7
Neuropsychological Rehabilitation
Evaluation and Treatment Approaches

DEBORAH M. BENSON AND MARYKAY PAVOL

The Role of the Neuropsychologist

Clinical neuropsychologists are professionals within the field of psychology with special expertise in applying the principles of brain–behavior relationships to individuals with various neurological injuries or illnesses, as well as other medical, developmental, and/or psychiatric conditions (National Academy of Neuropsychology [NAN], 2001). Using various tests, techniques, and principles, neuropsychologists evaluate individuals' cognitive, behavioral, and emotional strengths and weaknesses, and the impact of these on the person's ability to function. This information, combined with information from other professionals (physician, occupational, speech-language, physical therapists, etc.) and families/significant others, is utilized to develop, recommend, and implement treatment interventions.

Neuropsychologists hold a doctoral degree in psychology, and are licensed in their state to practice psychology. In addition to their doctoral degree, recent guidelines (NAN, 2001), suggest that neuropsychologists have at least two full-time years of supervised experience and specialized training in the study and practice of clinical neuropsychology and neurosciences, at least one of which is postdoctoral. As further evidence of advanced training, board certification in neuropsychology can be obtained through the American Board of Professional Psychology (ABPP; www.abpp.org) or the American Board of Clinical Neuropsychology (ABCN; www.theabcn.org). Neuropsychologists working in rehabilitation settings may also be board certified through the ABPP in rehabilitation psychology, a specialty area within professional psychology which focuses on assisting the individual with an injury or illness and his or her family in achieving optimal physical, psychological and interpersonal functioning. Rehabilitation psychology emphasizes interdisciplinary teamwork and a holistic, integrated approach, integrating medical, psychological, social, environmental, and political considerations in order to achieve optimal rehabilitation goals.

Neuropsychologists serve in varied roles in neuro-rehabilitation settings. They often function as team leaders or directors of neuro-rehabilitation programs, providing both clinical and administrative supervision and oversight of program functions. They may serve as consultants, called in to evaluate cognitive and emotional

functioning in patients with brain injury and to provide further insight to the rest of the interdisciplinary team regarding barriers to participation and make recommendations regarding potential treatment interventions. Often, neuropsychologists are directly involved in educating and counseling patients and families regarding the nature of the injury, effects on cognition/behavior/emotion, expectations for recovery, and recommendations for management of ongoing impairments. Given their background training as research scientists, neuropsychologists are often involved in clinical research activities, as well, utilizing the wealth of information obtained by patients and families to contribute to a greater understanding of the principles, processes and factors underlying rehabilitation outcomes.

Neuropsychological Evaluations in Rehabilitation

A neuropsychological evaluation is used to provide insights into the presence and nature of cognitive impairment. If, for example, a patient complains of memory problems, the neuropsychological assessment will indicate whether the memory failure is due to a primary memory deficit or, instead, to impairments in attention, language, or executive skills that are leading to memory problems. Finding the source of a cognitive problem will have direct implications for treatment and may help to refine a diagnosis. A neuropsychological evaluation consists of paper-and-pencil, question-and-answer, and/or computer-administered tests. The examiner, either a neuropsychologist or qualified technician working under the supervision of a neuropsychologist, will prefer to work with the patient in a quiet environment. Results of a recent survey indicate that 76% of neuropsychologists use a flexible battery approach as opposed to a fixed battery, meaning that a majority of neuropsychologists will use a variable but routine group of tests for different types of patients (Sweet et al., 2006).

Prior to beginning testing, the patient should provide consent for the evaluation and should be informed of any limits to confidentiality (American Psychological Association, 2002; NAN, 2003). All tests must be administered and scored in a manner that is consistent with the test publisher's directions; standardized procedures are critical to valid interpretation. The areas assessed might include orientation, attention, memory, language, visual perception/construction, executive function, academic, sensory motor and intellectual skills.

Estimates of premorbid function may also be performed. These estimates of pre-injury ability may be derived from demographic characteristics or from performances on measures believed to be relatively resistant to change (such as reading ability). Examples of methods that use demographic characteristics include those created by Barona et al. (1984) and Krull et al. (1995). These estimation methods have been found to have limited accuracy, especially in the highest and lowest ranges of intellectual function (Basso et al., 2000). An example of an estimation method that uses reading ability is the North American Adult Reading Test (NAART or NART-R), in which the patient is asked to read irregularly pronounced words (Blair & Spreen, 1989). There is evidence that estimates of IQ based on

reading skill perform as well or better than estimates based on demographics (Blair & Spreen, 1989; Bright et al., 2002). Johnstone and colleagues provided data suggesting that another test of reading ability (Wide Range Achievement Test-Revised or WRAT-R) provides an even better estimate of low-range verbal IQ, although both the NAART and WRAT-R were best at estimating average IQ, with tendencies to underestimate high-range IQs and overestimate low-range IQs (Johnstone et al., 1996). These estimates based on reading may not perform well at predicting cognitive domains *other* than IQ (Schretlen et al., 2005). Yet another method of estimating IQ comes from combining demographic characteristics with Wechsler Adult Intelligence Scale-III subtests to create algorithms (Schoenberg et al., 2003). Some researchers recommend using different estimation methods for patients in different IQ ranges (Griffin et al., 2002).

The nature and length of the evaluation will differ according to the setting and the patient. A patient in an acute rehabilitation setting who is medically ill, highly confused, perhaps lethargic or agitated, will not be appropriate for lengthy, complicated assessments. In fact, the attempt to assess such a patient with sophisticated instruments will likely result in an invalid profile that does not provide useful information. Instead, this type of patient will require brief, bedside assessments. These evaluations may include assessments of arousal, behavior, orientation, basic language, thought content, visual-fields, simple memory, insight, and mood (Guy & Cummings, 2003). Formal instruments are used whenever possible. Available measures include the Galveston Orientation and Amnesia test (Levin et al., 1979), the Orientation Log (Jackson et al., 1998), the Cognitive Log (Alderson et al., 2003), the Temporal Orientation Test (Benton et al., 1964), Mini Mental Status Examination (Folstein et al., 1975), the Short Test of Mental Status (Kokmen et al., 1991), the Executive Interview (EXIT) (Royall et al., 1992), and the Confusion Assessment Protocol (Sherer et al., 2005). Rating scales such as the Agitated Behavior Scale may also be useful (Corrigan, 1989). The reader is referred to the website provided by the Center for Outcomes Measurement in Brain Injury for additional suggestions for brief assessment and rating scales (Santa Clara Valley Medical Center, 2006). For patients emerging from coma, some commonly used tests include the Coma/Near Coma Scale (Rappaport et al., 1992) and the Coma Recovery Scale-Revised (Kalmar & Giacino, 2005). The following vignette describes a patient who was appropriate for this limited type of cognitive assessment.

JD, a 65-year-old male, was admitted for inpatient rehabilitation for treatment of deficits due to a right frontal hemorrhage. He was known to have had a left frontal hemorrhage 2 years earlier. In the initial evaluation the patient was pleasant and alert but highly distracted, touching and commenting on everything around him. The Cognitive Log was administered and he obtained a score of 3 (out of 30 possible points). He was oriented to his name only. He did not attempt responses to most structured questions. Severe motor perseveration was evident in a writing sample. In a follow-up assessment 4 days later, the patient showed slight improvement in his ability to benefit from cues for orientation to place; he was able to begin a mental sequencing task but could not complete it and again obtained a score of 3. He appeared less distracted by his environment. In the final session prior to discharge, attention appeared to improve further (3-5 minutes). He had severe difficulty initiating and persisting

on a simple sequencing task, but, after much prompting, he completed the sequence. His total score was 7. His poor attention and initiation was evident in his other therapies as well.

