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8. Perspectives on the Future of Neuropsychological Assessment

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Perspectives on the Future of Neuropsychological Assessment

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PERSPECTIVES ON THE FUTURE OF NEUROPSYCHOLOGICAL ASSESSMENT

The relationship between human behavior and the functioning of the brain has intrigued scholars for centuries. Although the antecedents are clear, our present knowledge of the relationship between observable behavior and the physiology of the central nervous system owes more to the research vigor of the past 40 years than any other time in history. Of continuing interest to psychologists and other neuroscientists has been evidence of the correspondence between the functioning of the brain and cognitive, sensorimotor and affective dimensions of behavior. With such knowledge as a foundation has come the development and continuing validation of psychological methods which allow inferences concerning individuals’ cortical functioning. Thus, what has become known as neuropsychological assessment attempts to relate behavior culled under standardized conditions to the functional efficiency of the brain. Although we are far from consensus on the role neuropsychological assessment should play in routine clinical examinations, numerous authors have argued in favor of a neuropsychological perspective in our understanding of psychiatric as well as neurological disorders (e.g., Dean, 1982a, Golden, 1978; Hartlage & Hartlage, 1977; Reitan, 1955, 1976).

The intent of this chapter is to examine the present status and approaches to neuropsychological assessment in light of a half century of research in the area. Following a review of the critical issues and psychometric adequacy of assessment procedures, this paper pursues developments within the neurosciences which may shape the direction of neuropsychological assessment during the next two decades.
Current Status of Neuropsychological Assessment

**Historical Elements**

As in most areas of measurement, neuropsychological assessment grew out of a need in an applied area. In the case of neuropsychology, the most salient influence has been the desire on the part of the medical community to more fully describe the behavioral effects of brain damage (Reitan, 1966). The administration of experimental and standardized psychological measures to patients with documented structural brain lesions gave rise to a database which allowed investigation of the sensitivity of these measures to brain damage (Halstead & Settlage, 1943; Hunt, 1943; Reitan, 1955). In the post World War II years, these data were expanded with the relatively large number of patients with documented brain lesions resulting from head wounds (Boll, 1974; Luria, 1963; Reitan, 1966). Such events when combined with the growing empirical emphasis beginning in the decade just prior to World War II nurtured a quantitative approach which continues to characterize neuropsychological assessment in North America (Dean, 1982a; Luria & Majovski, 1977). Moreover, theoretical notions concerning brain function mattered less than the utility of assessment procedures in predicting and localizing cortical damage.

Neuropsychological assessment has often been considered an adjunct to the neurological examination. Basically a noninvasive technique, neuropsychological assessment was often seen as a viable alternative to physical diagnostic procedures which often held a mortality probability in themselves (e.g., angiogram) (Reitan, 1955). Although the emphasis on diagnostic prediction continues, increasing importance has been placed on outlining the extent of behavioral impairment, as well as defining the adaptive behavior remaining following brain damage. For, although definitive knowledge concerning the anatomical integrity of the brain may be available, rarely is the neurologist or neurosurgeon in a position to predict the behavioral expression of a given lesion in the patient’s premorbid environment (Dean, in press).

The history of brain-behavior relations may be followed back some 2,500 years (Gibson, 1962). This is as clear as the fact that only since the late 19th century has public evidence begun to accumulate (Broca, 1861; Hebb, 1949; Jackson, 1874). Since this time, a good deal of scientific attention has been focused on the localization of specific functions to areas of the cerebrum (see Boring, 1942; Jackson, 1974; Nielsen, 1953; Wernicke, 1874). The early promise that observable behaviors could be localized to specific structures of the cerebral cortex (e.g., Broca, 1861) has not been realized (e.g., Reitan, 1976). Moreover, the luxury of retrospect allows us to criticize these rather naive attempts to document one-to-one correspondence between behavior and microstructures of the brain. Over the past 100 years, it has become clear that individual differences within cortical structures, variability in the magnitude of lo-
calized lesions, and the functional interaction within the brain threaten the heuristic value of pursuing a specific localization approach to the study of brain-behavior correlates (e.g., Boll, 1974; Reitan, 1955). Conversely, although the notion of static localization has been rejected by most neuroscientists (Dean, 1982a; Parsons, 1970; Reitan, 1974; Sperry, Gazzaniga, & Bogen, 1969), the validity of "organicity" as a single nosological category is also of questionable value (Reitan, 1955). "Organicity" as a unitary behavioral constellation grew from the early assumption that the effects of damage to the brain were similar regardless of location (Reitan, 1955). From this early point of view, the severity of cortical involvement and the patient's premorbid personality were the factors which accented the behavioral manifestations of cortical damage (Goldstein, 1942; Tymchuk, 1974). Operating under this predilection, numerous attempts were made to isolate a classical syndrome of behavioral and psychogenic signs which would be indicative of "organicity" (see Meier, 1963, for a review). In the main, such attempts have been unsuccessful; and, in fact, damage to grossly different microanatomical structures has been shown to manifest itself in a predictably distinct fashion on psychometric measures (e.g., Halstead, 1947; Hartlage & Hartlage, 1977; Parsons, 1970; Reed & Reitan, 1963; Reitan, 1955). It also has become quite clear that considerations such as the patient's age at onset, the acuteness of damage, and the length of the interval between onset and neuropsychological assessment are of such importance in test results that the search for a unitary organic syndrome is at best a quixotic pursuit (see Meier, 1963). It seems extraordinary that even with the wealth of knowledge that has been collected favoring complex organization of functions in the brain, the search for a "single measure of organicity" continues (e.g., Bender-Gestalt) (Tymchuk, 1974).

Due more to pressures existing in the applied setting than theoretical visions of neuropsychological assessment, the field has emphasized diagnostic aspects. Historically, the emphasis in assessment has been on offering data relevant to the diagnosis of neurologically based conditions (Boll, 1974; Diller & Gordon, 1981; Reitan, 1974). As mentioned previously, other than information useful in predicting the locus and extent of cortical involvement, neuropsychological assessment offers an objective baseline of neurologically related behavior functions (e.g., Lezak, 1976). This aspect emphasizes both impaired functions and adaptive behavior remaining after onset and, hence, provides a benchmark by which a patient's condition can be followed. This approach has been shown to be of considerable utility in following the course of progressive condition and outlining the extent of recovery (Dean, in press). As opposed to a diagnostic emphasis, this perspective also holds considerable implication for treatment planning and offers a synthesis of neuropsychological, educational, and behavioral information useful in establishing realistic treatment goals given the patient's level of functioning (Golden, 1978; Goldstein, 1979). Thus, neuropsychological assess-
ment findings have the potential for providing rehabilitation specialists (physical medicine, occupational therapy, etc.) with an overview of the patient’s physical, cognitive, and emotional rehabilitative needs (see Diller & Gordon, 1981).

Approaches to Neuropsychological Assessment

**Quantitative Approach.** Consistent with the North American empirical tradition in measurement, neuropsychological assessment has evolved with a distinct quantitative emphasis (Boll, 1974; Dean, 1982a; Luria, 1966; Reitan, 1976). Although exceptions exist, specific tests have been chosen and batteries assembled on the basis of estimates of reliability and the ability to distinguish groups with documented brain lesions (Golden, Hammemeke, & Purisch, 1978; Klove, 1974; Reitan, 1955; Smith, 1975). Thus, specific tests have evolved more because of their psychometric adequacy than any global theoretical point of view of the functioning of the brain. Although this approach has a number of attributes that recommend it, a few seem rather unique to neuropsychology and the setting in which assessment is applied. Working within the medical setting, it became important early on to demonstrate the sensitivity of neuropsychological assessment procedures to differential diagnoses made by medical specialists (Reitan, 1955). For example, a method of validation employed extensively has been that of the “clinically blind” technique. More familiar in medicine than psychometrics, this validation procedure involves the administration and interpretation of test results without knowledge of the patient’s history or admitting diagnosis (e.g., Reitan, 1955). Neuropsychological inferences and diagnoses resulting from test data are then evaluated against unambiguous neurological findings available for each patient. The objectives of this procedure are twofold. First, an estimate of the utility of the assessment procedure, and, second, an attempt to gain credibility within the medical setting (Crockett, Clark, & Klonoff, 1981; Parsons & Prigatano, 1978; Reitan, 1966).

The roots of neuropsychology lie in behavioral neurology and both clinical and experimental psychology. This fact is reflected in the measures presently utilized in neuropsychological assessment (Boring, 1942; Dean, 1978a; Reitan, 1976). This conclusion is quite clearly portrayed in presently available batteries (Golden, Hammemeke, & Purisch, 1978; Reitan, 1969; Smith, 1975) and specialized tests (Dean, 1978b; Jortner, 1965) of neuropsychological functioning. Although the comprehensiveness varies, most batteries attempt to assess language, intellectual, sensorimotor, and personality factors that have been shown to relate to cerebral functioning (Boll, 1981; Reitan, 1974; Reitan & Davison, 1974). Table 8.1 offers an outline of the neuropsychological functions most consistently examined in the course of assessment. The assessment of individual functions while excluding the influence of others is often a tautological pursuit (Dean, Schwartz, & Smith, 1981). This is true because organic impairment is rarely isolated to one specific function (e.g., Luria, 1966), and measuring many
## Neuropsychological Functions Considered During Assessment

### I. COGNITIVE FUNCTIONS

#### A. General Ability

#### B. Verbal Functions

1. Language
   - Receptive
   - Expressive
   - Knowledge Base

2. Abstract Reasoning
   - Concept Formation
   - Symbolic Manipulation

3. Memory/Learning
   - Registration
   - Immediate (Short-term) Memory
   - Long Term (Intermediate Memory
   - Remote
   - Acquisition Rate

4. Integrative Functions
   - Visual-Verbal
   - Auditory-Verbal
   - Motor-Verbal

5. Numerical Ability
   - Receptive
   - Expressive
   - Knowledge Base

#### C. Nonverbal Functions

1. Perceptual Organization
   - Receptive
   - Expressive

2. Abstract Reasoning
   - Concept Formation
   - Spatial Manipulation

3. Memory
   - Registration
   - Immediate (Short-term) Memory
   - Long Term (Intermediate Memory
   - Remote
   - Acquisition Rate

