PART ONE

OVERVIEW AND INTRODUCTION TO NEUROPSYCHOLOGICAL ASSESSMENT

Chapter 1

INTRODUCTION TO NEUROPSYCHOLOGICAL ASSESSMENT

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OVERVIEW OF NEUROPSYCHOLOGICAL ASSESSMENT

Neuropsychology is the study of brain-behavior relationships. Clinical neuropsychological assessment is the application of this knowledge to evaluate and to intervene in human behavior as it relates to normal and abnormal functioning of the central nervous system. Neuropsychology involves assessing such areas as memory, abstract reasoning, problem solving, spatial abilities, and the emotional and personality consequences of brain dysfunction. The result of a neuropsychological assessment is ideally a clear, coherent description of the impact that brain dysfunction has had on a person's cognitions, personality, emotions, interpersonal relationships, vocational functioning, educational potential, and ability to enjoy life. The practical importance of this knowledge consists of assisting with case management, rehabilitation planning, and the monitoring of progress, as well as the enlarging of the discipline's research base. Over the past 50 years, clinical neuropsychology has evolved from and represented a synthesis of psychometric testing, clinical psychology, and behavioral neurology. However, it is also distinctly different from the emphasis in neurology: Whereas neurologists might explain how the *brain* is functioning, the neuropsychologist assesses how the *person* is functioning *as a result of changes in the brain.*

The major purposes of neuropsychological assessment are to provide answers related to the following four areas: (1) differential diagnosis, (2) treatment planning, (3) rehabilitation, and (4) legal proceedings. *Differential diagnosis* most typically occurs within medical contexts when practitioners are asked to discriminate between neurological disorders and psychiatric disorders. For example, a neurologist with a patient having unexplained seizures might wish to know whether the patient's psychological characteristics are consistent with conversion disorder. This information would then be used to help decide whether the patient should be referred for further medical evaluation or for psychotherapy. The most frequent referral within a general psychiatric context is for assessment of the possible presence of organic functioning as a result of changes in the brain. An invaluable contribution of neuropsychological assessment is detecting and evaluating cerebral dysfunction in the absence of clear anatomical evidence of alterations. Such a condition is most likely to occur following exposure to neurotoxic substances, cognitive decline associated with substance abuse, the behavioral

impact of cardiac surgery, and cognitive changes associated with chronic obstructive pulmonary disease. An increasingly important type of differential diagnosis is determining whether an older person who presents with memory complaints is suffering from the early signs of dementia or is merely experiencing the cognitive disruption of depression.

Treatment planning involves various decisions related to the nature and the extent of brain dysfunction. A person who had a stroke might consider returning to work. If the person does decide to return to work, he or she might be helped by the development of some awareness regarding the likely job complications that may occur due to the presence of specific mild deficits. Another patient might have had a mild head injury and is experiencing a variety of psychosocial complications. Assessment might focus on his or her readiness for psychotherapy by considering awareness of deficits, motivation to change, and capacity for abstract reasoning. Another patient with a more serious but moderate head injury might need to be evaluated to determine capacity for self-care.

Patients with brain dysfunction are frequently considered for neuropsychological *rehabilitation*. This typically involves a careful consideration of their relative strengths and weaknesses, thereby enabling rehabilitation practitioners to ideally capitalize on the patients' strengths and improve their weaknesses. Unless these areas are clearly evaluated, rehabilitation efforts may be ineffective. For example, patients with poor awareness of their deficits might be placed in a module to improve their attention. Because they are only minimally aware of their deficits, they might be poorly motivated, which could result in little improvement. Another patient might be experiencing a number of brain-related personality changes. This person's rehabilitation might include working with the family to accommodate these changes. A school-age child who is experiencing learning difficulties would require evaluation to more fully understand the nature of his or her difficulties. Once these difficulties are understood in more detail, special education teachers can focus their interventions around the child's difficulties. Finally, monitoring a patient's progress as she or he works through and is later discharged from a program is an important role of neuropsychology. This monitoring role might have important implications for the patient, but it would also help researchers to more fully evaluate specific types of programs for different types of patients.

Neuropsychologists have become increasingly involved in *legal proceedings*. One of their primary roles has been to document the causes, nature, and severity of brain dysfunction in personal injury cases. For example, litigation might stem from damage allegedly caused by a car accident in which the injury was caused by another driver who has been found to be at fault. Alternatively, a large company might not have taken appropriate safety measures to protect employees from exposure to neurotoxic substances. A neuropsychologist might be requested to assess the possible presence and extent of brain dysfunction as well as the patient's potential for recovery. Another scenario might involve neuropsychological assessment to determine the capacity of patients to defend themselves during legal proceedings. Another patient might have committed a violent crime and need to be assessed to determine whether there were mitigating organic factors such as epilepsy that might have influenced the patient's actions.

These four areas demonstrate the wide variety of information related to neuropsychological assessment. It should be apparent that such evaluations involve considerably more than just psychological testing. The competent neuropsychologist needs to draw

on a wide variety of knowledge areas including abnormal psychology, psychological testing, functional neuroanatomy, neurological disorders, disability issues, community resources, and vocational and educational options. Competent evaluations also involve taking a flexible, creative, problem-oriented approach toward working with individual clients.

The field of neuropsychological assessment has traditionally been organized around the following perspectives: specialized neuropsychological tests, domains of functioning, types of disorders, or a functional assessment of the different lobes of the brain. Each of these facets or angles of approach has various strengths and weaknesses. The emphasis in this book is on developing a working knowledge of the most frequently used neuropsychological tests. This approach is familiar to most psychologists, provides relative ease of learning, and can potentially cover a wide band of areas. The danger is that practitioners learning neuropsychology from such a test-oriented focus might rely too much on tests rather than on having the tests function as tools to assist in solving client-related problems. Thus their reports might end up being "test driven" rather than "person driven." Efforts are made throughout the book to correct for this by emphasizing the importance of integrating information from a wide variety of sources, including history, behavioral observations, and medical records. In addition, there is an emphasis on refining the referral question(s) to assist in making decisions related to a client. Further emphasis is given to presenting data according to functional domains (memory, executive functions, etc.) as well as to providing answers to specific referral questions. It is believed that this emphasis will keep clinicians focused on people and their lives rather than on the tools-tests used to understand these people.