For patients with sufficient attention and endurance, somewhat longer tests may be used such as the Repeatable Battery for the Assessment of Neuropsychological Status (Randolph et al., 1998), the Dementia Rating Scale-2 (Jurica et al., 2001), and the Neurobehavioral Cognitive Status Examination (Kiernan et al., 1987). These tests offer the advantage of relative brevity (approximately 30 minutes) while assessing a range of cognitive areas. These screening instruments may also be used when the suspicion of cognitive deficit is low but there remains an interest in ruling-out impairment. These tests do not, however, represent a thorough assessment of cognition, particularly in the area of executive function.

When a patient appears to have sufficient stamina and attention to tolerate at least 1 hour of assessment, he or she is appropriate for the more complex and sophisticated measures. These types of assessments tend to occur in post-acute and outpatient settings. These comprehensive evaluations are lengthy and provide the most detailed information about the nature and extent of any cognitive dysfunction. The specific contents of the test battery will vary depending on the clinician, the setting and the referral question. As was noted earlier, the majority of neuropsychologists use a flexible battery as opposed to a firmly fixed battery approach, but this flexible battery may contain a fixed battery. One of the best-known fixed batteries is the Halstead–Reitan Neuropsychological Test Battery (Reitan & Wolfson, 1993). These extended evaluations will include assessment of a wide range of skills and each skill area may include assessments of more specific skills: assessments of attention may include tests of sustained and divided attention; assessments of memory may include tests of verbal, visual, free recall, forced choice, and recognition memory; assessments of language may include tests of naming, comprehension, reading and writing; assessments of visual skill may include tests of visual-spatial and visual-constructional skill; assessments of executive function may include tests of problem-solving, verbal fluency, response inhibition, and mental flexibility. Evaluations of motor skill, personality, malingering, and psychiatric status will frequently be included. Muriel Lezak has published the fourth edition of her widely respected and referenced text on neuropsychological assessment (Lezak et al., 2004) and Spreen and colleagues have recently published a new edition of their detailed test descriptions (Strauss et al., 2006). These are among the many publications describing the specific contents and interpretation of comprehensive test batteries. The following vignette describes a patient who received brief assessment during his inpatient admission followed by a more lengthy assessment after his discharge to home.

MH, a 50 year-old carpenter, fell from a ladder at work and sustained a traumatic brain injury. He underwent inpatient rehabilitation and showed improved attention and memory during his inpatient admission. His score on the Galveston Orientation and Amnesia Test (GOAT) improved to the normal range shortly before discharge to his home, at which time he was typically oriented to self, place, date, and event. He was deemed inappropriate for more advanced cognitive assessment during the time his GOAT score was impaired. After

discharge he was seen in the outpatient clinic and completed a full cognitive assessment. The outpatient evaluation showed impairments in memory and visuospatial organization. In particular, immediate learning was generally below expectation and delayed recall showed more significant deficits. His delayed recall was characterized by a tendency to make intrusion errors with information from similar semantic categories. In other words, he used category groupings to guide his recall but was inaccurate in recalling the exact information to be remembered. Errors of this nature are common following traumatic brain injury. Regarding visuospatial skill, his performances on measures of visual construction and ability to judge line angles were impaired and the quality of the errors was suggestive of right hemisphere dysfunction. Scores on tests of language, auditory attention, mental flexibility, and reasoning were within normal limits. Although these performances were not impaired compared to normative samples, they possibly represented a slight decline relative to premorbid function based on one estimate of premorbid IQ and on his wife's report of his abilities prior to the fall. The patient and wife reported that he cried much more frequently following the injury but his self-report did not indicate significant symptoms of depression. He did report mild symptoms of anxiety, including increased fears of death. Increased lability is commonly reported after traumatic brain injury and the anxiety was attributed to his recent serious injury.

When all testing is completed, the examiner scores the results according to the published guidelines. The scores are then compared to normative samples. Normative samples from the test manual or from published studies may be used. These normative samples provide data that may vary according to the demographic characteristics of the patient (age, gender, education, race), and a judgment about a patient's performance will be made according to how that patient compares to others with similar characteristics. Accurate interpretation of a patient's performance relies heavily on the use of appropriate normative samples but should not stop there. In addition, the performance should be interpreted according to estimates of a patient's pre-injury abilities. In other words, findings in the average range may not appear problematic but, if the patient typically performed in the superior range prior to injury, the average findings may actually indicate cognitive decline (Lezak et al., 2004). Lezak also recommends using the *pattern* of cognitive strengths and weaknesses to identify characteristics of particular disorders and to understand the specific nature of poor performances (Lezak, 2003; Lezak et al, 2004). Assessment of strengths and weaknesses is particularly important in a rehabilitation setting, where cognitive strengths may be used to compensate for weaknesses. In addition to the quantitative data derived from test scores, qualitative information (test-taking behavior) can also provide important insight into the nature and source of cognitive impairment (Lezak et al, 2004). These qualitative observations may relate to the patient's affect, frustration tolerance, arousal, speech, emotional state, or the particular nature of the impaired response. Conclusions based on all of these perspectives will provide the most balanced and meaningful information for the patient, family, and treatment team. Once the test performances are thoroughly evaluated, they must be integrated with the patient's social and medical histories in order to develop the diagnoses. The following vignette illustrates the situation where the scores are not frankly impaired compared to normative samples but nonetheless suggest a decline from the patient's premorbid function.

RR, a 40-year-old, right-handed woman with a bachelor's degree, was working overseas as an architect. She and her family report that she was intelligent and successful in her career. She developed sinus-type complaints and reduced hearing in the left ear that was misdiagnosed. On a visit to the United States she was diagnosed with an acoustic neuroma. She underwent surgery for resection but recovery was complicated by a cerebellar bleed. After completing inpatient rehabilitation for gait ataxia and cranial nerve abnormalities, the patient had an outpatient neuropsychological assessment. Verbal IQ was found to be High Average and Performance IQ was Average. Verbal memory was Average, visual memory was High Average, and untimed problem-solving was High Average. Mild impairments were found in auditory attention, visual-motor attention, and visual-motor sequencing. This pattern was believed to suggest mildly decreased information processing speed. Although verbal memory was Average, the test findings, and information from the patient's family, suggested that this represented a decline relative to her premorbid skills. Overall, the assessment findings and family reports indicated reduced performances in timed conditions or when attempting to manage large amounts of information, most likely as a consequence of the cerebellar hemorrhage. The implications of these findings regarding her return to work were discussed with the patient, family, and treatment team.

Once the patient's performances have been evaluated, the findings are included in a report. Strauss et al. (2006) provide a useful chapter on neuropsychological reports, with detailed descriptions and recommendations. The report will typically contain relevant medical and social information as well as the reason for the evaluation. A listing of the tests administered may be provided. All reports should include a comment on whether the findings are believed to be a valid and reasonable reflection of the patient's cognitive status. The validity may be reduced by various factors, including sensory impairment, fatigue, language barrier, pain, or psychiatric difficulties. The report should contain specific information about the test findings. There will also be an interpretation or summary section that provides the examiner's conclusions and diagnoses. Recommendations based on the conclusions should be offered. The recommendations may include directions for treatment (medication, psychotherapy, cognitive rehabilitation), supervision/assistance needs, environmental modifications/accommodations, or recommendations for additional evaluations. Lastly, but perhaps most importantly, a feedback session should be held with the patient (and significant other) to review the findings and recommendations. The feedback session is critical to helping the patient and family understand the nature and severity of any deficits and therefore create an ideal environment for the patient. The feedback may also improve the patient's insight into his or her deficits. Thus, providing feedback represents good clinical practice and, moreover, is mandated by the American Psychological Association (American Psychological Association, 2002). The next vignette illustrates a situation in which the patient's complaints appear to be related to anxiety and poor coping skills as opposed to cognitive impairment per se. This finding has direct implications for treatment recommendations.