4. Integrative Functions
   - Visual-Motor
   - Auditory-Motor
   - Tactile-Motor

5. Construction

### II. PERCEPTION

#### A. Visual

1. Acuity
2. Fields of Vision
3. Ocular Dominance

#### B. Auditory

1. Acuity
2. Discrimination
   - Verbal
   - Nonverbal

3. Lateralization of Ability

| continued... |
higher-order functions (e.g., verbal abstract reasoning) is predicated on the assumption of normal contributory functions (e.g., receptive and expressive language) (Dean, 1983a). Therefore, poor performance on a measure of verbal abstract reasoning is a necessary but not a sufficient condition to infer impairment of this function. These factors when combined with routine psychometric considerations make the assessment of functions outside of a wide-band approach offered by a battery a tenuous procedure (Reitan, 1966). Clearly, the interpretation of measures of neuropsychological functioning for individual cases must be made within the context of patterns of strengths and weaknesses (Baron, 1978; Reitan, 1974) rather than the use of the “level of performance” for a single test. Similarly, a number of inferential techniques have evolved which hold predictive utility in inferring brain dysfunction and outlining neuropsychological abilities (Reitan, 1974). Pathogenic signs, long employed in clinical medicine, involve the comparisons of an individual’s performance with behavior constellations known to be consistent with specific neurological conditions. Such behavioral signs rely upon symptoms that would rarely be displayed in patients without neuropathology and therefore increase the probability of cortical impairment. Another method relies on knowledge of hemispheric lateralization of functions and allows left—right localization of functions normally served by different hemispheres of the brain (Boll, 1972a). This knowledge in conjunction with the fact that sensory and motor functions on one side of the body are served by the contralateral hemisphere provides additional inferential support for a neuropsychological hypothesis (Reitan, 1974). Finally, pattern analysis provides what many consider as an integration of the level of performance, pathognomic sign, and lateralization of function approaches (Reitan,
Here, the patient’s assessed strengths and deficits are compared with known test patterns indicative of neuropathology (Smith, 1975). This methodology seeks to identify configurations of individual test scores that are characteristic of specific types of diffuse and localized cortical dysfunction. While problems exist in such a pattern approach (Dean, in press), numerous researchers have stressed the diagnostic, localization, and descriptive power of this method which also serves to reduce the subjectivity inherent in clinically blind interpretations (Anthony, Heaton, & Lehman, 1980; Dean, 1978b; Reed & Reitan, 1963; Russell, Neuringer, & Goldstein, 1970; Selz & Reitan, 1979).

Pattern analysis in conjunction with actuarial norms has generally shown it to be superior to more subjective methods of differential diagnosis (Kiernan & Matthews, 1976; Klove, 1974; Knights, 1973; Russell et al., 1970; Spitzer & Endicott, 1974; Wedding, 1983). Moreover, as a number of researchers have shown in other areas of applied assessment, a mechanical/statistical approach to neuropsychology assessment results has been found superior to more clinically based attempts (Dean, 1978b; Finkelstein, 1976; Russell et al., 1970).

In sum, the emphasis of the quantitative approach to neuropsychological assessment has been on the development of standardized test batteries which allow the actuarial identification of aberrant cortical functioning from a neurostructural point of view (Klove, 1974; Reitan, 1955). Interpretation of measures is facilitated by normative standards and information gleaned from groups with documented neurological conditions (Parsons & Prigantano, 1978; Satz, Fennell, & Reilly, 1970). In keeping with such an orientation, neuropsychological functions are viewed as individual difference variables. Assessment allows the description of the patient on norm-based psychological measures shown to relate to neurological functioning when groups of normals are compared with known neuropathological groups. Such data have been shown to be of considerable utility in making inferences concerning cortical integrity and the behavioral consequences of known lesions.

The Halstead—Reitan Batteries. The Halstead—Reitan Neuropsychological Test Battery is the best known and most widely used comprehensive measure of neuropsychological functioning in North America (Dean, 1983a). This battery represents a melding of experimental and clinical approaches to psychology and behavioral neurology (Reitan, 1974). The vast majority of tests within the battery were originally developed for distinct, experimental, and clinical purposes and were adapted, standardized, and interpretations expanded such that inferences could be gleaned concerning cortical functioning.

The battery is comprised of a number of psychological measures originally developed by Halstead (1947) on the basis of extensive experiments with patients having documented brain lesions. From a battery of experimental procedures, Halstead selected 13 which were seen to be sensitive to cerebral lesions and appeared to be complementary in terms of the range of functions assessed. This
number was later shortened to the 10 measures which best discriminated aberrant cortical functioning (Halstead, 1947).

Ralph Reitan is primarily responsible for the present configuration and validation of measures which have come to be known as the Halstead—Reitan Neuropsychological Test Battery (Reitan, 1969). Reitan’s (1955) early validation study led to the discontinuation of three measures (Time Sense Test, Critical Flicker Frequency, and Deviation) originally proposed by Halstead (1947). Although many of the individual tests were adapted and extended from other measures, brain-behavior findings have allowed quite distinct neuropsychological interpretations. Reitan (1955) further refined Halstead’s original battery with the replacement of the Henmon—Nelson Intelligence Test with the Wechsler—Bellevue Scale and later the Wechsler Adult Intelligence Scale (WAIS). As was true for the inclusion of other tests in the battery, the addition of the Wechsler Scale was prompted by data showing the incremental validity of this measure in diagnosing neuropathology while expanding comprehensiveness of the assessment system (Reitan, 1955, 1966). Although data support the sensitivity of the Wechsler Scales to cerebral impairment in their own right (see McFie, 1975), Reitan (1959, 1966) offers rather convincing evidence that combined subtests from the Halstead—Reitan Battery (referred to as the Halstead Impairment Index) are more sensitive to brain damage in adults than subtests of the Wechsler Scale (Wechsler—Bellevue, Reitan, 1955; Wechsler Adult Intelligence Scale, Reitan, 1974). A good deal of evidence suggests that verbal and nonverbal factor scores are selectively affected by left and right hemispheric lesions respectively (Matarazzo, 1972). Thus, Reitan’s adoption of the Wechsler Scale represented an improvement in psychometric sophistication and comprehensiveness of the battery (Reitan, 1955, 1966, 1974).

Other adjuncts to the battery have been the inclusion of the Minnesota Multiphasic Personality Inventory (MMPI) and the Wide Range Achievement Test (WRAT) (see Reitan & Davison, 1974). Two related factors led to the inclusion of the MMPI. First, because the referral question often asked relates to the discrimination of neurological involvement from psychogenic syndromes. Second, the Halstead—Reitan Battery is oriented toward more intellectual, cognitive, and the sensorimotor end of the measurement spectrum often to the exclusion of the affective factors. The MMPI offered a more comprehensive picture of the respondent’s level of emotional functioning and provided a number of specialized scales of some utility in differential diagnosis of brain damage from various forms of psychopathology (Horton & Timmons, 1982; Jortner, 1965). The Wide Range Achievement Test is often included in the battery with children and when one’s premorbid occupation appears related to academic skills.

Halstead’s (1974) and Reitan’s (1955) methods for the choice and development of neuropsychological assessment devices typifies the quantitative—actuarial approach. Moreover, the emphasis has been the diagnosis and subdivision of brain damage using psychological measures known to have a relationship to
specific brain functions (Dean, 1982a). In sum, the method could be characterized as the development and adaptation of experimental procedures which offer information relevant to psychological deficits shown to result from cortical lesions (Boll, 1981; Halstead, 1947; Klove, 1974; Reitan, 1974). It should be clear that such an approach that relies on a correlational data base may be given to over-interpretation (Klove, 1974).

It is not the intent here to duplicate a number of indepth examinations of the Halstead–Reitan Battery (e.g., Boll, 1981; Dean, 1982a; Reitan & Davison, 1974), but rather as an overview of the present status of neuropsychological assessment. To this end, Table 8.2 is offered as an overview of the battery in terms of the source of specific measures, constructs measured, and the technical adequacy. It is hoped that this summary will provide the reader unfamiliar with neuropsychological assessment a reference for the remainder of the presentation. This recapitulation also makes the distinction between tests included in the Adult Battery (> 15 years) and those of the two children’s versions of the assessment system.

Generally speaking, the greater opportunity to validate brain-behavior relationships during surgery and autopsies and the large number of neurological referrals during the post World War II era has led to greater sophistication in neuropsychological assessment with adults than that with children and adolescents (Boll, 1974; Obrzet, 1981). Therefore, the empirical approach that has characterized adult neuropsychological assessment is a comparatively recent endeavor with children and adolescents who have suffered brain damage. For a number of methodological reasons, clinical and experimental inferences concerning brain-behavior relationships are lacking with children (Benton, 1974; Boll, 1974). Recognizing the possible clinical utility of neuropsychological assessment procedures appropriate with children and early adolescents, Reitan (1969) administered the Halstead–Reitan Battery to a sample of normal children under the age of 15 in an attempt to establish a downward revision of the battery. This modified battery was administered to successively younger children until the lower age limit of 9 years was established based on psychometric properties of tests and predictive statements which could be made for children. In what has become known as the Halstead Neuropsychological Test Battery for Children (9–14 years), most of the individual tests of the battery have remained as a downward revision of the adult battery. Other than the substitution of the Wechsler Intelligence Scale for Children for the WAIS and alteration in the number of items and their organization, few substantive changes were made in the original battery.

