that the greater the motor and psychomotor requirements of the task, the poorer her performance tended to be. Another example of this is seen in her performance on the Picture Completion subtest (scaled

performance on the Object Assembly subtest, which requires the manipulation of puzzle parts, was outstandingly low (scaled score = 4). It was interesting to note that, on the latter test, she did recognize the object (e.g., stated "this is a car"), but was unable to assemble it in an appropriate manner. Further, her performance on the Trail Making Test, Part A, was at least low-average, whereas she encountered serious difficulty with the Trail Making Test, Part B version of the task. This may have reflected some inflexibility in her thinking (i.e., being unable to shift back and forth between numeric and alphabetic sequences) as opposed to problems with the visual-spatial characteristics of the test.

There was also compelling evidence of deficiencies in her tactile-perceptual abilities. On two occasions (out of four trials), she misperceived simple tactile stimulation delivered to the left hand, and on one occasion (out of four trials) she suppressed tactile stimulation delivered to her left hand when her right hand was simultaneously stimulated. There was some evidence of bilateral finger agnosia, and she performed rather poorly when required to discriminate between coins of various denominations on the basis of tactile analysis. Finally, there was evidence of considerable difficulty on the Tactual Performance Test. Indeed, she was only able to place four of the six blocks on the initial trial with her right hand. This trial was terminated after 10 minutes when it became clear that she was becoming very frustrated. However, a positive practice effect was noted on repeated trials involving her left hand and both hands together.

Evaluation of her verbal skills revealed some mild difficulties. For example, poor performances were obtained on a Speech-Sounds Perception Test, the Auditory Closure Test, and the Sentence Memory Test. However, she was able to generate words based on a phonemic rule (Verbal Fluency Test) in an age-appropriate manner. Also, as has already been noted, the majority of the subtests on the Verbal portion of the WISC yielded scores within Normal limits, the only exception to this being the Information (scaled score = 7) and Comprehension (scaled score = 4) subtests. Evaluation of her Reading and Spelling performances on the Wide Range Achievement Test revealed some appreciation for sound-symbol relationships. For example, her misspellings of longer, presumably less familiar, words could best be characterized as "phonetically accurate." However, her reading responses suggested a "best-guess" approach to the decoding of longer, more complex words. Although it was difficult to ascertain for certain, there seemed to be little evidence of an attempt to analyze such words in a phonetic fashion.

In summary, it was clear that this youngster's simple motor, psychomotor, and tactile- and kinesthetic-perceptual skills were quite

Closure Test, which requires the ability to blend spoken sounds to form a target word.

Examination of the response pattern on individual tests revealed additional inconsistencies. For example, on the Auditory Closure Test he incurred errors on some relatively simple items followed by correct responses to lengthier, more complex items presented later in the test. A similar inconsistency in response mode was also noted on the Underlining Test which, briefly described, requires the child to underline, in a series of 13 subtests, various simple and more complex stimuli (e.g., single letters and numbers, combinations of letters forming pronounceable and unpronounceable nonsense words, short meaningful words, simple and more complex geometric configurations) interspersed amongst similar, but incorrect, stimuli (see Appendix). This youngster performed rather poorly on subtests involving relatively simple stimuli (e.g., a single number, a simple geometric form, a single letter), while exhibiting at least average levels of performance on subtests which involved relatively more complex stimuli. A rather puzzling inconsistency was noted in some of his responses on the Vocabulary subtest of the WISC. For example, he provided rather poor responses to words such as fur, spade, nuisance, and brave, but provided excellent responses to presumably less familiar words such as nitroglycerine, fable, and shilling.

It has been our experience that children who perform in the variable manner exhibited by this boy are often found, upon investigation, to be experiencing some form of socioemotional disturbance. It seemed unlikely that the pattern of test results obtained could be accounted for on the basis of a central processing deficiency. In any case, the levels of academic achievement obtained on the Wide Range Achievement Test seemed improbable in a child who was experiencing some form of cerebral dysfunction, but are not atypical of children who are experiencing mild to moderate emotional disturbance. His treatment and family counseling were recommended and impleduced a number of scale elevations consistent with this formulation (see Figure 7-13b). The pattern obtained on the Personality Inventory for Children suggested that, in addition to concerns regarding his intellectual potential, the mother saw her son as being socially isolated, emotionally labile, and prone to unhappiness and self-criticism. On this basis, an interview was arranged with the parents during which it was revealed that the boy was exhibiting a number of behaviors which, if not bizarre, were at least unusual. For example, he apparently refused to wear white socks because they contained ghosts. He was very meticulous about ensuring that his clothes were placed in a cupboard or drawer (out of sight), claming that his clothes had eyes. His mother also reported, as she put it, "hang-ups" regarding issues of crib death and breast feeding.