JK, a 21-year-old female, underwent brief inpatient rehabilitation after being struck by a car while she was walking. At the time of her injury she was a full-time college student and worked for the city transit authority. She reportedly managed this busy schedule well. The inpatient rehabilitation team found no evidence of dysphagia, cognitive impairment, or

coping difficulty and she was sent home after a few days. An outpatient neuropsychological assessment done soon after revealed no evidence of cognitive deficits but indicated mild anxiety complaints. The patient, however, denied any anxiety. Two months later she returned to the physiatrist complaining of difficulty swallowing, impairments in attention and memory, and inability to return to work or school as a result of her injuries. She was deemed neurologically stable. The report of decreasing function in a neurologically stable patient was inconsistent with the expected recovery course. She was referred back to the neuropsychologist who discovered elevated symptoms of anxiety. The patient began psychotherapy and was also referred to a psychiatrist for psychotropic medication management.

Referral Questions

In the earlier years of neuropsychology, patients were referred for cognitive assessment in order to determine the presence and location of a lesion in the brain. With the advent of sophisticated imaging techniques (CT, MRI) a neuropsychological evaluation is no longer needed to ascertain the location of a stroke, tumor, or other structural abnormality. The indications for neuropsychological assessment have thus changed to some degree. Of course, if imaging results are inconclusive the neuropsychological exam continues to serve as part of a medical work-up to determine the cause of identified behavioral changes. When a lesion has been identified, a neuropsychological evaluation may be useful in determining the functional consequences, as the imaging techniques can tell *where* a lesion is located but not *what* effect that lesion may have on behavior. In a rehabilitation context, the neuropsychological findings are important in identifying the cognitive strengths and weaknesses that will influence the patient's ability to benefit from the rehabilitation program. The findings may be used to suggest therapeutic approaches or medication management. The assessment may be important in justifying treatment to insurance companies. Following the treatment, a repeat evaluation may be useful in assessing treatment efficacy, although it is recognized that a patient may make functional improvements that are not reflected in neuropsychological test scores (see discussion below regarding ecological validity). Further, the specific tests and timing of administration must be considered to avoid practice effects that may cloud interpretation. Repeat evaluations are also used to assess the recovery or decline from a medical condition. The evaluation should provide meaningful recommendations regarding supervision needs, capacity for decision-making and readiness for return to work or school. An area of increasing referrals is the forensic setting in which neuropsychological assessments are being used to support or refute legal claims. The following vignette describes a patient who was referred for evaluation of memory complaints.

LQ, a 75-year-old woman, was referred by her neurologist for assessment of memory complaints. The patient and her son reported that she had fallen and hit her head 6 months prior. She denied loss of consciousness and had no post-traumatic confusion. She was evaluated in an emergency department and was sent home, but her memory had become progressively worse since the fall. Results of cognitive testing revealed impairments in memory,

naming, and visual-motor sequencing. Recognition memory was better than free recall but not intact. The patient appeared to have some difficulty hearing the examiner. Although this performance pattern may occur in traumatic injuries, the severity of deficits was inconsistent with the mild head injury and the worsening of deficits was inconsistent with recovery from traumatic injury. Given her medical history and specific cognitive profile, the neuropsychologist concluded that Alzheimer's disease was the most likely diagnosis. Recommendations included reassessment in 12 months, hearing screening, additional medical workup to rule-out treatable causes of dementia, genetic or ApoE testing to strengthen the diagnosis, treatment with dementia medications, supervision of complex activities, and use of a memory book.

The next vignette describes a patient for whom the cognitive assessment was useful in making treatment and discharge recommendations.

WM, a 57-year-old male, was admitted for inpatient rehabilitation following a right thalamic hemorrhage. He worked as a phlebotomist in a clinic and lived alone prior to admission. He had few supports in the community and was eager to return to home and work. The patient complained of word-finding and memory deficits, but the results of the brief initial evaluation were equivocal. The rehabilitation team later reported signs of left neglect and impulsivity in therapies. Results of an inpatient cognitive examination revealed mild to severe impairments in immediate memory, attention, visual-spatial skills, and trial-and-error learning. A left neglect was noted on one task. Language, delayed memory, and hypothetical problem-solving were within normal limits (Average to Low Average). His delayed memory (Low Average) was possibly reduced by poor initial learning. These findings, coupled with the reports from his therapists (impulsivity, reduced safety awareness, poor insight), suggested significant decline from pre-injury levels of function. The patient was educated about the findings and was advised to have supervision for complex activities (medications, finances, cooking, appointments). He was advised against traveling in the community alone and was recommended to live with a friend or family member until his function improved. He was advised to refrain from driving and returning to work immediately after discharge. Additional outpatient cognitive testing and a formal driving assessment were recommended. The patient's inpatient treatment team used these findings to set treatment goals for the remainder of his admission, with focus on complex activities and travel in the community. The patient was referred to a Medicaid waiver program for brain-injured individuals living in the community.

Strengths of Neuropsychological Evaluations

As is noted in other chapters of this text, the neuropsychologist is not the only member of the rehabilitation team who will assess cognition. In fact, in many rehabilitation settings, all staff have a role in the assessment and treatment of cognitive deficits. Guidelines to improve the collaboration between neuropsychologists and speech-language pathologists were recently published and highlighted the degree of overlap in these assessments (Brown & Ricker, 2003). So what distinguishes the neuropsychologist from the other team members? Whereas the various therapy areas (physical, occupational, speech-language, and recreation) will tend to be focused on cognition that relates to their specialty, the neuropsychologist

will assess a broad range of behavior. Moreover, the therapists will often assess cognition from a functional perspective while the neuropsychologist will utilize a broader array of paper-and-pencil instruments. As described above, these instruments will be administered in a standardized manner and the findings will be interpreted according to normative data. This allows the neuropsychologist to make adjustments for the specific demographic characteristics of a patient. The strength of the neuropsychological approach lies in the fact that it relies on objective measurements and interpretations across a breadth of behaviors. This is not to say that other disciplines don't perform any standardized assessments or that the neuropsychologist does not include any functional assessments. The difference lies in degree of emphasis on standardized and objective techniques and the wide range of behaviors assessed.

Limitations of Neuropsychological Evaluations

While neuropsychological evaluations can provide much useful information, limitations and shortcomings exist. The findings can be influenced by poor motivation, anxiety, depression, pain, sensory problems, medication side effects, and a host of other factors. Presence of confounding factors may reduce the validity of the results and should be noted in the report. It is the neuropsychologist's responsibility to recognize, minimize, and interpret how much the findings are affected by these factors. The assessments themselves tend to be time-consuming and costly. Obtaining insurance approval for neuropsychological assessments and treatments can be challenging and often requires education on the purpose of the evaluation or treatment.