Clinicians should also broaden their competencies by becoming familiar with other perspectives of clinical neuropsychology. In particular, client functions, and the tests that measure these functions, can be organized according to different domains, the most important of which are memory and learning, mental activity (attention and processing speed), visuoconstructive abilities, verbal functions and academic skills, motor performance, executive functions, and emotional status (see Groth-Marnat, 1999; Lezak, 1995). This approach has the advantage of organizing a client's functions into logical groupings which can relate both to specific tests as well as to client problems. Accordingly, this domain-based approach is also emphasized throughout the book. Test descriptions and test selection focus on functional domains as do issues related to treatment planning and the format of psychological reports.

One perspective is to focus either on knowledge of specific types of clinical syndromes or on different types of disorders, along with how these syndromes or disorders might be assessed. For example, various syndromes might include aphasia, alexia, agraphia, acalculias, body scheme disturbances, agnosia, or neglect (see Heilman & Valenstein, 1993). Information might also be organized according to the considerations that are relevant for such disorders including head injuries, learning disabilities, epilepsy, stroke, or exposure to neurotoxic substances. Through an understanding of these syndromes-disorders, a clinician can be guided through the interview-and-assessment process. In some instances, the nature of the disorder is emphasized above and beyond issues related to measurement. In other cases, specialized batteries have been developed for assessing specific syndromes. This is especially true for aphasia, dementia, and neurotoxicity.

Yet another approach is to understand the client and the assessment procedures according to the different lobes of the brain (see Kolb & Whishaw, 1996; Walsh, 1991). Knowledge essential for this approach is understanding the types of symptoms that might emerge from damage to a particular lobe as well as the procedures used to assess for these symptoms. For example, parietal lobe injury frequently results in such difficulties as deficits in naming things from touch (tactile **agnosia**), difficulty constructing (**constructional apraxia**), disorders of drawing, and right-left confusion. Specific tests to measure these functions might include tests of drawing (Bender Visual Motor Gestalt Test, Rey-Osterrith Complex Figure Test), ability to recognize objects from touch (Tactual Performance Test, Sensory Perceptual Examination), or measures of the ability to distinguish right from left. Competent neuropsychological assessment requires a working knowledge of each of the perspectives mentioned previously.

ORGANIZATION OF THE BOOK

When working with a client, neuropsychologists typically become involved with a series of processes. This begins with clarifying the referral question, developing initial hypotheses, conducting an interview, selecting and administering tests, interpreting test results, and integrating relevant information into a case-focused, problem-oriented psychological report. Accordingly, the book is organized around each of these steps in such a way as to guide practitioners through the different stages of neuropsychological assessment. Chapters 1 and 2 cover basic orienting information related to such areas as understanding the context of neuropsychological assessment, refining the referral question, selecting appropriate tests, and general guidelines for assessment. Chapter 3 briefly reviews basic information on neurological disorders and neurological methods of diagnosis. Chapter 4 covers both unstructured and structured methods of obtaining relevant client information through interview.

Chapters 5 to 14 (the central and major portion of the book) introduce, review, and provide interpretative guidelines on the most frequently used tests and test batteries in clinical neuropsychology. The major test batteries, in order of presentation in the book, are the Wechsler intelligence scales, Wechsler Memory Scales, Halstead-Reitan Neuropsychological Test Battery, and the Luria-Nebraska Neuropsychological Test Battery. Frequently used tests according to functional domains are the Rey Auditory Verbal Learning Test and Rey-Osterrith Complex Figure Test (memory and learning); Boston Naming, Woodcock-Johnson Psychoeducational Battery Wide Range Achievement Test and Controlled Oral Word Association Test (language functions and academic skills); Paced Auditory Serial Addition Test and Stroop (mental activities); Bender Visual Motor Gestalt (visuoconstructive abilities); and the Minnesota Multiphasic Personality Inventory (emotional functioning). Each chapter includes discussions of strategies for assessing the respective domain of functioning. These discussions define the domains themselves along with ways that other tests and procedures can be used to further assess the domain. Often tests will be referred to which were included in the chapters on test batteries. For example, the chapter on memory and learning (Chapter 9) discusses the Wechsler Memory Scales along with the Digit Symbol/Coding subtests from the Wechsler intelligence scales. An additional chapter on executive functions has been included

due to the importance of this aspect of assessment (Chapter 13). However, no specific tests have been included due to the multifaceted nature of assessing executive abilities and to the fact that specific tests have not been found to be particularly helpful.

Over the past 15 years, neuropsychological rehabilitation has become progressively more important. Along with this emphasis has emerged knowledge on test results and treatment planning. Accordingly, Chapter 15 provides a systematic approach to tailoring client information around client management and rehabilitation planning. The last chapter (Chapter 16) provides a format for integrating test results into a concise, case-focused neuropsychological report. Examples of reports from the three most frequently encountered contexts (differential diagnosis, treatment planning, legal) have been included.

PATTERNS OF TEST USE IN NEUROPSYCHOLOGY

During the past 30 years, surveys in the general area of professional psychology have carefully documented the patterns of test use. Noteworthy findings are that these patterns have changed little and that often the selection of tests is based more on perceived clinical utility and tradition than on the strength of empirical support. The most frequently used tests have consistently been the Wechsler intelligence scales, Minnesota Multiphasic Personality Inventory, Bender Visual Motor Gestalt, Rorschach, Thematic Apperception Test, Projective drawings (all kinds), Millon Multiaxial Clinical Inventory, California Psychological Inventory, and the Beck Depression Inventory (Lubin, Larsen, & Matarazzo, 1984; Piotrowski & Zalewski, 1993; Watkins, Campbell, Nieberding, & Hallmark, 1995).