With the collection of developmental data with the Halstead Battery for Children, it became clear that major revisions would be necessary in the assessment of younger children (< 9 years) (Boll, 1974; Reitan, 1969). The Reitan Indiana Neurological Test Battery for Children (5—8 years) represents major revisions in the tests of the Halstead Battery for Children and the addition of a number of
TABLE 8.2
Tests Included in the Halstead-Reitan Neuropsychological Battery

<table>
<thead>
<tr>
<th>Name</th>
<th>Origin</th>
<th>Format</th>
<th>Technical Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category Test</td>
<td>Halstead (1947)</td>
<td>Semiautomated visual presentation of slides with underlying concept. Feedback provided as to correctness after depression of one of four learners. Controlled learning experiment.</td>
<td>Reitan (1955)</td>
</tr>
<tr>
<td>Tactual Performance Test</td>
<td>Sequin-Goddard</td>
<td>Shapes placed in form board without aid of vision (dominant, non-dominant, both hands). Recall of shapes and location of board</td>
<td>Reitan (1974)</td>
</tr>
<tr>
<td>Speech-Sounds Perception</td>
<td>Halstead (1974)</td>
<td>Select paralog presented auditorially from four (three) alternatives, total of 60 items</td>
<td>Reitan (1974)</td>
</tr>
<tr>
<td>Rhythm Test</td>
<td></td>
<td>Identification of 30 pairs of rhythmic beats as being &quot;same&quot; or &quot;different&quot;</td>
<td>Reitan (1955)</td>
</tr>
<tr>
<td></td>
<td>Generals Office (1944)</td>
<td>B--Connect 25 (15) numbered or alphabetic circles alternating between numeric and alphabetic order (i.e., 1-A-2-B...)</td>
<td>Boll (1974)</td>
</tr>
<tr>
<td>Finger Oscillation Test</td>
<td>Halstead (1947)</td>
<td>Measure of number of taps with index finger in 10 seconds for each hand. Dominant, non-dominant scores = means of five trials for each hand</td>
<td></td>
</tr>
<tr>
<td>Adjunct Measures¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reitan-Indiana Aphasia Screening Test</td>
<td>Halstead &amp; Wepman (1952)</td>
<td>Thirty-two (22) items requiring naming, spelling, reading, write, math, calculations, enunciate, identify body parts, pantomime actions, perform acts, draw, shapes, and identify directions</td>
<td>Reitan (1969)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Klove (1974)</td>
</tr>
<tr>
<td>Strength of Grip Test (Hand Dynamometer)</td>
<td>Reitan (1955)</td>
<td>Measure of strength of grip. Alternating measures for preferred and nonpreferred hands</td>
<td>Reitan (1955)</td>
</tr>
</tbody>
</table>

¹In addition to the above, the age appropriate Wechsler Intelligence Scale, Minnesota Multiphasic Personality Test, Lateral Dominance, and Wechsler Memory Scale are most often incorporated.

newly developed measures (Reitan, 1969). New tests were included to measure gross skeletal function, abstraction, and a number of visual—spatial relationships.

Since Halstead’s (1947) early efforts to operationalize his theory of biological intelligence and later with Reitan’s (1955) refinements and extensions has come a plethora of research concerning the utility and technical adequacy of these measures. The adult battery has undergone repeated cross validation since Reitan’s (1955) early report (e.g., Reitan, 1958, 1959, 1960, 1964; Vega & Par-
8. NEUROPSYCHOLOGICAL ASSESSMENT

<table>
<thead>
<tr>
<th>Explicit Constructs</th>
<th>Implicit Constructs</th>
<th>Forms</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept Formation</td>
<td>Visual Acuity</td>
<td>Adult--208 slides</td>
<td>Total Errors</td>
</tr>
<tr>
<td>Abstraction</td>
<td>Attention</td>
<td>9-15--168 slides</td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td>Concentration</td>
<td>5-9--80 slides</td>
<td></td>
</tr>
<tr>
<td>Tactual Discrimination, Manual Dexterity, Kinesthesia</td>
<td>Kinesthesia</td>
<td>Adult--10 shapes</td>
<td>(1)Time</td>
</tr>
<tr>
<td>Incidental Memory</td>
<td>Tactual-motor</td>
<td>9-15--6 shapes</td>
<td>(2)Memory</td>
</tr>
<tr>
<td>Spatial Memory</td>
<td>Integration</td>
<td>5-9--6 shapes</td>
<td>(3)Location</td>
</tr>
<tr>
<td>Verbal Auditory Discrimination</td>
<td>Auditory acuity</td>
<td>Adult--4 alternatives</td>
<td>Total Errors</td>
</tr>
<tr>
<td>Auditory-Visual Integration</td>
<td>Language</td>
<td>9-15--3 alternatives</td>
<td></td>
</tr>
<tr>
<td>Attention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonverbal Auditory Discrimination</td>
<td>Attention</td>
<td>Total Errors</td>
<td></td>
</tr>
<tr>
<td>Auditory Perception</td>
<td>Concentration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A--Motor speed, visual scanning, visual-motor integration</td>
<td>Visual Acuity</td>
<td>Adult--25 circles</td>
<td>Separate Time</td>
</tr>
<tr>
<td></td>
<td>Attention</td>
<td>9-15--15 circles</td>
<td>A &amp; B</td>
</tr>
<tr>
<td>Motor speed</td>
<td>Concentration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dexterity</td>
<td>Distractibility</td>
<td>Same</td>
<td>Mean Taps Each Hand</td>
</tr>
<tr>
<td>Wide Band Language and</td>
<td>Education</td>
<td>Adults--32 items</td>
<td>By Item, Total</td>
</tr>
<tr>
<td>Nonverbal Functions</td>
<td>Occupation</td>
<td>9-15--32 items</td>
<td>Error Score</td>
</tr>
<tr>
<td></td>
<td>Concentration</td>
<td>5-9--22 items</td>
<td></td>
</tr>
<tr>
<td>Lateralized Sensory Perception</td>
<td>Distractibility</td>
<td>Total Errors</td>
<td></td>
</tr>
<tr>
<td>(Visual, Auditory,</td>
<td></td>
<td>Left vs.</td>
<td></td>
</tr>
<tr>
<td>and Tactile)</td>
<td></td>
<td>Right side of body</td>
<td></td>
</tr>
<tr>
<td>Motor Strength</td>
<td></td>
<td>Left and Right hand Scores</td>
<td></td>
</tr>
</tbody>
</table>

In general, using various test combination procedures, the battery has been shown to discriminate brain damaged groups from normal controls with considerable accuracy (84–98%) (e.g., Boll, Heaton, & Reitan, 1974; Reitan, 1976; Wheeler, Burke, & Reitan, 1963). The localization accuracy in the discrimination of left from right hemispheric damage and localized from diffuse involvement has been consistently shown to be of clinical utility (> 70% accuracy) (Vega & Parsons, 1967; Wheeler, Burke, & Reitan, 1963; Wheeler & Reitan, 1963). For various reasons, the battery has fared less well in diagnosing brain damage when psychiatric groups were included as controls (e.g., Watson, Thomas, Anderson, &
Felling, 1968). This area of research is discussed at length later in this chapter, but it suffices to say that at this point the HRB suffers its sharpest drop in predictive efficiency when utilized in an attempt to distinguish brain damage from schizophrenia (Lacks, Harrow, Colbert, & Levine, 1970; Watson et al., 1968) and other psychotic disturbances (Dean, 1982b).

Similar to the findings for the adult HRB, research has shown sensitivity to brain damage for the children’s and adolescent versions of the battery (e.g., Boll, 1974; Dean, 1982c; Klonoff & Low, 1974; Reed, Reitan, & Klove, 1965; Reitan, 1971). Although, as is pointed out further, while the research with adults is far from unequivocal in a number of areas, research with children on the HRB, and for that matter neuropsychology in general, is far more tentative (Boll, 1972b; Dean, 1982a; Hartlage, 1981; Reitan, 1974). Problems notwithstanding, the finding of impaired performance for brain-damaged children when compared with normal cohorts seems robust (Boll, 1974; Day & Ulatowska, 1979; Reed, Reitan, & Klove, 1965; Reitan, 1974). Although this is true, differential diagnoses of location with brain-damaged groups seem a far more tenuous procedure with children than with adults. Moreover, brain damage of “middle” childhood onset produces a more global deficit in cognitive ability than that found for adults (Ernhart, Graham, Eichman, Marshall, & Thurston, 1963; Reitan, 1974). As Dean (1982a) points out, “older brain-damaged children (> 9 years) display greater discrepancy from normals on high level language and motor functions than is usually found with younger brain-damaged children” [p. 190]. In this regard, Reed and Reitan (1969) offer data favoring fewer lateralized effects from frank neurological damage with children in general than that found in adults.

**Qualitative Approach.** Numerous authors have characterized the strict empirical emphasis of neuropsychological assessment in North America as being so quantitative that it has become atheoretical (Luria, 1966; Luria & Majovski, 1977; Rourke, 1976). Rourke (1976) argues that with efforts to reduce a plethora of behavioral information to a differential diagnosis, much of the comprehensiveness necessary in understanding the individual patient and planning rehabilitation is lost. Moreover, many neuropsychologists stress the comprehensive understanding of the patient’s functioning in favor of the more quantitative information (e.g., Lezak, 1976; Luria, 1966; Rourke, 1976). Rourke (1976) suggests a dynamic interaction between neuropsychological assessment and rehabilitation. An implicit assumption here is that diagnosis or syndrome identification is heuristic only to the extent to which differential treatment or understandings are conveyed. For many neurological, nosological categories, little is gained in our appreciation of the individual patient’s capacity or, in fact, the patient’s needs in rehabilitation planning (Luria & Majovski, 1977). From this point of view, the actuarial approach which has characterized neuropsychological assessment in North America is seen as investing itself in the development of standardized batteries to the decrement of an understanding of the patient’s functional capacities (e.g., Luria, 1966).
A more qualitative approach to neuropsychological assessment had been articulated by Luria (1963, 1966, 1973). Rather than the neo-structural point of view which has typified the quantitative approach as reflected in the HRB, Luria (1966) argued in favor of a theoretically consistent overview of functional systems of the brain. Specifically, Luria (1963, 1966, 1973) envisioned neuropsychological assessment as a dynamic procedure, the objective of which is the understanding of the integrity of functions as a prelude to the development of rehabilitation strategies. Thus, the selection of specific assessment techniques is based on pathognomonic signs, medical history, and an extensive interview with the patient. A clinical procedure, assessment involves definition of specific symptoms. In this way, specific behaviors are investigated which allow the formulation of hypotheses concerning the brain functions for individual patients (Luria, 1970). It will be recognized that not only does this orientation represent a departure from the psychometric concerns of a qualitative approach, but also represents a reconceptualization of inferences concerning the brain. As opposed to the neo-structural assumptions implicit in quantitative assessment, this approach has at its foundation an orientation to behavior as it may relate to functional systems of the brain. Luria (1966) long maintained that higher forms of human psychological activity are based on the participation of all levels of cortical activity. Therefore, behaviors are more heuristically related to functional systems of the brain than specific structural components (Luria, 1966; Luria & Majovski, 1977). During assessment, specific techniques are formulated to examine patterns of “functioning” (e.g., Luria, 1973), rather than relying on standardized methods and comparisons with normative samples. Thus, specific tests utilized vary from patient to patient depending on the early hypothesis of the patient’s impairment. Such flexibility in assessment would most often be considered more consistent with a “clinical technique” than what we in the West have considered as assessment (Dean, 1983a). This qualitative emphasis is most often faulted as being far too subjective an approach to allow opportunities to establish other than clinical norms (Luria, 1973). Consistent with a clinical orientation, interpretation relies upon the knowledge and experience of the clinician. Unlike the psychometric orientation adapted in the construction of the HRB, in which assessment methods were selected on their predictive efficiency, Luria’s (1966, 1973) methodology relied heavily on his theory of brain functioning in the choice of tasks during assessment. “In sum then, the quantitative school is often portrayed as being atheoretical and ignoring descriptive data; whereas, the qualitative approach has often been faulted for its reliance on case study methods and a failure to systematically evaluate assessment methods” [Dean, 1982a, p. 18].