One perceived limitation of neuropsychological assessment is the fact that the findings may not reflect functional improvement in a patient. For example, a patient who has sustained an injury may return for re-assessment of cognition after a period of months or years after an initial evaluation. Since the first evaluation, this patient may have made significant life-style improvements (e.g., improved independent function in the home, participation in volunteer or part-time work, increased social interaction). The neuropsychological findings may, however, not show significant improvement on standardized measures. One might be tempted to conclude that the neuropsychological assessment is invalid, but this would be inaccurate. Rather, this example may reflect a situation in which the assessment reveals continued *impairment* and the functional status reveals that the patient has more *activity* (or less *disability*) because he/she has compensated for the impairment. This interpretation is consistent with the latest definitions from the World Health Organization's (WHO) International Classification of Functioning, Disabilities and Health (World Health Organization, 2002). From this perspective, the neuropsychological assessment is not invalid but instead reflects *impairment* as opposed to *activity* in the same way that a test of motor strength may reveal *impairment* in a hemiparetic leg for a patient who is nonetheless able to use a walker to go to the store (*activity*).

An issue closely related to the topic of functional status is ecological validity. Ecological validity refers to the degree to which a formal test of cognition accurately predicts or correlates with behavior in natural settings. To phrase the issue in WHO terms, as was done by Odhuba et al. (2005), if a neuropsychological evaluation can provide a valid indication of *impairment*, how well does it reflect a patient's ability to perform a task in the "real" world (i.e., *disability* or *activity*)? In recent years there has been increased interest in this question. The data from studies of executive function, driving, and memory skill suggest modest relationships between neuropsychological test findings and measures of everyday functioning (Brown et al., 2005; Burgess et al., 1998; Chaytor & Schmitter-Edgecombe, 2003; Odhuba et al., 2005; Kalechstein et al., 2003; Grace et al., 2005; Higginson et al., 2000; Silver, 2000). The lack of strong correlations between standardized testing, measures of everyday function, and/or clinician ratings suggests that these assessments are sensitive to different skills and are all necessary to obtain a well-rounded evaluation of a patient. In fact, the WHO distinction between *impairment* and *activity* suggests that an imperfect correlation is to be expected when comparing the neuropsychological measures (*impairment)* and the functional assessments *(activity)*. Therefore, we need the functional measures to see **what** the patient cannot do and we need the neuropsychological testing to know **why** (and thus know what to treat). While we may agree that both formal and functional measurements are useful, valid measurements of adaptive function are difficult to obtain for several reasons: difficulty re-creating real-life scenarios, differences between methods of evaluating function (formal functional assessments vs. clinician/family ratings), and lack of available instruments with large normative samples (Chaytor & Schmitter-Edgecombe, 2003; Moritz et al., 2004; Silver, 2000). Nonetheless, tests which are believed to have reasonable ecological validity (and which rely more on measures of *function*) include the Multiple Errands Test –Simplified Version (Alderman et al., 2003), the Rivermead Behavioural Memory Test-II (Cockburn & Keene, 2001; Wilson et al., 2003), the Behavior Rating Inventory of Executive Function (BRIEF) (Gioia & Isquith, 2004; Gioia et al., 2000), and the Behavioral Assessment of the Dysexecutive System (Wilson et al., 1996). Burgess and colleagues provide a detailed account of how more "function-led" tests of executive function may be developed (Burgess et al., 2006). For questions of driving safety, the best approach is multidisciplinary including input from physicians, occupational therapists, and neuropsychologists and includes cognitive assessment followed, if the patient performs sufficiently well, by an on-road evaluation (Brown et al., 2005; Grace et al., 2005; Schanke & Sundet, 2000; Whelihan et al., 2005).

Assessment of Malingering

The assessment of malingering or suboptimal performance has become increasingly common, particularly in forensic settings (Slick et al., 2004). According to a survey of board-certified neuropsychologists, these assessments have revealed high base rates of malingering in personal injury and disability cases (Mittenberg

et al., 2002). In the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), malingering has been defined as "the intentional production of false or grossly exaggerated physical or psychological symptoms, motivated by external incentives such as avoiding military duty, avoiding work, obtaining financial compensation, evading criminal prosecution, or obtaining drugs." (American Psychiatric Association, 1994, p. 739). It is seen as distinct from Factitious Disorder in which external incentives are absent and there instead appears to be a need to maintain a sick role. Malingering is also distinguished from Conversion Disorder, in which the behavior is believed *not* to be under conscious control of the patient and the symptoms appear to be related to psychological stressors. Limitations of the DSM-IV diagnostic criteria have been noted and alternative definitions have been offered, the most influential of these coming from Slick and colleagues (Slick et al., 1999). They proposed diagnostic criteria and practice standards designed to improve objectivity and standardization in the assessment of malingering. Their diagnostic system distinguishes between "Definite," "Probable," and "Possible" malingering. This system also outlines specific criteria for malingering: (A) presence of substantial external incentive, (B) evidence from neuropsychological testing, (C) evidence from self-report, (D) behaviors meeting necessary criteria from groups B or C are not fully accounted for by psychiatric, neurological or developmental factors. The authors note that alternative explanations for what appears to be malingering behavior must be carefully excluded and the consequences of diagnostic error must be considered.

Neuropsychological assessment of malingering may be done through a variety of methods, some of which rely on "conventional" tests and others which were designed specifically for detection of suboptimal effort (Strauss, et al., 2006). A thorough review of the many measures and methods of assessing malingering is beyond the scope of this chapter; the interested reader will find a wealth of research articles and an increasing number of texts addressing this topic such as those by Heilbronner (2005), Larrabee (2005), and Strauss et al. (2006). Examples of commonly used tests that may be employed in the assessment of malingering include the Minnesota Multiphasic Personality Inventory-2 (Larrabee, 2003; Lees-Haley et al., 1991), the California Verbal Learning Test-II (Curtis et al., 2006), and the Wechsler Adult Intelligence Scale-III (Iverson & Tulsky, 2003). These performances may be judged according to established cut-off scores or new indices developed to detect particular patterns of responding. Other measures that were designed specifically for the assessment of effort (also known as Symptom Validity Tests) include the Test of Memory Malingering (Tombaugh, 1996, 1997), 21-Item Test (Iverson et al., 1991), and the Victoria Symptom Validity Test (Slick et al., 1995; Slick et al., 1996). The tests from this latter group fall into one of two categories: (1) Tests which rely on the production of errors that are uncommon in patients with legitimate cognitive deficit; (2) tests that rely on a forced-choice format with probabilistic analysis of performance (Strauss et al., 2006). The use of *multiple* measures of malingering is recommended to enhance diagnostic accuracy (Bianchini et al., 2001). Bianchini et al. also noted the benefit of increasing the apparent difficulty and reducing "transparency" of the various measures.

In summary, the assessment of malingering or feigned impairment is becoming more common, especially in medico-legal settings. The most accurate diagnoses include consideration of multiple factors (medical history, presenting symptoms, secondary gain, neuropsychological findings, thorough differential diagnosis) and should include input from the entire treatment team. A malingering diagnosis should not be made on the basis on one finding or factor alone.

Neuropsychological Treatment

As indicated earlier, providing feedback to patients, families, and other members of the interdisciplinary team is one of the most important elements of the evaluation process. Recommendations generated from the evaluation may include referral to other specialists (e.g., neuropsychiatrist for medication management of depression or attentional disturbance; neuro-optometrist for further evaluation and treatment of vision impairment identified on neuropsychological evaluation). They may include recommendations to external parties such as employers and/or schools regarding strategies or accommodations (e.g., job coach, extended time on exams) that will enable the patient to re-integrate successfully into that setting. Most importantly, recommendations for cognitive or behavioral interventions can serve as a springboard for the development of appropriate and effective treatment interventions. These may include specific cognitive rehabilitation strategies, individual, family or group counseling, and are critical to integrate within the overall rehabilitation treatment plan (Gordon & Hibbard, 2005).