In contrast to the general field of professional psychology, neuropsychology has not been surveyed until relatively recently. Existing surveys indicate that test use varies according to whether the professionals surveyed are specialty neuropsychologists (versus more general practitioners who also offer neuropsychological services), the region (U.S. patterns versus international patterns), context (forensic versus general neuropsychological), or theoretical orientation. Summarizing across surveys indicates that the two tests that most frequently emerge are the Wechsler Adult Intelligence Scale-Revised (WAIS-R) and the Wechsler Memory Scale (revised and original forms). Other frequently used tests are the following: partial Halstead-Reitan Battery (particularly Trail Making and Finger Tapping), Minnesota Multiphasic Personality Inventory, Wide Range Achievement Test, Rey Auditory Verbal Learning Test, Bender Visual Motor Gestalt, full Halstead-Reitan Battery, Luria Nebraska Battery, Wisconson Card Sorting, and the Rey-Osterrith Complex Figure (Butler, Retzlaff, & Vanderploeg, 1991; Guilmette, Faust, Hart, & Arkes, 1990; Lees-Haley, Smith, Williams, & Dunn, 1995; Retzlaff, Butler, & Vanderploeg, 1992; Sullivan & Bowden, 1997; Sweet, Moberg, & Westergaard, 1996). Most neuropsychologists use a core battery comprised of either their preferred tests or a formally developed battery, particularly the Halstead-Reitan. They also routinely supplement their assessments with additional tests of memory, of speech and language, and of visuospatial, psychomotor, executive, and personality functioning. The selection of these supplemental tests is based on the type of additional information that needs to be obtained. In order to

collect actual test data, the majority (between 59% and 69%) of neuropsychologists use technicians, although nearly all of them (97%) conduct the interview themselves (Sweet et al., 1996).

A more detailed analysis of test usage has been derived by considering theoretical orientation. Specifically, different patterns of test usage have been found associated with eclectic, hypothesis testing, process, and Halstead-Reitan orientations (Retzlaff et al., 1992). All orientations were consistent in giving strong support for using the Wechsler intelligence scales. As would be expected, neuropsychologists endorsing an eclectic orientation (34% of persons surveyed) did not endorse any one test or test battery but instead selected tests from a wide variety of options. Thirty-one percent of respondents endorsed a hypothesis testing approach and were more likely to avoid the Halstead-Reitan tests and to instead use the Wide Range Achievement Test, Rey Auditory Verbal Learning Test, Rey-Osterrith Complex Figure Test, Wechsler Memory Scales, Boston Naming, California Verbal Learning Test, Wisconson Card Sorting, Controlled Oral Word Association Test, and Token Test. Neuropsychologists using a process approach (25% of those surveyed) were most likely to use Trail Making, Finger Tapping, Wide Range Achievement Test, Wechsler Memory Scales, California Verbal Learning Test, Rey-Osterrith Complex Figure Test, Wisconsin Card Sorting, Boston Naming, Boston Diagnostic Aphasia, and the Rey Auditory Verbal Learning Test. The Halstead-Reitan approach was endorsed by 20% of respondents, who, as would be expected, were most likely to use the Halstead-Reitan battery along with the Minnesota Multiphasic Personality Inventory, Wide Range Achievement Test, and, to a lesser extent, the Wechsler Memory Scales. The preceding discussion strongly indicates that the clearest clusters are the Halstead-Reitan approach on the one hand and the hypothesis-testing and the process approaches on the other hand. These two latter approaches seemed to have considerable overlap in the tests they preferred to use. It should also be noted that a recent survey indicates that the fixed-battery approach is now used by only 14% of those surveyed (Sweet et al., 1996). This suggests that flexible, hypothesis-testing approaches are becoming the dominant trend in neuropsychology. The existing surveys also suggest that there is more diversity in neuropsychology than in the more general area of clinical psychology.

HISTORY AND DEVELOPMENT OF CLINICAL NEUROPSYCHOLOGY

Neuropsychological assessment as a well-defined discipline began in the 1950s with the work of Halstead, Reitan, and Goldstein in the United States, Rey in France, and Luria in the Soviet Union. Within the United States, the experimental and statistical orientation of American psychology was clearly reflected in test design and use. Norms were refined and used for comparisons with an individual patient's performance. Optimal cutoff scores were developed to distinguish impaired from normal performance. In particular, the Halstead-Reitan Neuropsychological Test Battery (HRB) grew out of Ward Halstead's selection of 27 tests that he believed measured cerebral functioning and "biological intelligence." Halstead reduced the 27 tests to 10 tests, which Reitan (1955) later reduced to 7. Cutoff scores were developed on these

tests, and, based on the proportion of tests in the impaired range, an Impairment Index was calculated. Downward extensions have been developed for children aged 9 to 15 (Halstead Neuropsychological Test Battery for Children and Allied Procedures) and aged 5 to 9 (Reitan-Indiana Neuropsychological Test Battery for Children).

Early success was achieved with the HRB in distinguishing not only the presence of brain damage, but also the location and nature of existing lesions (Reitan, 1955). During the days before sophisticated neuroradiological techniques, this was extremely useful information. These efforts emerged into an emphasis on what has sometimes been referred to as the three L's of neuropsychology: **L**esion detection, **L**ocalization, and **L**ateralization. In contrast, there was relative neglect in the study of diffuse impairment in favor of the stronger emphasis on focal involvement.

Concomitant with the developments in the United States was the work of Alexander Luria in the Soviet Union and of Rey in France. Luria and Rey relied extensively on close patient observation and in-depth case histories. They were not so much interested in what score a person might have obtained but rather in why he or she performed in a certain manner. Their work emphasized and laid the groundwork for the flexible pathognomonic sign or qualitative approach. Rather than developing a series of quantitatively oriented tests with optimal cutoff scores, Luria developed a series of procedures that he believed would help the client to express relevant behavioral domains. As such, his approach relied far more heavily on clinician expertise and observation than on formal psychometric data. A.-L. Christensen (1979) later organized Luria's procedures into a flexible, hypothesis-testing format, which has been summarized into a text, manual of instructions, and test cards. Golden, Purisch, and Hammeke (1985) also formalized Luria's procedures into the standardized but less flexible Luria-Nebraska Neuropsychological Battery.