Luria’s Neuropsychological Assessment Strategies. Within his functional theory of the brain, Luria (1973) characterized neuropsychological assessment as involving attempts to analyze “zones” of the brain which were “responsible for the performance of complex mental activities” [p. 33]. Rejecting the notions of direct cerebral localization and equipotentiality, Luria (1966, 1973) argued in
favor of the evaluation of "zones" of the brain only for their relevant contribution to more complex, functional systems. Early in his theoretical formulation, Luria distinguished between different definitions of "function." Function in neuropsychological assessment was seen as "the complicated adaptive activity of the organism . . . [and was] determined by a specific operation [Luria, 1973, p. 16]. Individual functions were not seen to be localized to specific cortical locations; rather, such functions were seen as being "distributed in a complex system, or constellation of cooperating zones of the cerebral cortex and subcortical structures. . . each of the areas makes a highly specific contribution to ensue the operation of a functional system" [Luria, 1973, p. 17].

It soon becomes obvious that the knowledge of Luria's functional theory of the operation of the brain is the *sine qua non* of the assessment system. This theory is organized around three "blocks" of the brain which incorporates its basic functions. Consisting of the reticular formation and association areas of the brain stem, the arousal block is viewed as the regulator of the cortex energy level. Input and integration of sensory stimuli forms a second block and is seen as consisting of the temporal, parietal, and occipital lobes. The frontal lobe is attributed with primary responsibility for the behavioral planning and execution (Luria, 1966, 1973). Functional blocks are seen as containing specific zones responsible for individual abilities. Importantly, damage to any one block is thought to affect a number of functional systems (e.g., reading, speech, and writing) (Luria, 1966). Table 8.3 presents the areas of functioning most often assessed within this theoretical model.

Christensen (1975) has emphasized that neuropsychological tasks represent but one element in the evaluation of an individual patient in Luria's system. Patient evaluation involves three phases; each attempt to define intact and impaired functions. Brain lesions are seen as disturbing groups of psychological functions rather than a single ability to the exclusion of others within a given block. The initial phase of the neuropsychological assessment procedure involves a clinical interview with the patient. This portion of the evaluation is seen as important, for it allows the clinician an opportunity to generate hypotheses relevant to the nature and location of the lesion. In what is similar to the initial portion of a medical examination, information regarding the patient's history, personality, level of consciousness, and attitude toward illness is gathered.

The second stage of assessment involves the administration of a number of brief tasks meant to outline how multiple functions relate to general mental activity. The item selection, administration, and performance on these tasks are done in a quite subjective fashion (Luria, 1973). By analogy to a more quantitative approach, this phase may well be viewed as a screening procedure. Areas of deficit performance are investigated further in the final phase of the assessment procedure. The objective at this point is to explicate and expand on areas of performance not fully understood in the second phase of assessment. Here, the clinician is encouraged to modify and adapt tasks to maximize the functional
### TABLE 8.3
Summary of Individual Scales of the Luria-Nebraska Neuropsychological Battery

<table>
<thead>
<tr>
<th>Individual Scale</th>
<th>Description</th>
<th>Items</th>
<th>Technical Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Functions</td>
<td>Assess a number of motor skills for left and right sides of body. Unilateral and simultaneous simple and complex motor movement</td>
<td>51</td>
<td>Golden et al. (1978)</td>
</tr>
<tr>
<td>(Rhythm Scale)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher Cutaneous</td>
<td>Without aid of vision must identify where touched, head and point of pin, direction of movement, geometric and alphametric symbols traced on wrist, matching movements, and item identification</td>
<td>22</td>
<td>Golden et al. (1982)</td>
</tr>
<tr>
<td>Kinesthetic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial (Visual Functions)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receptive Speech Scale</td>
<td>Requires written, oral, and motoric response to spoken speech</td>
<td>33</td>
<td>Golden (1981)</td>
</tr>
<tr>
<td>Expressive Speech Scale</td>
<td>Items involve orally repetition words, increasingly complex sentences, name, count, recite, offer missing words, and organize mixed-up sentence</td>
<td>42</td>
<td>Golden (1981)</td>
</tr>
<tr>
<td>Writing Scale</td>
<td>Involves basic writing skills—spelling, copying words and letters from cards and memory. Writing words and letters from dictation and spontaneously</td>
<td>13</td>
<td>Golden et al. (1978)</td>
</tr>
<tr>
<td>Reading Scale</td>
<td>Range from reading letter sounds, syllables, words, sentences, and a short story</td>
<td>13</td>
<td>Golden et al. (1978)</td>
</tr>
<tr>
<td>Arithmetic Scale</td>
<td>Involves simple number identification, writing, and reading series of numbers, simple skills to more complex skills</td>
<td>22</td>
<td>Golden et al. (1981)</td>
</tr>
<tr>
<td>Memory Scale</td>
<td>Requires learning word list, picture memory, rhythmic pattern, hand positions, sentences, story, and paired associate task</td>
<td>13</td>
<td>Golden et al. (1982)</td>
</tr>
<tr>
<td>Intellectual Scale</td>
<td>Sequencing pictures, abstract theme of pictures, identify picture absurdities, proverbs, definitions, opposites, and analogies, and word problems</td>
<td>34</td>
<td>Golden &amp; Berg (1983)</td>
</tr>
</tbody>
</table>
performance of the patient. Of interest to rehabilitation recommendations are the
types of compensations which are possible within the respondent’s spectrum of
abilities. Luria (1966) encourages the examiner to at times change the tempo and
adapt the tasks such that an appreciation of the patient’s performance may be
gained under alternative conditions. Although these procedures may allow
clinical insights into intraindividual differences useful in rehabilitation, they do
not allow the investigation of the validity of either the theoretical underpinnings
or the assessment procedures in a public fashion. Therefore, a discrimination
of the utility if Luria’s procedures from his clinical expertise had been im-
possible.

Recently, attempts have been made to operationalize Luria’s methods (Chris-
tensen, 1975, 1980; Golden, Hammke, & Purisch, 1978; Majovski, Tanguay,
Russell, Sigman, Crumley, & Goldenberg, 1979a, 1979b) and aspects of this
theory (e.g., Das, 1973; Kaufman & Kaufman, 1983). The degree to which these
attempts reflect Luria’s (1966) original thinking is controversial, and the impli-
cations of such models are examined at length later in this chapter.

Critical Issues and Future Areas of Emphasis

The previous section hopefully has provided an overview of the current status of
neuropsychological assessment with an examination of two distinctly different
systems that exemplify the major approaches to the field. For the reader un-
familiar with the area of neuropsychology, these systems would best be consid-
ered as opposite poles of a qualitative–quantitative dimension. Both hold im-
lications for the future complexion of neuropsychological assessment and will
influence how critical questions which face neuropsychology will be approach-
ed. It should be noted that in the clinical setting evaluation of the individual
patient often involves a combination of these approaches.

Among the most salient influences in the future of neuropsychological assess-
ment, certainly research in the clinical and basic neurosciences would seem to
rank high. Obviously, adaptation of advances in basic psychometrics to neuro-
psychological questions will continue. A less obvious and infrequently articu-
lated influence is what could be termed as a “paradigm shift” in American
Psychology. Moreover, the recent polemics in psychology could hardly be seen
as fertile ground for the growth of neuropsychology. Clearly, the late 1970s
heralded a more flexible, cognitive approach to our understanding of human
behavior. Since this time, the number of systematic investigations which have
begun to outline neurological correspondence to complex human behaviors have
grown geometrically (Dean, 1983a). The remainder of this chapter attempts to
define a number of critical issues in neuropsychological assessment, relate pre-
ently available research in the area, and offer tentative projections.
Interpreting Neuropsychological Assessment Results

Despite the sensitivity with which neuropsychological assessment procedures have been shown to have in distinguished brain damage from normal functioning (e.g., Reitan, 1955; Wheeler et al., 1963) and psychiatric disturbances (Golden, 1977; Klonoff & Low, 1974), the interpretation of individual results remains obscure. That is to say, it is often difficult to base the interpretation of a patient’s protocol on the available research for groups. Moreover, the individual patient’s premorbid history, age at onset of disturbance, time from onset to assessment, and behavioral reaction to impairment all interact to make findings for groups obscure for the individual case (see Dean, 1983a). This state of affairs seems reasonable, for the luxury of control of extraneous variables found in research is not possible in individual interpretations. Reitan (1974) has offered some direction in the use of inferential techniques. These have involved (a) evaluation of the patient’s “level of performance” with the use of cutting scores and normative standards; (b) pathognomonic constellations of behaviors indicative of neuropathology; (c) comparisons of sensory and motor performance for left and right sides of the body, and (d) comparisons of relative strengths of neuropsychological functioning for the individual in light of group patterns of dysfunction. Each of these methods has been shown to have utility in predicting the individual’s neurological status. However, two obvious questions arise in the interpretation of the results for the individual patient. First, how are these methods combined to make a specific conclusion concerning the individual’s test findings? Second, what weight should be given to such moderating variables as education, age at onset, and the like? Such questions are not unique to neuropsychological assessment but, rather, are critical where clinical decisions must be made for the individual client based on vast numbers of variables. Often then, the psychologist is left with few alternatives to “clinical prediction” in the interpretation of an individual’s performance (Boll, 1981).

The Impairment Index, originally offered by Halstead (1947) and later refined (Reitan, 1955; Klove, 1974), is the proportion of a series of HRB tests found to be in the impaired range. This rather simple actuarial measure has shown considerable accuracy in predicting the degree of cortical impairment (Halstead, 1947; Klove, 1974; Reitan, 1966). Kiernan and Matthews (1976) also provide some evidence favoring actuarial prediction using the simple average of standard scores of the subtests of the HRB. It should be recognized that while both methods provide the psychologist some rudimentary information concerning overall impairment, each falls short of aiding in the interpretation of an individual’s performance.