In many neuro-rehabilitation programs, neuropsychologists perform individual, group and family counseling. Other disciplines that may also render these services include social workers and certified rehabilitation counselors. Counseling survivors of brain injury and their families requires specialized experience and training. Due to the cognitive and behavioral challenges often posed by the brain injury, traditional psychotherapeutic techniques may be inappropriate or ineffective with this population, or require modification in order to be beneficial. Incorporation of cognitive rehabilitation techniques into psychotherapeutic work with brain injury survivors can enable the survivor to experience and process complex, abstract information and utilize the counseling session in a way that facilitates positive changes (Laatsch, 1999). Working with the family to understand family dynamics and goals/needs and to provide education and support, is also essential (Sander, 2005). Neuropsychologists are in a unique position within the interdisciplinary team, having the training and knowledge-base needed to address both emotional and cognitive changes and challenges, including family education and support, in order to develop integrated approaches to treatment. Such holistic approaches have been advocated by many (Ben-Yishay et al., 1985; Gordon & Hibbard, 2005; Laatsch, 1999; Mateer et al., 2005; Prigatano, 1999; Wilson, 1997; Uzzell, 2000). Specific psychotherapeutic issues and interventions for survivors and families are covered in subsequent chapters of this text, so will not be reviewed further here.

While neuropsychologists may incorporate cognitive rehabilitation techniques in counseling with brain injury survivors, in many interdisciplinary neurorehabilitation programs both occupational and speech-language therapists are trained and competent in integrating cognitive rehabilitation techniques into their practice, as well. Nevertheless, with their training in the fundamentals of research and critical analysis, it is the neuropsychologist who typically serves as educator and sets the model for the interdisciplinary team regarding the utilization of evidence-based approaches to cognitive rehabilitation.

Cognitive Rehabilitation

Cognitive rehabilitation has been defined as a "systematic, functionally oriented service of therapeutic cognitive activities, based on an assessment and understanding of the person's brain-behavior deficits" (Harley et al., 1992). Cognitive rehabilitation services are often differentiated into two approaches; "restorative" approaches, in which the goal is to achieve functional improvements by "reinforcing, strengthening, or reestablishing previously learned patterns of behavior," and "compensatory" approaches, in which the goal is to enable functional improvement by "establishing new patterns of cognitive activity or compensatory mechanisms for impaired neurological systems" (Harley et al., 1992). Mateer and Raskin (1999) have further differentiated approaches to cognitive rehabilitation by including "environmental modifications" as a distinct intervention, with a focus on altering the external environment, rather than the individual themselves (Mateer & Raskin, 1999).

The case of JD, the 65-year-old male whose status post right (and older left) frontal hemorrhage was described earlier in the chapter, illustrates the combined use of restorative, compensatory, and environmental approaches to facilitate improvement in cognitive functioning. Based on the neuropsychological assessment, the certified nursing assistant (who also had certification as a Brain Injury Specialist) was instructed to perform daily orientation exercises, designed to provide repetitive stimulation and cuing re: basic autobiographical and environmental information. When he did not respond to open-ended questions, a multiple-choice format was used. To compensate for his severe attentional impairments, treatment sessions were broken down into 15-minute increments spaced over the course of the day. Environmental modifications included room placement away from high-traffic, noisy areas of the unit (e.g., nurses station), working with his family to reduce visual stimulation in his room (e.g., minimizing room decorations) and providing 1:1 treatment in smaller treatment areas.

In 1998, the National Institutes of Health (NIH) convened an expert panel to critically review practices, principles, and efficacy critically in the area of rehabilitation following traumatic brain injury (TBI), including a review of therapeutic interventions for cognitive and behavioral sequelae of traumatic brain injury. At that time, after reviewing available evidence to date, the panel reported that "despite many descriptions of specific strategies, programs and interventions, limited data on the effectiveness of cognitive rehabilitation programs are available because of

heterogeneity of subjects, interventions, and outcomes studied" (NIH, 1998). Nevertheless, they concluded that "evidence supports the use of certain cognitive and behavioral rehabilitation strategies for individuals with TBI in particular circumstances. These interventions share certain characteristics in that they are structured, systematic, goal-directed, and individualized and they involve learning, practice, social contact and a relevant context." The panel recommended that "rehabilitation of persons with TBI should include cognitive and behavioral assessment and intervention". Since that time, a number of reviews of research and literature in the field of cognitive rehabilitation have concluded that available evidence exists to support the use of a number of cognitive rehabilitation strategies/techniques to alleviate impairments and improve the functioning of individuals with brain injuries (Carney et al., 1999; Cicerone et al., 2000, 2005; Malia et al., 2004; Teasell et al., 2003).

In their review of the effectiveness of cognitive rehabilitation on outcomes following TBI, Carney et al. (1999) found very few controlled studies on the effects of cognitive rehabilitation on health or employment outcomes, though they noted that several studies demonstrated improvements on intermediate measures (e.g., neuropsychological test scores) following cognitive rehabilitation. They concluded that "based on the evidence found in this review, we recommend the application of compensatory cognitive strategies, adapted to patient groups and to individuals, to improve the functional ability of persons with TBI." They noted that additional, well-designed, research was needed, which should include standard definitions of interventions and relevant outcome measures.

The case of MH, the 50-year-old carpenter who sustained a work-related TBI from a fall from a ladder, illustrates the use of compensatory memory strategies to improve functional memory abilities following brain injury. Since his language and auditory attention abilities were relative strengths, MH was deemed a good candidate for use of a memory notebook. He was trained to use the notebook to record pertinent to-be-remembered information, such as appointments, phone numbers, and phone messages. The memory book was organized into sections, including structured daily pages, contacts, and a "thoughts and feelings" section, where he was encouraged to record episodes of heightened emotion and thoughts related to these feelings. Written instructions for breathing/relaxation exercises served as a cue to assist him in managing his emotional lability. In weekly counseling sessions, he reviewed this section and worked with the neuropsychologist to identify triggers and develop more adaptive coping strategies for anxiety/stress. Due to his visuospatial deficits, he had some difficulty maintaining the organization of the notebook, and his occupational therapist worked with him to simplify the structure of the notebook and set up a structured weekly routine for "clean up and organization" of the book. MH continued to use a smaller, less elaborate version of notebook/planner long after completion of his rehabilitation, and served as a model for others in this regard during monthly survivor support group meetings.

In a meta-analysis of 30 studies of the effectiveness of attention training after acquired brain injury (subjects included those with TBI, stroke or surgical lesion), Park and Ingles (2001) concluded that "specific-skills training significantly improved performance of tasks requiring attention" and that "acquired deficits of attention are treatable using specific-skills training." However, they also noted that

"the methods included in the meta-analysis did not significantly affect outcomes" and suggested that "the learning that occurs as a function of training is specific and does not tend to generalize or transfer to tasks that differ considerably from those used in training". They challenged rehabilitationists to develop training procedures and programs structured to the needs (and cognitive limitations) of individuals with brain injury, including breaking down complex skills into simpler components, providing repetitive practice, and straightforward performance feedback.