From these early beginnings, there emerged two distinct strategies of approaching neuropsychological assessment. One was the comprehensive battery approach epitomized by Halstead and Reitan and formalized into the HRB. The other was a more flexible, qualitative, hypothesis testing strategy as represented by Rey, Goldstein, and Luria. Each of these approaches has different strengths and weaknesses (see Bauer, 1995; Jarvis & Barth, 1994; Russell, 1995, 1998). The battery approach has the advantages of providing an assessment of a broad spectrum of behaviors and assessing both strengths and weaknesses. It is easier to use for research, is more extensively normed and researched, can be administered by trained technicians, and is easier for students to learn. Its disadvantages are that it is typically quite time consuming, may overlook the underlying reasons why a client obtained a specific score, and is more difficult to tailor toward the unique aspects of the client and the referral question. The advantages of the contrasting qualitative hypothesis-testing approach are that it can be tailored to the specifics of the client and the referral question, emphasizes the processes underlying a client's performance rather than a final score, and is quite time efficient. Measurements of a client's strengths and weaknesses or of certain reasons for ambiguous responses can be pursued in more depth according to decisions made by the examiner. Weaknesses frequently attributed to this approach are that, in practice, it focuses on a client's weaknesses, relies too extensively on clinician expertise, is more difficult to research, is not as extensively researched, and provides a narrower slice of a client's domains of functioning.

The preceding description is somewhat polarized in that it does not do justice to the fact that in actual practice most practitioners use a combination of approaches. Whereas HRB practitioners focus extensively on test scores, they also consider various hypotheses along with relevant qualitative responses (client response to failure, quality of drawings, etc.). Similarly, practitioners emphasizing a flexible, hypothesis-testing approach test not only to further understand the idiosyncrasies of client responses, but also to pay close attention to the scores clients achieve. Thus, it is more a question of emphasis than of blind adherence to a given tradition. In addition, there is increasing support within the neuropsychological community for a flexible-fixed battery comprised of a relatively short fixed or core battery combined with additional flexible tests that are selected based on the uniqueness of the client and the specifics of the referral questions (Benton, 1992; Sweet et al., 1996). Consistent with this integration of approaches is the finding of Retzlaff et al. (1992) that the greatest percentage of neuropsychologists (34%) identify with an eclectic orientation. A further development that suggests an integration between the approaches has been the development of objective, in-depth, computerized scoring systems that can help to understand the underlying qualitative processes a client makes in responding to test items (i.e., scoring for the California Verbal Learning Test; Delis, Kramer, Kaplan, & Ober, 1987).

Perhaps reflective of this integration of traditions is the process approach, which in many ways is a synthesis between the qualitative, hypothesis-testing approach and formal psychometric methods. The process approach relies on neuropsychological tests with strong psychometric properties. However, its main distinction is the development of procedures to evaluate the process a client undergoes when responding to the test materials. As such, it is quite closely aligned with the qualitative, hypothesis-testing approach. One of the major developments of the process approach has been specialized administrations and analyses of the WAIS-R (WAIS-R Neurological Impairment or WAIS-R NI; Kaplan, Fein, Morris, & Delis, 1991) and WISC-III PI (Kaplan, Fein, Morris, Kramer, & Delis, 1999). For example, administration of the Block Design subtest includes a superimposed grid to determine if this external structure enhances performance. Information retrieval difficulties might be assessed by using a multiple-choice adjunct to the information subtest. Patients who once knew the answers but had difficulty retrieving them would be expected to perform considerably better on the multiple-choice version, which requires recognition, a task that is easier than retrieval.

Concurrent with the development of the early testing procedures and batteries, there was also an emphasis on brief screening instruments. The Bender Visual Motor Gestalt Test, or simply the Bender Gestalt Test, was one of the earliest of these. It was first developed by Lauretta Bender in 1938 and is comprised of nine designs that a client is requested to reproduce. A similar but more complex visuoconstructive test was originally devised by Rey in 1941 and was expanded by Osterrith in 1944 (Osterrith, 1944; Rey, 1941). It has since been refined and is referred to as the Rey-Osterrith Complex Figure Test. Patients are requested first to complete the drawing while it is directly in front of them and then to make a second reproduction of the drawing from memory. Rey also developed the Rey Auditory-Verbal Learning Test (Rey, 1964), which screens for difficulties with short-term verbal memory. Clients are instructed to listen to a series of items that is read to them and then to repeat back as many of the items as possible. One final example of an early screening test for attentional

difficulties is the Stroop procedure (Stroop, 1935). This test presents clients with a series of color names that are written in colored ink different from the written name of the color given. For example, the name green might be written in red ink. The client is then requested to read through the list and give the name of the color of the ink (i.e., red) rather than merely reading the word (i.e., green).

During the 1970s and 1980s, many screening procedures were combined to form short assessment batteries. For example, Wysocki and Sweet (1985) developed a seven-test battery comprised of Trail Making, finger-tapping speed, drawing a Greek cross, the Pathognomonic Scale of the Luria-Nebraska Neuropsychological Battery, the Stroop, and the Logical Memory and Visual Reproduction subtests of the Wechsler Memory Scale. Total administration time is approximately 60 minutes. Another representative screening system is the BNI Screen for Higher Cerebral Functions (Prigatano, Amin, & Rosenstein, 1992). The test is given to determine if a patient is capable of taking other neuropsychological tests, to evaluate their level of self-awareness, to provide qualitative information regarding cognitive functioning, and to assess a wide range of cerebral functions. The entire procedure typically takes 10 to 15 minutes to complete. There have also been two abbreviated versions of the HRB by Golden (1976) and Erickson, Caslyn, and Scheupbach (1978). Such tests are currently undergoing careful empirical scrutiny to determine which ones are relatively more sensitive for various types of patients (i.e., Chouinard & Braun, 1993).

During the 1980s and into the 1990s, clinical neuropsychology moved from being primarily an assessment discipline to becoming increasingly concerned with interventions primarily within the context of rehabilitation. A 1995 survey indicated that 64% of neuropsychologists were involved with treating patients with brain dysfunction (Sweet et al., 1996). Rehabilitation has typically occurred within the context of multidisciplinary teams often in day-treatment settings. Neuropsychological activities have included cognitive retraining, memory training, visual-spatial training, and individual, group, and family therapy. These activities have typically occurred and been integrated with interventions from psychiatrists and physiatrists along with speech, occupational, physical, and recreational therapists. However, many interventions have not been fully validated and frequently suffer from outcome measures unrelated to ecological validity. Clinical neuropsychology is currently in the process of carefully evaluating which methods do or do not have demonstrated benefits to patients (Carney et al., 1999).