Certainly, more extensive normative data which controls for age, sex, race, and socioeconomic status would aid in individual interpretation. Such a database would provide the clinician with the prerequisites to estimate premorbid func-
tions based on the patient's demographics. Wilson, Rosenbaum, Brown, Rourke, Whitman, and Grisell (1978) and Reynolds and Gutkin (1979) offer evidence of a considerable relationship for demographic variables on general cognitive ability scores. More important, this research provides a means with which to estimate "expected premorbid levels" of functioning with a given demographic profile. Although more extensive normative data which accounts for demographic variables is basic to the future of actuarial prediction, the problem of data integration for the individual goes beyond demographics.

The clinical procedures necessary for data integration have remained a rather mystical procedure for the neophyte. A number of authors have argued that attempts to quantify the interpretative process beyond basic level of performance statements would do more to obscure the understanding of the results for the individual patient than to edify. Embryonic research in mechanical interpretation has usually taken one of two approaches in the development of objective means of data integration. One approach has been the development of algorithms for making interpretative decisions. Russell, Neuringer, and Goldstein (1970) have attempted to establish taxonomic keys with the HRB for the diagnosis of brain damage in general and the localization and identification of the organic process (i.e., acute, static, or congenital). Russell et al., (1970) in an initial validation provided encouraging data with diagnostic hit rates ranging from 62% to 94% when neurological group formation was based on clinical judgment. More recently, Finkelstein (1976) developed a computer based refinement of this algorithmic approach (BRAIN I). This program allows direct input of raw data from the HRB and attempts to predict the presence of brain damage, location, acuteness, and provides a "most consistent neurological diagnosis." Finkelstein (1976) reports impressive accuracy in predicting the presence of brain damage (96%), the lateralization of the lesion (75%), acuteness (83%), and neurological diagnoses (64%). Anthony, Heaton, and Lehman (1980) have compared the utility of Russell et al.'s (1970) and Finkelstein's (1976) methods to the predictions made on the basis of the Halstead Impairment Index. Consistent with Klove's (1974) data, this investigation showed superior classification of brain damaged and normals with the use of the Impairment Index.

Another system which has been seen as having actuarial potential is a multivariate statistical approach (Wheeler & Reitan, 1963). Using a priori defined neurological groups, a number of investigators have demonstrated the utility of a cross validated discriminant function in the prediction and localization of brain damage from HRB data (Golden, 1977; Goldstein & Shelly, 1972; Struss & Trites, 1977; Wheeler, 1964). Wedding (1983) compared the classification accuracy for a number of actuarial methods for a sample of 263. His results indicated the superiority of discriminant functions in accuracy and localization when compared with both Russell et al.'s (1970) key approach and Finkelstein's (1976) BRAIN I. Consistent with research in other areas of applied assessment,
these data supported the superiority of a mechanical/statistical methodology to the interpretation of neuropsychological test data.

Although not without methodological problems (e.g., Willson & Reynolds, 1982), such reports are encouraging and indicate considerable potential in statistical/mechanical methods in the interpretation of neuropsychological test data and the development of extensive code books. Although few attempts have been made to predict the degree of return of function or interface predictions with rehabilitation efforts, certainly the technical procedures exist to provide such information. Efforts to statistically estimate premorbid levels of functioning and in turn compare these data with actual reports will begin to provide the methodology necessary to objectively outline the degree of loss of function for the individual patient.

**Attempts to Objectify Luria’s Theory**

Recognizing the heuristic value of a theoretically consistent view of the functioning of the brain, a number of recent attempts have been made to operationalize Luria’s neuropsychological theory. Other than some basic research supporting Luria’s theory (see Luria, 1965, 1966, 1973), the approach has appeal of providing a theoretically consistent template to aid in the development of neuropsychological assessment procedures. It should be recognized that the radical quantitative approach taken in the choice of neuropsychological tests in the West while increasing prediction has often alluded interpretation (Dean, 1983a). For a familiar example, the choice of subtests comprising the Wechsler Scales was made on quantitative grounds and Wechsler’s (1958) broad notion of aggregates of abilities. The Wechsler Scales have been shown to offer one of the best single predictors of extra-test behaviors (see Dean, 1982a). The interpretation of subtest scores for individuals and groups has been one of the most researched and yet controversial topics in applied assessment (Dean, 1982a; Kaufman, 1979). This is less of an indictment of the quantitative approach than an overview of the primitive status of our knowledge of brain-behavior relationships. Thus, while Luria’s assessment procedures would not satisfy elementary psychometric criteria (Dean, 1982a) necessary to be termed tests, his theoretical model of the functional organization of the brain provided a distinct advantage in the interpretation of performance and the planning of rehabilitation strategies.

Christensen (1975, 1980) has recently attempted to operationalize Luria’s neuropsychological assessment system by objectifying the tasks used by Luria. In this way, Christensen (1975) has stimulated the examination of Luria’s assessment tasks in a fashion which is more amenable to psychometric investigation. This is important and should allow investigation of the heuristic value of Luria’s assessment system free of the clinical expertise which had been developed by Luria and his associates. Although Christensen’s (1975, 1980) contribution to neuropsychological assessment is clearly recognized, these operationalized ver-
sions of Luria’s methods are now concrete, many of the techniques remain more subjective than would be desired from a quantitative point of view.

Majovski et al. (1979a, 1979b) have recently attempted an independent translation of Luria’s assessment system. Designed as an adolescent screening measure of cortical dysfunction, the measure focuses on the same categories proposed by Christensen (1975) (see Table 7.3) with the exclusion of the kinesthetic and cutaneous areas. Majovski et al. (1979a, 1979b) see the inclusion of these functions to be redundant with information gleaned from the neurological examination which generally precedes the neuropsychological referral. Containing 72 items, the instrument requires approximately one hour to administer to children 10 years of age and older. Although this time element represents a distinct advantage over other neuropsychological batteries, to date only minimal validation has been attempted. In sum, with the portability and relatively short administration time, the measure may hold utility for child psychologists. Although this is true, the psychometric properties of the instrument remain to be investigated.

In an “attempt ‘to wed’ Luria’s techniques with American clinical neuropsychology” [Golden, 1980, p. 517], Golden, Hammek, and Purisch (1978) have constructed an objective neuropsychological battery adapted from Luria’s functional theory of the brain. Of the 282 items comprising the battery, the majority of tasks are refinements of those operationalized by Christensen (1975). The objective here has been to retain many of the positive features of Luria’s functional theory of the brain while providing a standardized administration and scoring procedure (Golden, 1980). These items, referred to as the Luria–Nebraska Neuropsychological Test Battery (LNNB) (Golden et al., 1978) offer both portability and considerable reduction in the time necessary (approximately 2.5 hours) for assessment with more traditional, neuropsychological batteries (e.g., HRB—> 4 hours). As suggested in Table 7.3, the authors offer 10 discrete subscales which represent a nominalization of each functional zone proposed by Luria (1966) and operationalized by Christensen (1975, 1980).

Taking a quantitative posture in examining the adequacy of the measure, Golden and his associates (Golden & Berg, 1983; Golden, Fross, & Graber, 1981; Golden, Hammek, & Purisch, 1978; McKay & Golden, 1979; Moses & Golden, 1979; Moses, Johnson, & Lewis, in press; Purisch, Golden, & Hammek, 1978) reported a number of studies relative to the psychometric adequacy of the LNNB. The majority of these investigations report adequate test–retest reliability estimates for summary, localization, and individual “factor” scales. The exception being rather unacceptable reliability for two receptive speech factors (Golden, 1981). Interrater scoring agreement was also seen as adequate (see Golden, 1981). From a qualitative viewpoint, the battery has been shown to be sensitive in discriminating adult brain damaged patients from both normals (Golden et al., 1978) and hospitalized psychiatric patients (Moses et al., in press). Using combinations of the 10 factors of the LNNB, Golden and his
associates (Golden et al., 1981; McKay & Golden, 1979) report localization value for subscales. For example, in response to needs in the applied setting, McKay and Golden (1979) report the development of hemispheric localization scales shown to be of clinical significance in diagnosing lateralized brain damage. The majority of these findings appear to be robust with investigations from other laboratories reporting at least partial replication (e.g., Malloy & Webster, 1981; Shelly & Goldstein, 1982a, 1982b). Although impressive at first blush, extensive research will be necessary to completely define and assess the technical adequacy and utility of the LNNB.

Adams (1980) has argued that with the quantitative approach taken in the development and standardization of the Luria–Nebraska Neuropsychological Test Battery, much of the appeal of Luria’s theory of the functioning of the brain is lost. Indeed, more work with the LNNB has been done to offer psychometric credibility than to offer insights how the measure can make use of its theoretical underpinnings in understanding the patient and structuring rehabilitation plans. Although recognizing the contributions of Luria (1966) and Christensen (1975), Golden’s (1980, 1981) emphasis in the LNNB is not an attempt to develop a standardized version of Luria’s neuropsychological assessment system per se, but rather a quantitative sound system with a theoretically consistent foundation. Spiers (1981, 1982) argues that nonverbal abilities are difficult to assess with the LNNB because of the role played by language in the presentation and response requirements to nonverbal items. The nominal scoring system adapted in the LNNB has been seen to reduce the sensitivity of individual items (Spiers, 1981, 1982). Indeed, it would seem difficult to glean information relative to a patient’s performance in which his/her scores were found to be within normal limits. Golden, Ariel, Moses, Wilkening, McKay, and MacInnes (1982) argue that a patient’s scaled scores, item patterns, qualitative data, and the medical history must all be involved in an analysis of an individual’s neuropsychological functioning. In this regard, it should be noted that considerable sophistication with Luria’s (1966, 1973) model of brain functioning and technical aspects of the LNNB are necessary for the competent administration, scoring, and interpretation of this battery. Controversy may well continue concerning the extent to which Golden and his associates have been successful in melding both the quantitative–qualitative and functional–structured points of view in neuropsychology. Clearly, the LNNB does provide a coherent group of tasks which are theoretically consistent.