In the most comprehensive reviews to date, the Brain Injury Interdisciplinary Special Interest Group (BI-ISIG) of the American Congress of Rehabilitation Medicine (ACRM) conducted evidence-based reviews of the cognitive rehabilitation literature from 1966 through 1997 (Cicerone et al., 2000) and 1998 through 2002 (Cicerone et al., 2005). These reviews incorporated meta-analyses of published literature on the effectiveness of cognitive rehabilitation for individuals with TBI or stroke. One hundred and seventy-one articles were reviewed through 1997, and an additional 87 articles for the updated review. For these reviews, the group evaluated and classified each study with respect to the strength of their methods. Class I studies consisted of prospective, randomized controlled designs; Class II studies included prospective, nonrandomized, cohort studies; retrospective, case-control studies; or clinical series with well-designed controls. Clinical series without concurrent controls and those with appropriate single-subject methodology were classified as Class III. Practice recommendations were then generated based on the relative strengths of the evidence across designated areas of intervention. Practice Standards included those interventions for which there existed at least one well-designed, large Class I study, with supporting Class II or III evidence. Practice Guidelines included interventions with limited Class 1 or well-designed, large Class II studies; and practice options, those interventions with only Class II or Class III evidence substantiating them. Recommendations were generated for the remediation of attention and memory deficits, visuospatial deficits, apraxia, language and communication deficits, and deficits in executive function, problem-solving, and awareness. To summarize, the authors concluded that "support exists for the effectiveness of several forms of cognitive rehabilitation for persons with stroke and TBI" (Cicerone, et al., 2000). More specifically, they found that "there is substantial evidence to support cognitive-linguistic therapies for people with language deficits with left hemisphere stroke . . . new evidence supports training for apraxia after left hemisphere stroke . . . evidence supports visuospatial rehabilitation for deficits associated with visual neglect after right hemisphere stroke . . . substantial evidence to support cognitive rehabilitation for people with TBI, including strategy training for mild memory impairment, strategy training for post-acute attention deficits, and interventions for functional communication deficits" (Cicerone et al., 2005). They found an overall differential benefit of cognitive rehabilitation over other or no treatments in 78.7% of Class I studies included in both reviews.

The case of RR, the 40-year-old architect who sustained a cerebellar bleed following resection of an acoustic neuroma, illustrates the benefits of strategy training for attention deficits, as well as the interaction between cognitive rehabilitation and counseling/psychotherapy.

RR's cognitive rehabilitation treatment included systematic attention process training (Sohlberg & Mateer, 1987), which over time helped increase the amount of information she was able to manage, as well as the speed at which she was able to process this information. She was able to return to her pre-injury job, but revealed in ongoing supportive counseling sessions that she was experiencing significant stress during busy periods when she was handling multiple projects at one time. Working with her therapist and her employer (direct supervisor), she was able to problem-solve how to re-structure and delegate some of her responsibilities during these times, enabling her to manage her work demands successfully.

Of note, the area of computer-based cognitive rehabilitation has had a relatively long history within the cognitive rehabilitation field, though conclusions regarding the effectiveness of this approach have been mixed (Cicerone et al., 2005; Gontkovsky et al., 2002; Lynch, 2002). While the evidence supporting computer-based cognitive rehabilitation interventions is equivocal, newer approaches, including those utilizing computers and/or web-based applications for compensatory purposes, such as cuing or structuring tasks/activities (Jinks et al., 2004), or for receipt of support and information/education (Rotondi et al., 2005) hold promise. This may be true particularly for those survivors and families in rural areas, or who are homebound, with limited access to rehabilitative services. Relevant to these situations, there is some evidence indicating that home-based cognitive rehabilitation can be effective (Boman et al., 2004; Warden et al., 2000), though not as effective as intensive cognitive rehabilitation received in an inpatient hospital setting for patients with more severe brain injuries (Salazar et al., 2000).

In summary, while a considerable amount of research now exists to guide cognitive rehabilitation practice, it has been pointed out that there is still a need for more research to further define and tailor cost-effective cognitive rehabilitation interventions (Ricker, 1998).

Effectiveness of Specialized Neuro-Rehabilitation Programs and Interventions

Recent studies provide evidence demonstrating the relative effectiveness of specialized neuro-rehabilitation programs which incorporate neuropsychologically based treatment components (e.g., cognitive rehabilitation, psychotherapy), on functional outcomes (e.g., community integration) for individuals with TBI, stroke, and other acquired brain injuries. Cicerone (2004) performed a selective literature review of TBI rehabilitation programs, concluding that "a small number of studies suggest that post-acute TBI rehabilitation can produce improvements in participation and community integration." One such study compared an "intensive cognitive rehabilitation program" (ICRP), consisting of a highly structured program integrating cognitive and psychosocial interventions, including group, individual, and vocational or educational training, with a "standard neuro-rehabilitation" program (SRP), consisting of a less intensive, less structured program of physical, occupational, speech therapies and neuropsychological treatment, in outpatients with

TBI. The study found that while both groups showed significant improvement in community integration (as measured by the Community Integration Questionnaire), the ICRP group demonstrated greater improvement than the SRP group. Interestingly, the participants' perceived satisfaction with community functioning was unrelated to their level of community integration (Cicerone et al., 2004). Another study comparing TBI survivors participating in outpatient neuropsychological rehabilitation (including psychotherapy and cognitive rehabilitation) with a wait-listed control group, found that the treatment group demonstrated significant improvements in emotional functioning (including less anxiety and depression) and attention, although no changes were found in community integration scores (Tiersky et al., 2005). High Jr., et al. (2006) examined the impact of an outpatient community re-entry program (with emphasis on compensatory strategy training, environmental modification, counseling and education, and transition from clinic to community-based activities) on three groups of persons with TBI that differed in terms of their length of time post-injury (ranging from within 6 months of injury to over 1 year post-injury). They found that all groups demonstrated improvements on measures of overall disability, independence, home competency and productivity. The early-entry group (those injured less than 6 months prior) continued to improve after discharge from the program. The authors concluded that this type of post-acute rehabilitation can be effective "in improving functional outcome after TBI even for persons who have reached stable neurologic recovery at 12 or more months postinjury."

WM, the 57-year-old gentleman who sustained a right thalamic hemorrhage, was unable to return to his prior work as a phlebotomist due to the severity of his cognitive impairments, which persisted (albeit to a lesser degree) even after months of intensive cognitive rehabilitation. Predicting that he would need long-term supports, and given that he had few natural supports (e.g., family, friends) in his life, he was enrolled in the state's brain injury waiver program. He progressed to the point where he was able to travel independently using public transportation along familiar routes, though it was not recommended that he return to driving. As his insight improved, he accepted the recommendation that he not live alone, and joined a group of other individuals with brain injury to live in a supervised home in the community. He developed a routine of attending a structured day program for brain injury survivors 2 days per week, and was able successfully to obtain and hold a volunteer position within a local hospital, with the initial assistance of a life skills trainer accompanying him and providing cuing/coaching until he was able to accomplish the tasks with only intermittent supervision provided by the volunteer coordinator.