CURRENT TRENDS AND PATTERNS

New technology, emerging research, the impact of managed health care, and legal challenges have combined to create several current trends in clinical neuropsychology. These include computerized approaches, greater emphasis on understanding the nature of deficits (versus presence of brain damage), greater focus on application, organization of results around functional domains, and the development of test batteries specific to certain conditions. In particular, computerized techniques hold considerable promise (Groth-Marnat & Schumaker, 1989; Kane & Kay, 1992). They have the potential to reduce costs by reducing direct clinician (or technician) contact through computerized administration. They might also reduce clinician time through computers

assisting clinicians during assessment to generate hypotheses and, based on these hypotheses, to select future optimal assessment procedures (Hammainen, 1994). Tailoring item presentation based on previous responses in combination with various decision rules might result in a highly efficient means of gathering information. In addition, computer-assisted interpretation enables tentative interpretations to be based on a large database. As a result, several fully automated batteries are routinely used particularly in large organizational contexts such as the military and the Federal Aviation Administration (see Kane & Kay, 1992). Often these batteries have focused on particular types of problems. For example, COGSCREEN has been used in the selection of airline pilots; the military's UTCPAB was developed to assess the impact of drugs on the workplace; and the Neurobehavioral Evaluation System is particularly sensitive to the impact of environmental toxins.

Computerized batteries are being used more frequently, but they currently do not have the extensive validation associated with the more traditional tests such as the Halstead Reitan batteries. Even though computerized administration and interpretation procedures hold considerable promise, they still are not being used nearly as often as the more familiar individually administered neuropsychological tests or test batteries (Butler et al., 1991; Lees-Haley et al., 1995; Lezak, 1995). Furthermore, computerized administrations may not necessarily produce the same results as their clinician-administered versions (Van Schijndel & van der Vlugt, 1992). A further issue is that computer-generated interpretations need to be treated with considerable caution. Clinicians should consider all interpretations within the unique context of each client; they should avoid potentially obsolete software; and they should critically evaluate how the interpretations were generated within the software itself (Groth-Marnat, 1985; Groth-Marnat & Schumaker, 1989). Computer-based interpretations, then, should not be used to replace the clinician, but more appropriately to widen the number of interpretive possibilities.

Throughout the earlier history of clinical neuropsychology, a typical goal was to differentiate between organic difficulties and functional difficulties. Thus, a referral question was sometimes expressed in terms of "ruling out organicity" or of "differentiating" between organic and functional causes. More recently, the appropriateness of this goal, and the assumptions behind it, has been questioned. Leonberger (1989) has pointed out that there has been a gradual disintegration of the distinction between many functional and organic disorders. For example, early conceptualizations of schizophrenia considered it to be functional. In contrast, current research supports the presence of strong biochemical and structural correlates in a substantial portion of people with schizophrenia (Heinrichs, 1993; Raz & Raz, 1990; Weinberger & Berman, 1988). In addition, recent advances in neuroradiological and other neurologically oriented techniques have greatly refined the diagnosis of brain damage. As a result, the use of neuropsychological techniques in diagnosis has become deemphasized. In contrast, referrals from neurologists and psychiatrists are more likely to request information regarding the nature of already identified lesions. This is consistent with a 1990 survey that identified that the second most frequent reason to conduct a neuropsychological assessment is evaluating a client's work capacity (Guilmette et al., 1990). Finally, the biopsychosocial model for understanding disfunction emphasizes the dynamic interplay between biological, psychological, and social factors.

A further change over time has been that, rather than focusing on measurement, there has been greater emphasis on application (Johnstone & Farmer, 1997; Ponsford, 1988). Thus it is no longer sufficient to merely state that a client is experiencing cognitive deficits in certain areas. Instead, more functionally relevant areas are being evaluated, such as the client's employability, responsiveness to rehabilitation, and the need for certain types of environmental supports. This change in emphasis can be clarified by considering the differences between impairment and disability. *Impairment* typically reflects normative comparisons and test data. In contrast, the more functionally relevant term *disability* more closely takes into account the context of the client, including his or her circumstances, environment, and interests. For example, a client might be statistically in the mildly impaired range on tests requiring sequencing. If he or she was a computer programmer, this difficulty would result in a disability. In contrast, another client with different interests might not find this problem to be a disability. This means that there are increasing expectations on clinicians to work with both the test data and the specifics of the client to translate the impact of any test-related impairment on the level to which they might be disabled. This may also require using methods of analysis other than psychological tests, such as the ratings of relatives, ward observation charts, and simulations (Knight & Godfrey, 1996; Ponsford, 1988; Sbordone & Long, 1996).

Because the preceding questions related to a client's real-life functioning are becoming more important, neuropsychology is working to more clearly address the empirical basis for the inferences clinicians make from test scores to client functioning (Matarazzo, 1990). In other words, test results can actually predict how a specific client will adapt to a vocational, community, educational, interpersonal or, rehabilitation context. Whereas neuropsychologists are typically quite comfortable discussing test data, it is often necessary to stretch the meaning and empirical basis between scores and areas of real-life functioning. This difficulty often becomes most noticeable during legal proceedings when neuropsychologists are challenged to provide empirical support for their inferences. This is particularly an issue when a patient claims significant deficits with little corresponding objective medical evidence (i.e., computerized tomography scans indicating lesions, loss of consciousness surrounding the injury). The issue of test scores not relating sufficiently to real-life behaviors has been an important and welcome trend in neuropsychology since it has forced neuropsychologists to integrate past research and generate new research into establishing the ecological validity of assessment procedures. Currently there are available reviews of the ability of neuropsychological assessment to predict real-life behavior for such areas as attentional capacity, executive functions, perceptual abilities, memory, and personality (see Acker, 1990; Bowman, 1996; Crepeau & Scherzer, 1993; Groth-Marnat & Teal, in press; Sbordone & Long, 1996; Vilkki et al., 1994). Some of the research is quite supportive, whereas other literature indicates that neuropsychology needs to make considerable progress.