The Kaufman Assessment Battery for Children (Kaufman & Kaufman, 1983) (K-ABC) is a wide-band cognitive battery based on a functional theory of the brain. Unlike the atheoretical approach taken in the development of cognitive measures such as the Wechsler Intelligence Scales, the Mental Processing Scales of the K-ABC were developed to conform to the sequential–simultaneous processing dichotomy articulated by Luria (1966) and operationalized by Das (e.g., 1973). Although interpretations may differ, Kaufman and Kaufman (1983) pre-
sent a good deal of factor-analytic evidence consistent with a sequential-simultaneous distinction for subtests of the battery. The K-ABC also makes a very useful distinction between school related achievement and more basic elements of mental processing. Because less reliance is placed on past experience in scales of cognitive efficiency, the authors have argued in favor of a reduction in assessment bias and a wide range of information useful in remedial planning (Kaufman & Kaufman, 1983). Although it is not clear how the LNNB and K-ABC will stand the scrutiny of time, it seems apparent that Luria's functional theory of the brain will accent neuropsychological assessment as practiced in North America.

Neuropsychological Assessment of the Child

The early success in defining the behavior deficits following brain damage in adults stimulated such study with children and adolescents (Boll, 1974). By comparison, though, efforts to define brain-behavior relationships with children are even a more recent pursuit. Greater numbers of adult referrals with discreetely localized lesions have provided a rather large research base on which detailed neuropsychological studies could be made. Moreover, adult neurological disorders, as opposed to those seen in children, are more likely to provide the opportunity to validate assessment techniques during surgery and autopsies (Dean, 1983a; Reitan, 1974). As mentioned previously, a number of moderator variables exist which may modify the interpretation of adults’ performance on neuropsychological tests (history, demographics, time from onset to assessment, and the like). Clearly, such factors play an important role in psychological findings for children with cerebral dysfunction. In addition, the interpretation of children’s performance must account for a number of potential confounding variables not usually considered with adults (Dean, in press). The child’s premorbid developmental history (Benton, 1974), brain development at onset (Boll, 1974), the chronicity of the disorder (Hartlage & Hartlage, 1977), and environmental background (Dean, 1983a) combine interactively to make reliable inferences about the functioning of the child’s brain far more tenuous an undertaking than that with adults. Similar lesions in mature and developing nervous systems have been shown to produce far different neuropsychological test patterns and expectations for recovery of function (Dean, in press; Hartlage, 1981; Reed, Reitan & Klove, 1965).

Klonoff and his associates (Klonoff, Low, & Clark, 1977; Klonoff & Robinson, 1967; Klonoff & Thompson, 1969) present evidence that the type of brain damage most frequently occurring in childhood is responsible in part for adult-child differences in test impairment shown in these groups. Klonoff’s group reports epidemiological estimates showing brain damage resulting from falls was approximately three times more prevalent in children than adults. Therefore, it seems our knowledge of children’s neuropsychological assessment data will involve a greater understanding of the effects of closed head injury in the developing child.
8. NEUROPSYCHOLOGICAL ASSESSMENT

Although definitive conclusions concerning brain-behavior relationships remain to be made for adults, the neuropsychological interpretation of behavior with children is far more equivocal. Similar to findings for adults, a good deal of research indicates a sensitivity of neuropsychological batteries to brain dysfunction (Boll, 1972b; Dean, 1982c; Golden, 1981; Hartlage, 1981; Klonoff & Klove, 1974; Reed, Reitan, & Klove, 1965; Reitan, 1971; Reitan & Heineman, 1968). Reed, Reitan, and Klove (1965) and Boll (1974) using extensive neuropsychological batteries have provided evidence that patterns of deficits for adults and children who had sustained head injuries were much different. Brain damage in children seems to have more global effects than that found in adults with similar lesions. Children are more likely to exhibit a general depression of those cognitive abilities which have been shown to be rather resistant to impairment with adults (Ernhart, Graham, Eichman, Marshall, & Thurston, 1963; Reed, Reitan, & Klove, 1965). Using the HRB, Reitan (1974) reports scores of the Wechsler Intelligence Scale for Children to be more salient in predicting brain damage in children (6–8 years) than other measures of the battery. As pointed out earlier in the chapter, for adults, the Halstead Impairment Index is most often found to be a more sensitive indicator of brain damage than that offered by the Wechsler Scales (Reitan, 1955). Older, well practiced skills or, if you will, overlearned material is more resistant to cerebral insult in adults than that which has been found in children. In sum, the effects of brain damage in childhood are more profound than that found in adults; and, the earlier the insult occurs, the more generalized will be the resulting impairment on measures of neuropsychological functioning (Boll, 1972b; Fitzhugh & Fitzhugh, 1965; Reed & Fitzhugh, 1966, Reitan, 1974). Problems in translating adult neuropsychological research conclusions to children involves the ongoing autonomical changes in the child’s brain (Boll, 1974). Indeed, some research indicates that age-related differences in the psychological sequelae of childhood brain damage may be due to developmental changes in functional lateralization in children (Dean, 1982a).

Related to the neuropsychological assessment of children’s learning disorders is the relative lack of data regarding development trends for normally functioning children on tests of neuropsychological measures. Such data will begin to portray the development of cortically related behaviors and the amount of normal variability which can be expected. Crockett, Klonoff, & Bjerring (1969) emphasized the importance of this area with data showing that increasing neuropsychological complexity is necessary to describe the within-subject variability on some 32 neuropsychological variables with descending age. Whether these findings represent invariant developmental trends or fluctuations between development levels remains to be investigated. This area seems most promising in providing advances in both our understanding of the development of brain-behavior relationships and a base from which to evaluate the individual child’s performance from an individual difference approach.

Factors other than cortical functioning seem to play a more salient role in test results for children than adults. Indeed, the naive application of aberrant behav-
ioral patterns found in adult neurological disorders (encephalitis) to children exhibiting functional neurological disorders (e.g., Strauss & Lehtinen, 1948) may well be responsible for the rejection of neuropsychological studies with children. For, while consistent behavioral patterns may well be reliable predictors of adult cortical impairment, the assumption that these same behaviors reflect underlying cortical dysfunctions in children is tenable (Dean, 1978a, 1982a). This seems particularly true in our understanding of children’s learning disorders. For over a century attempts have been made to explain children’s classroom learning problems in terms of neurological aberrations. Although early overzealous attempts to explain all children’s learning problems in terms of neurological dysfunction have been rejected by most serious reviewers of the available literature, problems remain in nosological classification of children’s learning disorders.

Attempts have begun to isolate behavioral constellations from neuropsychological measures which may encourage further understanding of categories of learning problems (e.g., Dean, 1978a; 1983b, in press; Fisk & Rourke, 1979; Rourke, 1975, 1976, 1979). Clearly, some forms of children’s learning disorders relate to neurological dysfunction (Dean, 1982a). This conclusion is as obvious as the fact that many childhood learning problems may more heuristically be related to an interaction of environmental and developmental factors. Although a number of authors have argued in favor of a neuropsychological perspective which goes beyond the diagnosis of impaired neurological processes to the structuring of educational programs which maximize the child’s assessed strengths (Dean, 1982a; Hartlage & Reynolds, 1981), future attempts to statistically segregate behaviors for children with learning problems hold considerable promise in our understanding and treatment of children’s learning disorders.

It has also become apparent that children with histories of classroom failure retain an underlying emotional reaction to school-related tasks even after obvious success (Dean, 1983b; Lang, 1964; Severson, 1970). Therefore, attempts to isolate subtypes of learning disorders and offer treatment of these problems require a focus on an interaction of emotional and neuropsychological factors. Dean (1983b) offered early data favoring the combination of neurological and emotional factors in what amounts to systematic desensitization procedures to treat emotional reactions to failure. This procedure was effective in increasing school-related achievement while it had little effect on the child’s measures of neuropsychological functioning. Interestingly, Dean (1983b) also reported a reduction in behavioral problems concomitant with gains in classroom related achievement.

The issue of the relationship between emotional disturbance and brain damage with children is a complex one. Emotional disturbance has been reported with a significantly greater frequency in children who have suffered brain damage than normals (see Shaffer, 1974). Another line of research also indicates neuropsychological impairment occurs significantly more frequently in emotionally
disturbed children without an obvious neurological abnormality than that found in samples of normal children (Reed & Reitan, 1963). Although brain damaged children may well react to a perceived loss of function in an emotional fashion (Dean, 1982a), as plausible is the onset of emotional symptoms concomitant with damage to specific areas of the brain (Shaffer, 1974). The truth, of course, will probably be most clearly understood on a multivariate continuum involving etiological and environmental factors. Such study would seem of value when examined in conjunction with developmental trends of lateralization of functions. Although information necessary for a basic understanding of these issues remains to be reported, numerous laboratories have begun intensive projects which will allow a greater understanding of the basic issues in neuropsychological assessment with children.

Neuropsychological Assessment in the Later Years

Dementing disorders are syndromes originating from a rather wide variety of causes. The etiology of these disorders has been attributed to intrinsic changes in the brain cells, vascular insufficiencies, cardiovascular accidents, metabolic disturbances, and hormonal imbalances. Although some forms of dementia have been shown to be treatable, the majority is not (Barbizet, 1970). The course of dementia involves the deterioration of higher cognitive functioning, emotion, motoric behavior, and eventually death (NIH, 1981).

It has been estimated that 15% of the population of the United States older than 65 years has some form of dementing disorder, amounting to some three million persons (NIH, 1981). Clearly, then, while the vast majority of elderly do not develop such disorders, it does represent a significant health problem. This problem becomes acute when projections for increased life span and the growth of the number of individuals who will exceed 65 years in the early 21st century are examined. Thus, our ability to diagnose dementia and the understanding of the normal aging process is fast becoming even more critically important than it has in the past.

With the essential symptom of dementing disorders being the "loss of intellectual abilities of sufficient severity to interfere with social or occupational functioning" [DSM-III, 1980, p. 58], the neuropsychologist is often called upon to make a judgment on the extent of impairment from neuropsychological assessment procedures. Although memory losses are the most prominent feature of dementia (Barbizet, 1970), the neuropsychological measures recommended are "multifaceted and involve memory, judgment, abstract thought, and a variety of other higher cortical functions" [DSM-III, 1980, p. 159].