The positive impacts of specialized neuro-rehabilitation programs or specific interventions have been demonstrated for stroke survivors, as well. In a systematic review of randomized controlled studies of inpatient stroke rehabilitation, Foley et al. (2003) found that "improved functional outcomes and reduced length of hospital stays were reported among patients receiving specialized rehabilitation" in the majority of studies reviewed, though no differences in mortality or institutionalization were reported between the groups. The heterogeneity of subjects (ranging from mild to severe injuries) as well as treatment interventions (not always well-specified) in this study renders the conclusions less clear. In a study of occupational therapy (OT) interventions for inpatients receiving stroke rehabilitation, Richards

et al. (2005) found that patients who spent more OT time in instrumental activities of daily living (such as home management, community integration) versus basic activities of daily living, demonstrated greater improvements in functioning. In a similar population, Hatfield et al. (2005) examined speech-language therapy outcomes, and found that participation in cognitively and linguistically complex activities (e.g., problem-solving, executive function skill training) early on during the rehabilitation stay resulted in better outcomes, regardless of the level of severity of functional communication on admission.

Summary and Conclusions

The rehabilitation neuropsychologist may wear a number of hats within a neuro-rehabilitation program, including maintaining responsibility for administrative functions—providing clinical supervision/oversight; education and training of staff, students, patients, and families—and neuropsychological assessment and therapeutic intervention. It has been suggested that graduate academic curriculums be expanded to include neuropsychological rehabilitation (in addition to the greater emphasis typically found on assessment), in order to prepare clinical neuropsychologists better to assess and treat individuals with brain injuries (Uzzell, 2000). The neuropsychologist also serves a key role in assisting the interdisciplinary team in managing reactions to patients/families/each other, maintaining a creative and flexible, yet evidence-based approach to treatment, examining outcomes, and striving for ongoing performance improvement (Prigatano, 1999). By utilizing this holistic approach, the neuro-rehabilitation team can achieve the most coordinated and effective patient care and outcomes.

References

Alderman, N., Burgess, P.W., Knight, C., Henman, C. (2003) Ecological validity of a simplified version of the multiple errands shopping test. *Journal of the International Neuropsychological Society* 9:31–44.

Alderson, A.L., Novack, T.A., Dowler, R. (2003) Reliable serial measurement of cognitive processes in rehabilitation: The cognitive-log. *Archives of Physical Medicine and Rehabilitation* 84:668–672.

American Board of Clinical Neuropsychology. http://www.theabcn.org/.

American Board of Professional Psychology. http://www.abpp.org/.

American Psychiatric Association. (1994) *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. Washington, DC: American Psychiatric Association.

American Psychological Association. (2002) Ethical principles of psychologists and code of conduct. *American Psychologist* 57:1060–1073.

Barona, A., Reynolds, C.R., Chastain, R. (1984) A demographically based index of premorbid intelligence for the WAIS-R. *Journal of Consulting and Clinical Psychology* 52:885–887.

Basso, M.R., Bornstein, R.A., Roper, B.L., McCoy, V.L. (2000) Limited accuracy of premorbid intelligence estimators: A demonstration of regression to the mean. *Clinical Neuropsychology* 14:325–340.

Benton, A.L., Van Allen, M.W., Fogel, M.L. (1964) Temporal orientation in cerebral disease. *Journal of Nervous and Mental Disease* 139:110–119.

Ben-Yishay, Y., Rattok, J., Lakin, P., Piasetsky, E.D., Ross, B., Silver, S., Zide, E., Ezrachi, O. (1985) Neuropsychological rehabilitation: quest for a holistic approach. *Seminars in Neurology* 5:252–258.

Bianchini, K.J., Mathias, C.W., Greve, K.W. (2001). Symptom validity testing: A critical review. *The Clinical Neuropsychologist* 15:19–45.

Blair, J.R., Spreen, O. (1989) Predicting premorbid IQ: A revision of the National Adult Reading Test. *The Clinical Neuropsychologist* 3:129–136.

Boman, I.-L., Lindstedt, M., Hemmingsson, H., Bartfai, A. (2004). Cognitive training in home environment. *Brain Injury* 18(10):985–995.

Bright, P., Jaldow, E., Kopelman, M.D. (2002) The National Adult Reading Test as a measure of premorbid intelligence: A comparison with estimates derived from demographic variables. *Journal of the International Neuropsychological Society* 8:847–854.

Brown, P., Ricker, J.H. (2003) Evaluating and treating communication and cognitive disorders: Approaches to referral and collaboration for Speech-Language Pathologists and Clinical Neuropsychology. Technical report. *American Speech-Language-Hearing Association, Supplement* 23:47–57.

Brown, L.B., Stern. R.A., Cahn-Weiner, D.A., Rogers, B., Messer, M.A., Lannon, M.C., Maxwell, C., Souza, T., White, T., Ott, B.R. (2005) Driving scenes test of the Neuropsychological Assessment Battery (NAB) and on-road driving performance in aging and very mild dementia. *Archives of Clinical Neuropsychology* 20:209–215.

Burgess, P.W., Alderman, N., Evans, J., Emslie, H., Wilson, B.A. (1998) The ecological validity of tests of executive function. *Journal of the International Neuropsychological Society* 4:547–558.

Burgess, P.W., Alderman, N., Forbes, C., Costello, A., Coates, L. M.-A., Dawson, D.R., Anderson, N.D., Gilbert, S.J., Dumontheil, I., Channon, S. (2006). The case for the development and use of "ecologically valid" measures of executive function in experimental and clinical neuropsychology. *Journal of the International Neuropsychological Society* 12:194–209.

Carney, N., Chestnut, R.M., Maynard, H., Mann, N.C., Petterson, P., Helfond, M. (1999) Effect of cognitive rehabilitation on outcomes for persons with traumatic brain injury: A systematic review. *Journal of Head Trauma Rehabilitation* 14:277–307.

Chaytor, N., Schmitter-Edgecombe, M. (2003) The ecological validity of neuropsychological tests: A review of the literature on everyday cognitive skills. *Neuropsychological Review* 13:181–197.

Cicerone, K.D. (2004) Participation as an outcome of traumatic brain injury rehabilitation. *Journal of Head Trauma Rehabilitation* 19(6):494–501.

Cicerone, K.D., Dahlberg, C., Kalmar, K. Langenbahn, D.M., Malec, J.F., Bergquist, T.F., Felicetti, T., Giacino, J.T., Harley, J.P., Harrington, D.E., Herzog, J., Kneipp, S., Laatsch, L., Morse, P.A. (2000) Evidence-based cognitive rehabilitation: Recommendations for clinical practice. *Archives of Physical Medicine and Rehabilitation* 81:1596–1615.

Cicerone, K.D., Dahlberg, C., Malec, J.F., Langenbahn, D.M., Felicetti, T., Kneipp, S., Ellmo, W., Kalmar, K., Giacino, J.T., Harley, J.P., Laatsch, L., Morse, P.A., Catanese, J. (2005) Evidence-based cognitive rehabilitation: Updated review of the literature from 1998 through 2002. *Archives of Physical Medicine and Rehabilitation* 86:1681–1691.

Cicerone, K.D., Mott, T., Azulay, J., Friel, J.C. (2004) Community integration and satisfaction with functioning after intensive cognitive rehabilitation for traumatic brain injury. *Archives of Physical Medicine and Rehabilitation* 85:943–950.

Cockburn, J., Keene J. (2001) Are changes in everyday memory over time in autopsy-confirmed Alzheimer's disease related to changes in reported behavior? *Neuropsychological Rehabilitation,* 11:201–271.

Corrigan, J.D. (1989). Development of a scale for assessment of agitation following traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology* 11:261–277.

Curtis, K.L., Greve, K.W., Bianchini, K.J., Brennan, A. (2006) California Verbal Learning Test indicators of malingered neurocognitive dysfunction: Sensitivity and specificity in traumatic brain injury. *Assessment* 13:46–61.