Consistent with issues related to ecological validity is that more recent emphasis has not been so much on measuring the presence of brain damage but rather on assessing different functional domains, which might include such areas as memory, visuoconstructive abilities, mental activity, verbal functions, executive functions, and emotional status. Thus "brain sensitive" screening tests should not be considered to be tests of brain damage but rather tests of certain functions that *may* be consistent with

central nervous system (CNS) involvement. Clearly this means that, instead of using single tests, neuropsychological assessment should ideally use several instruments that assess different domains. Thus, the emphasis throughout this book is to organize and integrate the assessment results around different functional domains. Such an organization more easily allows clinicians to make inferences related to the client's functioning within vocational, community, educational, or interpersonal contexts.

One issue with this domain-based approach is that typically neuropsychological tests do not clearly fit into specific, well-delineated domains. A test such as Digit Symbol-Coding measures a wide variety of abilities, including processing speed, visual short-term memory, rote learning, flexibility, and sequencing. Although Digit Symbol-Coding is often categorized as a measure of processing speed, it might arguably be placed into another domain category, such as visuospatial ability or memory. More importantly, one patient might have the same score on Digit Symbol-Coding as another one but the reason for the score might be quite different (i.e., slow processing speed versus poor memory). Dodrill (1997) has provided psychometric support related to poor test specificity by emphasizing that the median correlation for common neuropsychological tests *within* domain groupings was .52, whereas the median correlation *between* groupings was .44. If the tests were specific to certain abilities (and not to others), it would be expected that the median correlations within groupings would be higher and that median correlations between groupings would be lower. This clearly suggests that the primary tools for assessment are not measuring specific domains/abilities as clearly as practitioners conceptualize them as doing.

In the past, most clinical neuropsychologists were content to use a selection of their preferred tests on most clients whom they assessed. More recently, there has been the development of recommended collections of tests for specific types of disorders. An important rationale for this is that there are often certain tests that are either quite sensitive to the presence of a particular condition or that provide essential information related to that condition. Each battery will usually use a combination of previously developed tests such as Trail Making and portions of the WAIS-III. For example, specialized batteries for the evaluation of neurotoxicity are the California Neuropsychological Screening Battery (Bowler, Thaler, & Becker, 1986), Pittsburgh Occupational Exposure Test (Ryan, Morrow, Parkinson, & Branet, 1987), and the Individual Neuropsychological Testing for Neurotoxicity Battery (Singer, 1990). Assessment and monitoring of some of the more important domains of dementia might be achieved with the CERAD Battery (Morris et al., 1989) or the Dementia Assessment Battery (Corkin et al., 1986). A similar specialized battery for detecting the early signs of AIDS-related dementia is the NIMH Core Neuropsychological Battery (Butters et al., 1990). It is likely that there will be the continued development of additional batteries tailored to optimally assess specific disorders or conditions.

Neuropsychologists have traditionally attempted to understand brain functioning by measuring cognitive changes following lesions to specific regions of the brain. This tradition was set in the early 1800s by Broca who noted that patients with lesions on the lateral slope of the left prefrontal cortex typically experienced difficulties with symbol formation along with difficulties producing speech in an orderly manner. Although this "lesion behavior" correlational approach is well established, it does not reflect developments in a wide variety of technologies. Indeed, clinical neuropsychology is struggling

to integrate the findings and implications from diverse technologies that include not only the older electroencephalograms (EEGs) and computerized tomography (CT) but also more recent techniques, such as magnetic resonance imaging (MRI), event-related potentials (ERPs), cerebral blood flow (CBF), positron emission tomography (PET), and single positron emission tomography (SPECT; Bigler, 1991). For example, Chase et al. (1984) used PET scans to study the glucose metabolism associated with various performances on the WAIS-R. They found Block Design performance was associated with greater metabolism in the right postereoparietal region. In contrast, performance on the Comprehension subtest was primarily associated with increased metabolism in the left hemisphere but with some associated right hemisphere activation associated with right hemisphere speech and language centers. A somewhat similar strategy found that cognitive processes associated with generating the names for objects were associated with activation of the frontal cortex (Zelkowicz, Herbster, Nebes, Mintun, & Becker, 1998). As more techniques are focused on specific clinical phenomenon, neuropsychology may not only undergo considerable advances in knowledge, but may even alter how patients are assessed. One technique that holds considerable promise is "importance modeling," which rates different brain structures on a continuum based on their relative importance to performance measures (Turkheimer, Yeo, & Bigler, 1990).

THE STATUS OF CLINICAL NEUROPSYCHOLOGY

During the past 30 years, clinical neuropsychology has evolved from a minor subspecialty of professional psychology to a well-developed, major, international discipline. There are now more than six journals devoted exclusively to clinical neuropsychology. Neuropsychology is also extremely multidisciplinary and draws from the knowledge base of neurology/neurosurgery, psychiatry, rehabilitation, occupational therapy, speech therapy, physical therapy, and neuroscience, as well as physiological, clinical, counseling, cognitive, and developmental psychology. Thus, neuropsychologists are likely to be involved with treatment teams or, if not directly involved with treatment teams, typically network with a variety of different health professionals. Whereas the discipline was initially concerned with assessment, more recently it has become progressively focused on methods of psychotherapy and rehabilitation. The dominant assessment methodology has become either an eclectic or a flexible-battery approach (Retzlaff et al., 1992; Sweet et al., 1996).

Many neuropsychologists believe training should most appropriately occur at the postdoctoral level and should be a proficiency stemming from clinical psychology (Sweet et al., 1996). In contrast, recent guidelines emphasize that neuropsychology as a speciality should begin at the doctoral level and extend into an internship and residency (Hannay et al., 1998). Additional guidelines are being developed for subspecialities within neuropsychology, which will most likely include child, pediatric, geriatric, and rehabilitation. Within the United States, it is estimated that specialty doctoral, internship, and postdoctoral programs graduate a combined total of over 400 neuropsychology graduates per year (Mathews, 1996).