Dementia is one of the most overdiagnosed disorders in the elderly (DSM-III, 1980). Part of the problem inherent with the diagnosis of this group of disorders relates to the fact that there are numerous other syndromes (e.g., affective disorders) with symptoms which resemble the early stages of true dementias. A
critical difference between these disorders is that many of the nondementing disorders (e.g., depression) may be successfully treated (Dean, in press). Confusion presently exists in the diagnosis of dementia which is due, in part, to a lack of our understanding of the effects normal aging has on the majority of the available neuropsychological measures. Second, yet no less important, is the lack of knowledge of how neuropsychological tests correspond to adaptive behaviors and the emotional stability necessary for independent living (Dean, in press).

Investigations have shown a substantial, negative relationship between age and performance on a number of measures of cortical functioning with healthy older adults (Reed & Reitan, 1963; Reitan, 1955; Vega & Parsons, 1967). Using the presently available adult norms, the performance on neuropsychological measures of healthy individuals above the age of 50 frequently falls into the range seen as reflective of organic impairment (Davies, 1968; Prigatano, 1978; Reed & Reitan, 1963). Bak and Greene (1980), using standard scoring procedures and available adult norms, showed 85% of a sample of healthy, normal functioning adults between 50–86 years of age would be classified as impaired. Of interest, the neuropsychological measures used in this investigation (i.e., Wechsler Memory Scale, Wechsler Adult Intelligence Scale, and the Halstead–Reitan Neuropsychological Battery) were those most commonly employed in the differential diagnosis of dementia. Although some authors (e.g., Finlayson, Johnson, & Reitan, 1977) have argued that many of the findings of impairment in normal older adults are compromised by educational level and omnibus intelligence, numerous investigators have reported concomitant decline for various memory and intellectual functions with increasing age (Matarazzo, 1972). Such findings call into question the utility of standardized neuropsychological measures in the diagnosis of impairment and as a reflection of adaptive functional behavior. Moreover, many normal older individuals classified as impaired on neuropsychological measures have been reported to be functioning normally in their environment in terms of daily living skills (Bak & Greene, 1980; Davies, 1968; Reitan, 1955). Obviously, the lack of information relative to the effects of normal aging on measures of neuropsychological functioning represents a major obstacle to their utility with this population.

Although it has been known for some time that age (> 45) interacts with the performance on measures of higher cortical functioning (Horn & Cattell, 1966, 1967; Matarazzo, 1972) and psychomotor speed of operation (McFarland, 1968), little normative data exist with which the clinician can compare obtained results on the majority of measures of neuropsychological functioning. Such investigations are rudimentary to our understanding of the aging process and vital in the diagnosis of dementia. Future normative data will aid in differential diagnosis of dementias and, more importantly, reduce misdiagnoses of dementia when other disorders exist which are more amenable to treatment. Clearly, the
interaction of neuropsychological functions, emotional stability, and daily living skills remains to be investigated with adults in their later years.

Neuropsychological Assessment of Adult Psychiatric Patients

Neuropsychological assessment procedures have in the main been developed after extended observations of patients with neurological disorders and more often than not documented brain lesions (e.g., Halstead, 1947; Luria, 1966; Reitan, 1955). The choice of items and the validation of resulting measures have often emphasized the discrimination of neurological groups from normal controls (e.g., Halstead, 1947; Reitan, 1955). As previously mentioned, such a methodology has served the field well with the predictive accuracy most often exceeding 85% when intact groups of norms and brain damaged patients are used (Klove, 1974; Reed & Reitan, 1963; Reitan, 1955, 1971; Wheeler, Burke, & Reitan, 1963). So too, the prediction of diffuse, left and right hemispheric lesions is fairly well established (Boll, 1972; Filskov & Goldstein, 1974; Reitan, 1966).

Because the most often experienced referral question asked involves differential diagnosis, a number of problems arise when attempts are made to infer the source of a behavioral disturbance. That is to say, in the medical setting, a diagnostic question often asked involves whether the patient’s behavioral disturbance has an “organic” base or if it may more heuristically be attributed to a “functional psychiatric” disorder. Here, “functional mental disorder” would imply a disturbance without a known physical abnormality of the brain; whereas, “organic mental disorder” has traditionally implied a behavioral aberration resulting from a biochemical or structured lesion. Of particular interest to the practicing neuropsychologist has been the accuracy of assessment procedures in the differential diagnosis of “functional” and “organic disorders.” Moreover, the differentiation of functional psychosis with concomitant aberrations in thought processes from patients with neurological disorders remains a difficult diagnostic problem (Dean, 1983a).

The research objectives in this area have focused on the ability of neuropsychological assessment procedures to differentially diagnose functional psychiatric and organically related disorders (e.g., Golden, 1977; Matthews, Shaw, & Klove, 1966; Reitan, 1976) and the establishment of performance patterns which would aid in differential diagnoses (Klonoff, Fibiger, & Hutton, 1970; Parsons & Klein, 1970; Watson, Thomas, Anderson, & Felling, 1968). A more basic question that is beginning to receive attention involves a neuropsychological understanding of the etiology and effects of functional mental disorders (Dean, in press; Flor-Henry, Fromm-Auch, Tapper, & Schopflocher, 1981; Rockford, Detre, Tucker, & Harrow, 1970; Taylor, Greenspan, & Abrams,
The previously suggested intervening variables of medical history, age at onset, educational level, chronological age, site of dysfunction, premorbid environment, and individual differences in anatomical structures are prominent factors in the evaluation of research in this area. In addition, a number of variables which are more unique to a psychiatric setting, often accent neuropsychological assessment data and obscure their interpretation. The most consistently mentioned factors involved:

(a) the chronicity of the disorder (see Watson, 1974);
(b) a failure to rule out an organic involvement for groups diagnosed with a functional mental disorder (see Dean, in press);
(c) apparent lack of appreciation for treatment effects associated with somatic interventions (e.g., medication, electro-convulsive therapy) in psychiatric disorders (see Baker, 1968);
(d) length of hospitalization (see Klonoff, Fibiger, & Hutton, 1970);
(e) failure to consider the severity of psychiatric symptoms (see Goldstein & Halperin, 1977);
(f) a failure to examine response style as an obviating variable of performance (see Hirsch & DeWolfe, 1977); and, finally,
(g) contamination of diagnosis with neuropsychological assessment data (see Golden, 1977).

Although the majority of studies in this area have utilized some combination of tests of the Halstead–Reitan Battery (Golden, 1977; Heaton, Vogt, Hoehn, Lewis, Crowley, & Stallings, 1979), a number have examined more specialized measures (e.g., Bender Visual Motor Gestalt Test; Benton Visual Retention Test; Birkett & Boltuch, 1977; Holland, Wadsworth, & Royer, 1975; Luria Nebraska Neuropsychological Battery; Memory-for-Designs Test; Minnesota Percepto-Diagnostic Test; Moses, Cardellino, & Thompson, 1983; Optimal Symbol Digit Modalities; Watson & Benton, 1976). It is not the objective here to attempt a duplication of a number of excellent reviews of this area of research (e.g., Heaton, Baade, & Johnson, 1978; Heaton & Crowley, 1981; Reitan, 1976) but, rather, to identify research developments as they may relate to new areas of emphasis in the field of neuropsychological assessment.

With this objective in mind, it seems clear that the diagnostic accuracy in differentiating functional, psychiatric, and organic disorders clearly suffers when chronic schizophrenics are included as a functional disorder (Goldstein & Halperin, 1977; Heaton et al., 1979; Watson et al., 1968). After a review of the available literature, Heaton et al., 1978, reported a median correct classification of functional and organic patients of 75% when chronic schizophrenics were eliminated from consideration. With the inclusion of chronic schizophrenics, the median “hit rate” dropped to a chance level in prediction (54%). These findings in combination with the research since 1975 indicate that the rates of correct
diagnosis between normals and brain damaged are not significantly different than rates found between organics and patients with functional psychiatric disorders when chronic or process schizophrenics are eliminated from consideration (Heaton et al., 1978; Heaton & Crowley, 1981). On both the HRB (e.g., Chelune, Heaton, Lehman, & Robinson, 1979) and LNNB (e.g., Moses, Cardellino, & Thompson, 1983) chronic schizophrenia seems more clearly related to an overall level of impaired performance than any specific test pattern of deficits. As is true with brain damaged patients (Doehring & Reitan, 1960), there appears to be a relationship between impaired, neuropsychological assessment findings, and the degree of emotional disturbance with schizophrenics (Schwartzman, Douglas, & Muir, 1962).

At this point in the discussion, it should be noted that relatively few attempts have been made to compare neuropsychological assessment results for different functional psychiatric disorders (e.g., depression, schizophrenia, etc.). Moreover, the focus of the bulk of the studies in this area has been the differentiation from organically related behavioral disturbances and psychiatric patients with the aid of neuropsychological assessment data. The tacit assumption here has often been that “functional disturbances” were less related to abnormal brain functioning than to psychosocial influences. However, recent evidence indicates that biochemical (Fish, 1977; Glassman, Perel, Shostak, Kantor, & Fleiss, 1977; Young, Taylor, & Holmstrom, 1977) and structural abnormalities (Andreasen, Olsen, Dennert, & Smith, 1982; Johnstone, Crow, Frith, Husband, & Kreel, 1976) exist in the brains of patients diagnosed with disorders hitherto considered to be functional. Therefore, difficulties in the past in differentiating organics from some forms of functional, psychiatric patients may relate to an underlying neurological substrate for some functional, psychiatric disorders (Dean, in press). Clear differences in brain chemistry have been identified for patients with affective disorders (Glassman et al., 1977; Jarvik, 1977; Young et al., 1977) and forms of schizophrenia (Fish, 1977; Goodman & Gilman, 1975). Similarly, although some methodological problems exist, data have been reported showing abnormalities in the brain structure and function for patients diagnosed as schizophrenic (Andreasen et al., 1982; Haug, 1963; Mirsky, 1969). The force of these data indicates a greater probability for abnormal electroencephalograms (EEG) (Lester & Edwards, 1966) and enlargement of ventricular structures (Luchins, 1982) concomitant with more debilitating forms of schizophrenia. A fair amount of evidence exists across investigations to hypothesize that patients diagnosed with a primary affective-depression show an abnormal decrease in activity of the right hemisphere (d’Elia & Perris, 1974); and, specifically, abnormal EEG findings have been reported in the area of the right temporal lobe (Flor-Henry, 1976).