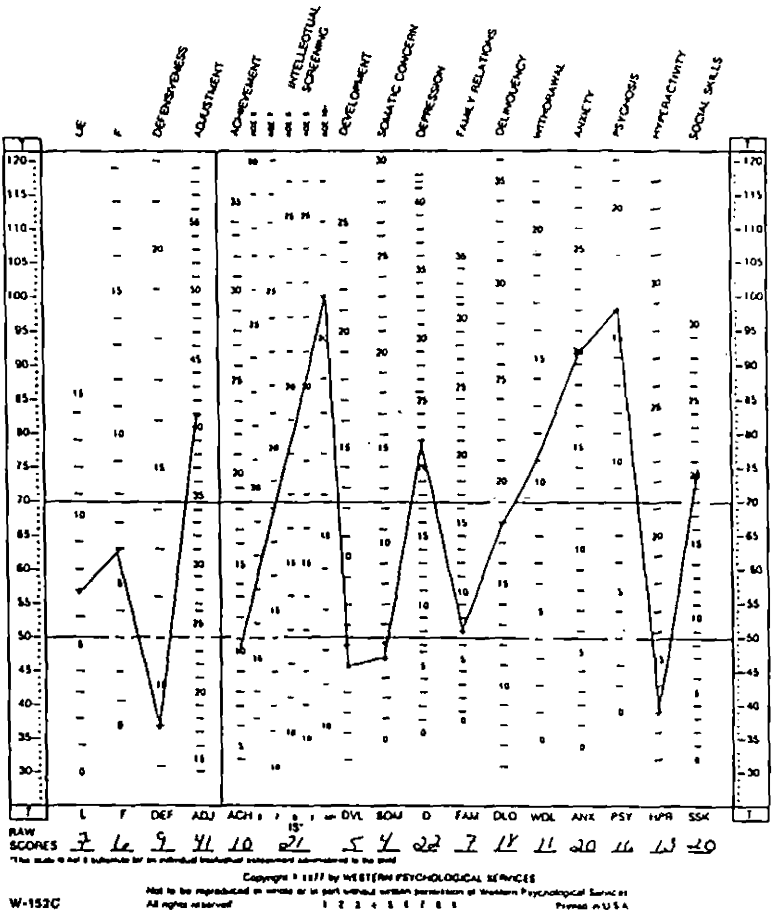

FIGURE 7-13b
Personality Inventory for Children profile—Case 13.

In any case, we arranged to interview the boy directly in order to obtain some impressions prior to a more thorough personality evaluation. During this interview, his behavior was quite inappropriate for a 12-year-old boy. His conversation was rambling, disjointed, and somewhat tangential, with frequent references to ghosts in his socks, fear of looking at himself in the mirror, and so forth. Throughout the half-hour of contact he seemed emotionally labile, alternating between episodes of silly "giddy" behavior and those of a more appropriate nature. On the basis of a rather extensive evaluation of the boy and his family, the opinion rendered by the psychologist in charge of this case was that this youngster might

representing the blocks in their proper spaces. In all, six measures are obtained. Scoring is based on the time needed to place the blocks on the board with the dominant, the nondominant, and both hands. A fourth measure is the sum of the time taken with the right, left, and both hands. The Memory component of this test is the number of blocks correctly reproduced in the drawing of the board; the Location component is the number of blocks correctly localized in the drawing.

CHILDREN'S WORD-FINDING TEST (Reitan, 1972; Pajurkova, Orr, Rourke, & Finlayson, 1976; Rourke & Fisk, 1976)

The test consists of 13 items, each item composed of 5 sentences. Each sentence contains a nonsense word, "Grobnik." The child is required to determine (10 seconds per sentence) the meaning of the nonsense word through the appreciation of its verbal context. *Score*: total correct. *Task requirement*: verbal problem solving and appreciation of contextual cues. *Stimulus*: spoken word. *Response*: spoken answer.

UNDERLINING TEST (Doehring, 1968; Rourke & Orr, 1977; Rourke & Petrauskas, 1977; Rourke & Cates, 1980)

These tests are intended to assess speed and accuracy of visual discrimination for various kinds of verbal and nonverbal visual stimuli presented singly and in combination. In general, the visual stimulus becomes more verbal and more complex with each succeeding subtest. Subtests 1 and 13 involve the same task in order to permit assessment of practice effect. A final test (14) is administered to control for motor speed. A short practice item is given for each subtest.

Subtest 1: Single Number

The child is required to underline the number 4 each time it appears on a printed page containing a random sequence of 360 single numbers. An example of the number to be identified is printed at the top of the page. A short practice test is given. *Score*: total numbers correctly underlined minus total incorrectly underlined in 30 seconds. *Task requirement*: locating and underlining a particular number interspersed among other numbers. *Stimulus*: random sequences of printed numbers. *Response*: simple underlining response to identify single numbers.

Subtest 2: Single Geometric Forms

The child is required to underline a Greek cross with a pencil each time it appears in random sequence among a series of 235 geometric forms, including squares, stars, circles, and triangles, and so forth. The forms are about ¼" in height. *Score*: total crosses underlined minus total errors in 30 seconds. *Task requirement*: as in previous subtest, but for identification of a geometric form.