The preceding overview attests to neuropsychology as a vital, robust, growing discipline. However, the bedrock of any discipline ultimately depends on the extent to which

it is has sufficient scientific support. This has become a particular issue in neuropsychology due to challenges to such vital areas as the reliability and validity of judgments, value of training in increasing judgment accuracy, and the appropriateness of neuropsychologists appearing as expert witnesses (Faust, 1991; Faust, Guilmette, Hart, Arkes, & Fishburn, 1988; Faust, Ziskin, & Hiers, 1991). The result has been that clinical neuropsychology has been through and continues to undergo a clear, sobering, and often critical reevaluation. Areas of particular importance are the reliability and validity of clinical judgment, ecological validity of measures, the importance of clinical experience, and the ability to detect malingering.

Reliability for judgments based on standardized neuropsychological tests is good to excellent (Garb & Schramke, 1996). Representative results indicate that interrater reliability for judging the presence or absence of impairment ranged from a low of .65 to a high of .94, and the rating of laterality of impairment was .84 (Garb, 1998; Garb & Schramke, 1996). More specific interrater ratings for cognitive domains were somewhat lower but still good (high of .88 for intelligence to a low of .53 for attention; Brown, Del Dotto, Fisk, Taylor, & Breslau, 1993). Intertest ratings between the HRB/WAIS and LNNB were .64 for the presence of brain damage, .72 for identifying the hemisphere involved, and .65 for ratings of more specific locations (left frontal, right temporal, etc.; Diamont & Hijmen, 1981). The preceding data refers to standardized battery approaches. Due to wide variation in using flexible approaches, no reliability data is currently available.

Validity for test batteries and for individual tests varies according to each test and according to the purpose and population for which it is being used. For example, WAIS-R factor scores (Verbal Comprehension, Perceptual Organization, Freedom from Distractibility) have good construct validity based on correlations with relevant neuropsychological tests (Sherman, Strauss, Spellacy, & Hunter, 1995). A meta-analytic review of tests indicated that the Stroop, Facial Recognition, Wechsler Memory-Visual delayed subtest, Grooved Pegboard, and Rey-Osterrith Complex Figure tests were particularly good at detecting diffuse damage (Chouinard & Braun, 1993). Another meta-analysis of 77 studies by Christensen, Hadzi-Pavlovic, and Jacomb (1991) found that neuropsychological tests were quite effective at differentiating patients with mild, moderate, or severe dementia from older people without dimentia (effect size = .68). The differentiations made with neuropsychological tests are quite clearly far more accurate than differentiations based on interviews or informal observations (i.e., Roca, Klein, & Vogelsang, 1982; S. Schwartz & Wiedel, 1981). More detailed information on test validity can be found and reviewed in the following chapters on each of the tests.

Clinical neuropsychologists typically make judgments in which they rely heavily on test results. In order to research this process, it has been necessary to standardize information given to each judge prior to the making of final conclusions. In many ways, this is an artificial task because it means clinicians are not given relevant behavioral observations, details related to the context of the assessment, or additional idiosyncratic features of the subject. The result might be that judgment accuracy is likely to be significantly lower in the artificial research situation than in actual clinical contexts. A further issue with this line of research is the ultimate yardstick or "Gold standard" to compare clinician judgments. For example, CT scans might indicate focal lesions but

might miss diffuse damage. Clinicians requested to localize a lesion might have their judgment confounded if the client under question has not only diffuse impairments but also specific lesions. In these cases clinicians might technically be considered "wrong" according to CT records but might be quite accurate in that they have detected a wide range of complications above and beyond the focal ones indicated by CTs. Finally, comparison group selection can greatly alter the accuracy of judgments. If patients with moderate to severe impairments are being compared to healthy comparison groups, judgment accuracy for presence of brain damage is likely to be high. In contrast, distinguishing patients with subtle deficits from healthy controls might be a considerably more difficult task resulting in much less accuracy. Somewhat similarly, differentiating people with severe psychiatric complaints from people with brain damage might be a relatively difficult task as well. These caveats should be taken into consideration when evaluating the following conclusions of research on clinical judgment.

Validity of judgments can be organized around detecting the presence of impairment, specifying lesion location, and identifying the process and etiology of the disorder. Reviews found that the overall hit rate (correct positives + correct negatives) for detecting impairment was a respectable 84% (Garb, 1998; Garb & Schramke, 1996). However, the level of accuracy across studies varied considerably. In addition, 21% of subjects were false positives (nonimpaired incorrectly classified as impaired) with a false negative rate of 14% (unimpaired incorrectly identified as impaired). As would be expected, clinicians who made the finer distinction of location of impairment (diffuse, right, left, left-anterior, etc.) had lower average hit rates, ranging from 68% to 70% (Garb, 1998; Garb & Schramke, 1996). Hit rates were a lower 60% to 64% when evaluating whether the condition was static or progressive. However, it should be noted that in practice the hit rates for acute/static differentiation should be considerably higher if the client is given repeat testing to monitor changes over time. Considerable variation has been reported when judgments were made on the specific etiology of the impairment (i.e., head injury, Alzheimer's disease, partial-complex seizures). Filskov and Goldstein (1974) reported a hit rate of 85%, and Reitan (1964) reported a similarly high hit rate of 84%. In contrast, Faust, Guilmette, et al. (1988) reported a much lower hit rate of only 23%.

The emphasis on validity refers primarily to neuropsychology's role in differential diagnosis. More recently, this focus has changed to emphasize ecologically important dimensions such as a patient's level of functioning in vocational, educational, interpersonal, and community contexts. The ability of neuropsychological procedures to predict such areas has been somewhat variable. An important reason for this is that the assessment session itself can be somewhat artificial; it is typically focused on specific tests given in a relatively structured, distraction-free environment. In contrast, real-life situations often present multiple demands on patients and require them to initiate and to organize their own behavior rather than to respond to tasks structured by the examiner. In addition, some symptoms occur intermittently and, thus, may not actually occur within the evaluation session. All this is further complicated by the fact that patients with impairments often can neither recall certain types of difficulties nor articulate them adequately, nor do they have much awareness regarding their deficits.