The neuropsychology of differing “functional” psychiatric disorders has only recently begun to be investigated in a systematic fashion. Studies have, in the main, attempted to define patterns of neuropsychological test scores which would differentiate schizophrenia and affective disorders (bipolar and unipolar).
Generally, patients of both nosological groups show significant impairment on measures of neuropsychological functioning (Flor-Henry, 1976; Golden, Moses, Zelazowski, Graber, Zatz, Horvath, & Berger, 1980; Miller, 1975). Flor-Henry (1976), using a stepwise discriminant analysis, was able to correctly classify some 90% of the schizophrenic and patients suffering from affective disorders (unipolar-manic) using neuropsychological test results. Interestingly, although both groups exhibited what was interpreted as frontal–temporal dysfunction, the abnormalities found in the group with affective disorders were significantly more right hemispheric. Specific impairment on neuropsychological tests of the right hemispheric functions seems robust (Taylor, Greenspan, & Abrams, 1979). Abrams and Taylor (1980) have since extended these data and noted deficit right hemispheric performance on measures of neuropsychological functioning for affective disorders in general (both unipolar and bipolar disorders). Although the neuropsychological test findings for schizophrenia seem to be more generalized frontal–temporal dysfunction, at least one study reported data favoring left hemispheric lateralization of neuropsychological deficit performance for schizophrenics (Rockford, Detre, Tucker, & Harrow, 1970).

As alluded to earlier, the level of chronicity and specific schizophrenia classification play a major role in the interpretation of data in this area. Some of the confusion here may well relate to the manner in which psychiatric groups were formed and the diagnostic criteria used. Although in some investigations the clinical impressions of a psychiatrist are used, most, more recent studies have begun to rely on criteria offered by the American Psychiatric Association (DSM–III, 1980), Research Diagnostic Criteria (Spitzer, Endicott, & Robins, 1977), or those known as Feighner Criteria (after Feighner, Robins, Guze, Woodruff, Winokur, & Munoz, 1972). This point of diagnostic criteria seems important to this area of research because of what amounts to a tacit assumption in the past that patients’ nosological placement was without error variance. Indeed, recent research indicates that while sets of diagnostic criteria may have similar interrater reliability, patients diagnosed as schizophrenic by one system may receive an entirely different diagnosis when the criteria of another system are employed (e.g., Endicott, Nee, Fleiss, Cohen, Williams, & Simon, 1982).

Abnormal neuropsychological assessment findings have been shown with psychiatric disorders other than schizophrenia and manic-depression; but, these data seem less striking and have yet to be replicated across laboratories (see Flor-Henry, Fromm-Auch, Tapper, & Schopflocher, 1981; Flor-Henry, Yeudall, Koles, & Howorth, 1979). The extent to which such findings of specific neuropsychological dysfunction for “functional psychiatric disorders” are amenable to psychotherapeutic or psychopharmacologic manipulations is unclear. Future research which compare consistently diagnosed psychiatric groups while controlling for somatic treatment modalities (see Heaton & Crowley, 1981) will be necessary to define whether distinctive neuropsychological test profiles exist which are consistent with specific diagnoses. Continued findings in a positive
direction would lead to the reconsideration of the locus of a number of psychiatric disorders which have been assumed to be "functional." While the amount of future research will need to be considerable, future and present neuropsychological assessment procedures would seem to hold promise in our understanding into the etiology of a number of psychiatric disorders and have the potential to aid in diagnosis and the planning of therapies for individual patients.

Neuropsychological Assessment in the Rehabilitation Process

Neuropsychological assessment has made its major contribution in providing diagnostic information for patients for which there was equivocal physical evidence of brain damage. The present diagnostic–etiological approach to assessment is more the result of pressures in the medical setting than a theoretical vision of the specialty (Dean, 1982a). However, the continuing sophistication of physical procedures may serve to de-emphasize the diagnostic role of neuropsychological assessment (Dean, 1983a).

The sophistication of noninvasive physical diagnostic techniques has grown geometrically in the past 20 years. The new generation of CT scanning equipment and more recent advances in positron emission tomography (Raichle, 1979) hold clear implications for the diagnosis of neurological disorders. Although problems presently exist in the reliability of these radiological techniques, the future extensions of these procedures are clear. In the past, the relative benign nature of neuropsychological assessment and a real mortality risk for some physical diagnostic methods made the utility of neuropsychological assessment as a diagnostic tool obvious. The future impact of more sophisticated radiological techniques seems clear. While presently providing a criteria for validating neuropsychological diagnostic procedures, continued refinement of radiological procedures may well reduce the dependence on neuropsychological assessment in diagnosis.

Although increasingly more accurate neurological knowledge will be available for the individual patient, rarely would it be possible for the neurosurgeon or neurologist to make specific predictions concerning the patient’s behavior or functioning. Dean (1982a) argues that the direction of neuropsychological assessment will be influenced by the continuing need to understand the patient’s behavioral deficits in the medical treatment of neurological disorders and in planning rehabilitation approaches. Neuropsychological assessment is seen by a number of researchers as offering a heuristic framework in which components of the patient’s emotional, cognitive, and physical functioning can provide rehabilitation specialists an indepth view of the patient. However, few attempts have been made to interface our sophisticated psychometric techniques designed to outline subtle cognitive, perceptual, and motor consequences of neuropathology with rehabilitation strategies (Ben-Yishay, Gerstman, Diller, & Haas, 1970; Golden, 1978).
The issues posed by rehabilitation are quite different than those of diagnosis. Assessment with the objective of outlining rehabilitation goals goes beyond diagnosing impairment relative to normative group performance. The focus here is on definition of how impairments are expressed as disabilities in the patient’s premorbid environment (Dean, 1983a). Unlike neurological diagnosis, which attempts to segregate a constellation of behaviors into a single disorder, rehabilitation works to define brain damage in terms of the medical, vocational, speech and hearing, and physical aspects in need of treatment. Moreover, brain damage seldom is expressed as a single impairment. Within the reality of the patient’s environment, neuropsychological assessment seeks to: (1) define the cognitive, emotional, perceptual, and sensory aspects of the patient’s functioning; (2) establish a baseline in which the rehabilitation can be followed; (3) predict the return of function in light of damage; (4) given multiple impairments and limited resources, what should be the priorities for a given patient; and (5) define in what ways will the patient’s impairments be expressed as disabilities in their premorbid environment (see Diller & Gordon, 1981, for a review). It seems fair to say that neuropsychological assessment in the past has focused on the acute phase of brain damage and, as such, represented a psychometric extension of the clinical neurologic examination. The research and applied emphasis in neuropsychological assessment has been within the areas numbered one and two above. Continuing rehabilitative needs and more reliance upon physical, diagnostic procedures will be expressed in greater concern for rehabilitative outcomes.

Although psychologists have contributed to theories of impairment and rehabilitation following brain damage (Goldstein, 1979), relatively few attempts have been made to use neuropsychological test results to answer basic, remedial questions. The extent to which neuropsychological assessment may predict different remedial outcomes has not been considered in any continuing fashion (Dean, in press). Ben-Yishay, Gerstman, Diller, and Haas (1970) have reported some evidence that left hemiplegics (right hemisphere damage) who exhibit less impairment in a number of spatial skills have shorter rehabilitation stays and learn activities necessary for daily living more quickly than left hemiplegics with more grossly impaired spatial skills. This finding seems congruent with other data showing positive relationships between performance on cognitive and perceptual measures and success in training daily living skills (e.g., Twitchell, 1951; Weisbroth, Esibill, & Zuger, 1971; Williams, 1967). Certainly, such work is seminal in an area where the relationship between neuropsychological tests and success in rehabilitation is unknown.

Which rehabilitative approach is more heuristic given a pattern of neuropsychological impairment is an empirical question which has only begun to be addressed (Diller & Gordon, 1981). A need also seems acute in our ability to predict activities of daily living (after Brown, 1960). For, it seems that the relationship between neuropsychological test findings and the ability of the pa-
tient to perform in their premorbid environment is incompletely understood (Ben-Yishay et al., 1970). In short, the future of neuropsychological assessment will depend, in part, on our ability to go beyond diagnosis. Goldstein (1979) and Horton (1979) argue rather convincingly in favor of an interface between neuropsychological assessment and behavior therapy in the prediction and evaluation of rehabilitation procedures.

The neuropsychological assessment in the coming decade may well involve traditional tests as well as measures designed to assess the acquisition rate of skills which in turn would allow prediction of plateaus in return of functions. Such measures will also allow an examination of the interaction between emotional responses to loss (e.g., depression, denial, and the like) and cognitive/perceptual factors in the rehabilitative process. This information would seem to be a prerequisite to cuing and cognitive retraining procedures presently being examined in the rehabilitation settings (e.g., Cermak, 1975; Crovitz, 1979; Hartlage & Reynolds, 1981; Meier, 1963).

From a rehabilitative point of view, the neurological diagnosis serves as an intervening variable. Diagnosis does not address how the patient should be treated differently because of membership in a given nosological category. Future efforts which attempt to relate neuropsychological test results directly to the differential outcomes from multiple remedial approaches, without the undue reliance on diagnosis which would improve the utility of assessment. Attempts to employ an actuarial approach to treatment outcomes have the potential of reducing our reliance on a pure clinical level of inference.

Summary

Neuropsychological assessment was portrayed as an attempt to psychometrically describe behavior change in patients following brain damage. This chapter has provided an overview of the present approaches to neuropsychological assessment. Although necessarily brief, a review of the research concerning the rationale and utility of the quantitative and qualitative schools of thought in neuropsychology were presented. Congruent with the rapid and extensive increase in our understanding of brain behavior relationships has come the ability to make valid inferences regarding brain functions for individual patients. Neuropsychology, in general, and neuropsychological assessment, specifically, are in their infancy and face a number of problems which will influence development. The rapid evolving knowledge base in the neurosciences was seen as a challenge to the conceptualization of the functioning of the brain and the methodology to be used in assessment. Future trends in neuropsychological assessment were drawn from a review of the literature which defines a number of critical issues in the area. Framing points within a historical context, theoretical extensions of Luria’s functional theory of the brain, and future assessment interpretive schemes were examined. Successes in the interpretation of neuropsychological measures in
early and middle adulthood were contrasted with the need for a developmental, individual difference approach in research in childhood and the later years. A reduction in neuropsychological diagnosis concomitant with advances in physical diagnostic techniques was offered as the stimulus to further define adaptive behavior and predict outcomes in the rehabilitation setting. Developments in the neurology of some "functional" mental disorders were seen as offering a future potential for neuropsychological test results as diagnostic markers of some psychiatric disorders.

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