Subtest 3: Single Nonsense Letter

A single nonsense letter is interspersed among 10 structurally similar nonsense letters in a random sequence of 126 letters. *Score*: total correct minus incorrect underlined letters in 30 seconds. *Task requirement*: as in previous subtest, but for identification of a nonsense letter.

Subtest 4: Gestalt Figure

The figure to be identified is a diamond about 8 mm in height containing a square which in turn contains a diamond. This figure is interspersed among similar figures in a random sequence of 168 figures. *Score*: total correct minus incorrect underlined figures in 60 seconds. *Task requirement*: as in previous subtest, but for identification of a complex figure.

Subtest 5: Single Letter

The letter "s" is interspersed among 360 randomized letters. *Score*: number underlined minus number of errors in 30 seconds. *Task requirement*: as in previous subtest, but for a single letter.

Subtest 6: Single Letter in Syllable Context

One hundred sixty-two four-letter nonsense syllables are presented, 47 of which contain the letter "e." The child is required to underline each syllable containing "e." *Score*: total correct minus incorrect in 45 seconds. *Task requirement*: as in previous subtest, but for a letter in syllable context.

Subtest 7: Two Letters

The letters "b" and "m" are interspersed among 360 randomized letters. *Score*: number underlined minus number of errors in 45 seconds. *Task requirement*: as in previous subtest, but for two letters.

Subtest 8: Sequence of Geometric Forms

Four geometric forms (triangle, Greek cross, circle, crescent) are presented in various orders for a total of 65 "syllables." The child is required to underline only the groups with the order triangle, cross, crescent, and circle. *Score*: total groups correctly underlined minus errors in 60 seconds. *Task requirement*: same as in previous subtest, but for groups of geometric figures.

Subtest 9: Four-Letter Nonsense Syllable, Unpronounceable

The child is required to underline a four-letter nonsense syllable ("fsbm") interspersed among 146 four-letter nonsense syllables. All syllables are made up of consonants, which renders them unpronounceable. *Score*: total correct

minus incorrect in 60 seconds. *Task requirement*: same as in previous subtest, but for nonsense syllables.

Subtest 10: Four-Letter Nonsense Syllable, Pronounceable

This task is the same as in the previous subtest except that it involves the identification of a pronounceable nonsense syllable ("narp") instead of an unpronounceable nonsense syllable. This syllable is interspread among other nonsense syllables made up of the letters "n," "a," "r," "p." *Score*: total correct minus incorrect in 60 seconds. *Task requirement*: same as in previous subtest but for a pronounceable nonsense syllable.

Subtest 11: Four-Letter Word

The word "spot" is interspersed among 146 four-letter syllables made up of the letters "s," "p," "o," "t." *Score*: total correct minus incorrect in 60 seconds. *Task requirement*: same as in previous subtest, but for a four-letter word.

Subtest 12: Unspaced Four-Letter Word

The word "spot" is interspersed among the letters "s," "p," "o," "t," in various orders, with no syllabic spacing. *Score*: total correct minus incorrect in 60 seconds. *Task requirement*: same as in previous subtest, but for an unspaced word.

Subtest 13: Single Number

This task is exactly the same as that involved in the first subtest except that the number to be underlined is 5 instead of 4.

Subtest 14: Single Rectangle

The child is required to underline a series of identical rectangles, approximately 1 cm × .5 cm. *Score*: total number underlined. *Task requirement*: speed of underlining.

YOUNGER CHILDREN'S BATTERY (AGES 5–8)

A. The following tests are the same as those administered to children 9–15 years of age:

The tactile, auditory, visual, and finger agnosia portions of the sensory-perceptual disturbances tests

Target Test

Sweep Hearing Test

Auditory Closure Test

Sentence Memory Test

Speech-Sounds Perception Test
Verbal Fluency Test
Auditory Analysis Test
Lateral Dominance Examination
Strength of Grip
Name-Writing Speed
Finger- and Foot-Tapping Speed
Mazes
Children's Word-Finding Test
Underlining Test

B. The following tests differ somewhat from those administered to children 9–15 years of age:

FINGERTIP SYMBOL-WRITING RECOGNITION

The procedure is identical to that described above for Fingertip Number-Writing Perception except that X's and O's are used instead of numbers.

TACTILE-FORMS RECOGNITION

The child is required to identify familiar forms placed in his hands. Four forms are used. Each of these is placed in either hand separately. Then, different pairings of the forms are placed in both hands simultaneously. In all, there are eight possible correct identifications for each hand. *Score*: total incorrect identifications in eight trials for each hand. *Task requirement*: recognition of forms by touch only. *Response*: spoken name of object or pointing to a representation of it.

HALSTEAD-WEPMAN APHASIA SCREENING TEST (Reitan & Davison, 1974)

Naming (Anomia)

Four items. Otherwise, the same.

Writing (Dysgraphia)

One item written, one item printed. Otherwise, the same.

Reading (Dyslexia)

Three items. Otherwise, the same.

Drawing (Constructional Dyspraxia)

Three items. Otherwise, the same.