Although it is not possible to review all areas of ecological validity in neuropsychology, assessment of attention, memory, executive functions, and personality deserve particular comment. Attention is crucial to a wide range of everyday activities.

However, formal assessment of attention is often so narrow in its focus that the multiple demands of everyday life are not taken into account (see Chapter 11). For example, a patient might temporarily perform well on a Digit Span type task but, in real life, is relatively easily distracted by two or more competing demands. This means assessment should not only take into account traditional test scores but should also consider more demanding, complex tasks along with patient self-reports and descriptions by significant others (Kerns & Mateer, 1996). The ecological validity of memory assessment has been enhanced with the development of tests of everyday memory functions. For example, the Rivermead Behavioral Memory Test (Wilson, Cockburn, & Baddeley, 1985) includes activities such as remembering a hidden object, an appointment, faces, or details from a newspaper article. Representative validity indicates good correlations with self and family ratings (Williams, 1987), with detection of patients with formal memory disorders (Kotler-Cope, 1990), and with ability to predict degree of independence following closed head injury (Wilson, 1991).

Executive functions refer to a person's ability to anticipate behavior, to select relevant goals, to sequence his or her actions, to monitor self-behavior, and to be actually motivated to perform certain behaviors (see Chapter 13). One of the crucial features of executive functions is self-awareness. However, assessing executive function is particularly problematic because it requires approaching the client from a variety of angles. This is further complicated by the fact that there are few formal procedures that adequately or specifically measure frontal lobe/executive functioning (Bigler, 1988; Reitan & Wolfson, 1994) although the new Behavioral Assessment of Dysexecutive Symdrome (BADS; Wilson, Alderman, Burgess, Emslie, & Evans, 1999) shows some potential for fulfilling this need. The clinical literature is filled with examples of normal-looking test performance in which the client still has significant executive dysfunction (i.e., Cripe, 1996). This has resulted in no clearly accepted assessment methodology with each clinician often using idiosyncratic qualitative approaches. Consistent with this is the fact that there is little research related to the ecological validity of the assessment of executive functions despite its acknowledged research and clinical importance.

In contrast to the limited strategies for assessing executive functions, there is body of research some of which supports the importance of using tests of emotional functioning in predicting relevant everyday functioning. For example, MMPI performance among people with neuropsychological impairments has been found to predict vocational function at least as accurately as cognitive assessment (Heaton, Beade, & Johnson, 1978). Similarly, California Personality Inventory performance (Social Presence, Self Acceptance, Capacity for status) predicted job performance among patients with epilepsy, especially if combined with WAIS scores (M. Schwartz, Denneril, & Lin, 1968). More recent work has included developing more specific instruments for assessing emotional functioning among people with neuropsychological impairments (Judd & Fordyce, 1996).

It would be expected that accuracy of clinical judgment would increase with additional training and experience. However, this has been given only limited research support. A supportive study by Goldstein, Deysach, and Kleinknecht (1973) found that, following training with the Halstead-Reitan Neuropsychological Test Battery, clinician accuracy increased from 53% to 95%. In contrast, other studies found that various measures of training (hours of practicum training, percentage of internship spent on neuropsychology,

completion of specialized postdoctoral fellowship, ABPP qualification) did not predict accuracy of ratings for presence/absence, location, or etiology of impairment (Faust, Guilmette, et al., 1988; Heaton, Beade, et al., 1978). One caution in interpreting the preceding equivocal results is that accuracy might be related to setting (Garb & Schramke, 1996). This would mean that under research conditions where neuropsychologists are given the same objective sets of data, there may be little opportunity for expertise to emerge. However, these same clinicians, working in their own specific clinical settings, might be able to enhance their accuracy, especially when compared with lesser trained professionals unfamiliar with the setting.

In legal contexts, particularly with personal injury and compensation cases, some patients might benefit from faking symptoms. Thus, it is crucial for neuropsychologists to be able to differentiate between actual and faked performances. However, the ability to do so has been controversial. Most formal studies have used simulated sets of faked test results and real test results that have then been ranked by neuropsychologists. The results have been generally disappointing (Faust, Hart, Guilmette, 1988; Faust, Hart, Guilmette, & Arkes, 1988; Heaton, Smith, et al., 1978; Schacter, 1986). Although these results question the ability of neuropsychologists to detect malingering, they should be accepted with considerable caution. First of all, numerous strategies have been specifically developed to detect malingering, yet they were not used in the aforementioned studies. One strategy is the use of forced choice items in which *below chance performance* indicates deliberate exaggeration of symptoms (i.e., Hiscock & Hiscock, 1989). Research has also indicated that event-related potentials could be used to detect actual from simulated memory complaints (Allen, Iacono, & Danielson, 1992; Rosenfeld et al., 1998). In order to adequately evaluate clinically relevant detection rates, these techniques need to be included as part of a test battery. In addition, neuropsychologists typically evaluate malingering within the context of the referral question. If there is the potential for malingering due to potential gain (i.e., higher compensation) combined with certain client characteristics (i.e., antisocial features), then a closer examination is warranted. This might involve careful history, ward observations, relevant personality testing, identification of patterns of inconsistent performance, symptoms that do not make neuroanatomical sense, and informal clinical testing for faking. Thus the ultimate test of a clinician's ability to detect faking should be made within the context of the referral question along with specialized techniques.

SUMMARY

Neuropsychological assessment has undergone considerable growth over the past 20 years. It has gone from a discipline primarily concerned with neuropsychodiagnosis to one which has become progressively involved with understanding the functional significance of assessment results and taking a larger responsibility for client care particularly in the rehabilitation context. Current trends also include the use of computer-assisted assessment, the development of more specialized assessment batteries, integration of knowledge from other disciplines, improving clinical judgment, ecological validity, and the accurate detection of malingering. Future challenges will be coping with the restrictions imposed by managed care (Sweet, Westergaard, & Moberg, 1995), demonstrating the financial efficacy of neuropsychological assessment (Groth-Marnat,

1999), improving treatment planning, incorporating new technologies from a wide number of areas, and re-defining the role of the clinician given developments both within the profession and changes in the delivery of health care.

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