Foley, N.C., Teasell, R.W., Bhogal, S.K., Doherty, T., Speechley, M.R. (2003) The efficacy of stroke rehabilitation: A qualitative review. *Topics in Stroke Rehabilitation* 10(2):1–18.

Folstein, M.F., Folstein, S.E., McHugh, P.R. (1975) "Mini-Mental state." A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research* 12:189–198.

Gioia, G.A. Isquith, P.K. (2004) Ecological assessment of executive function in traumatic brain injury. *Developmental Neuropsychology* 25:135–158.

Gioia, G.A., Isquith, P.K., Guy, S.C., Kenworthy, L. (2000) *Behavior Rating Inventory of Executive Function*. Lutz, FL: Psychological Assessment Resources.

Gontkovsky, S.T., McDonald, N.B., Clark, P.G., Ruwe, W.D. (2002). Current directions in computer-assisted cognitive rehabilitation. *NeuroRehabilitation* 17:195–199.

Gordon, W., Hibbard, M.R., (2005). Cognitive rehabilitation. In Silver, M., McAllister, T., Yudofsky, S. (eds.): *Textbook of Traumatic Brain Injury*. Virginia: American Psychiatric Publishing, Inc, pp. 655–660.

Grace, J., Amick, M.M., D'Abreu, A., Festa, E.K., Heindel, W.C., Ott, B.R. (2005) Neuropsychological deficits associated with driving performance in Parkinson's and Alzheimer's disease. *Journal of the International Neuropsychological Society* 11:766–775.

Griffin, S.L., Mindt, M.R., Rankin, E.J., Ritchie, A.J., Scott, J.G. (2002) Estimating premorbid intelligence: Comparison of traditional and contemporary methods across the intelligence continuum. *Archives of Clinical Neuropsychology* 17:497–507.

Guy, S.K., Cummings, J.L. (2003) The mental status exam. In Feinberg T.E., Farah M.J. (eds.): *Behavioral Neurology & Neuropsychology,* 2nd ed. New York: McGraw-Hill, pp. 23–32.

Harley, J.P., Allen, C., Braciszewski, T.L., Cicerone, K.D., Dahlberg, C., Evans, S., Foto, M., Gordon, W.A., Harrington, D., Levin, W., Malec, J.F., Millis, S., Morris, J., Muir, C., Richert, J., Salazar, E., Schiavone, D.A., Smigelski, J.S. (1992) Guidelines for cognitive rehabilitation. *NeuroRehabilitation* 2:62–67.

Hatfield, B., Millet, D., Coles, J., Gassaway, J., Conroy, B., Smout, R.J. (2005) Characterizing speech and language pathology outcomes in stroke rehabilitation. *Archives of Physical Medicine and Rehabilitation* 86(2):S61–S72.

Heilbronner, R.L. (ed.). (2005) *Forensic Neuropsychology Casebook.* New York:Guilford Publications, Inc.

Higginson, C.I., Arnett, P.A., Voss, W.D. (2000) The ecological validity of clinical tests of memory and attention in multiple sclerosis. *Archives of Clinical Neuropsychology* 15:185–204.

High, W., Roebuck-Spencer, T., Sander, A.M., Struchen, M.A., Sherer, M. (2006) Early versus later admission to postacute rehabilitation: Impact on functional outcome after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation* 87:334–342.

Iverson, G.L., Tulsky, D.S. (2003) Detecting malingering on the WAIS-III: Unusual Digit Span performance patterns in the normal population and in clinical groups. *Archives of Clinical Neuropsychology* 18:1–9.

Iverson, G.L., Franzen, M.D., McCracken, L.M. (1991) Evaluation of an objective assessment technique for the detection of malingered memory deficits. *Law and Human Behavior* 15:667–676.

Jackson, W.T., Novack, T.A., Dowler, R.N. (1998) Effective serial measurement of cognitive orientation in rehabilitation: The orientation log. *Archives of Physical Medicine and Rehabilitation* 79:718–720.

Jinks, A., Kellinger, F., Garber, H.J. (2004) Handheld pc/web-based task reminder for brain-injured adults [Abstract]. *Rehabilitation Engineering & Assistive Technology Society of North America* http://www.resna.org/ProfResources/Publications/Proceedings/2004/Papers/Research/CAC/.

Johnstone, B., Callahan, C.D., Kapila, C.J., Bouman, D.E. (1996) The comparability of the WRAT-R reading test and NAART as estimates of premorbid intelligence in neurologically impaired patients. *Archives of Clinical Neuropsychology* 11:513–519.

Jurica, P.J., Leitten, C.L., Mattis, S. (2001). *Dementia Rating Scale-2.* Odessa, FL: Psychological Assessment Resources.

Kalechstein, A.D., Newton, T.F., van Gorp, W.G. (2003). Neurocognitive functioning is associated with employment status: A quantitative review. *Journal of Clinical and Experimental Neuropsychology* 25:1186–1191.

Kalmar, K., Giacino, J.T. (2005) The JFK coma recovery scale-revised. *Neuropsychological Rehabilitation* 15:454–460.

Kiernan, R.J., Mueller, J., Langston, J.W., Van Dyke, C. (1987) The neurobehavioral cognitive status examination: A brief but differentiated approach to cognitive assessment. *Annals of Internal Medicine* 107:481–485.

Kokmen, E., Smith, G.E., Petersen, R.C., Tangalos, E., Ivnik, R.C. (1991) The short test of mental status. *Archives of Neurology* 48:725–728.

Krull, K.R., Scott, J.G., Sherer, M. (1995) Estimation of premorbid intelligence from combined performance and demographic variables. *The Clinical Neuropsychologist* 9:83–88.

Laatsch, L. (1999) Application of cognitive rehabilitation techniques in psychotherapy. In Langer, K.G., Laatsch L., Lewis L. (eds.): *Psychotherapeutic Interventions for Adults with Brain Injury or Stroke: A Clinician's Treatment Resource*. Connecticut: Psychosocial Press, pp. 131–148.

Larrabee, G.J. (2003) Exaggerated MMPI-2 symptom report in personal injury litigants with malingered neurocognitive deficit. *Archives of Clinical Neuropsychology* 18:673–686.

Larrabee, G.J. (ed.). (2005) *Forensic Neuropsychology: A scientific approach.* New York: Oxford University Press.

Lees-Haley, P.R., English, L.T., Glenn, W.G. (1991) A fake-bad-scale for personal injury claimants. *Psychological Reports* 68:203–210.

Levin, H.S., O'Donnell, V.M., Grossman, R.G. (1979) The galveston orientation and amnesia test: A practical scale to assess cognition after head injury. *Journal of Nervous and Mental Disease* 167:675–684.

Lezak, M.D. (2003) Principles of neuropsychological assessment. In Feinberg, T.E., Farah M.J. (eds.): *Behavioral Neurology and Neuropsychology,* 2nd ed. New York: McGraw-Hill.

Lezak, M.D., Howieson, D.B., Loring, D.W. (2004) *Neuropsychological assessment*, 4th ed. New York: Oxford University Press.

Lynch, B. (2002) Historical review of computer-assisted cognitive retraining. *Journal of Head Trauma Rehabilitation* 17(5):446–457.

Malia, K., Law P., Sidebottom, L., Bewick, K., Danziger, S., Schold-Davis, E., Martin-Scull, R., Murphy, K., Vaidya, A. (2004) Recommendations for best practice in cognitive rehabilitation therapy: Acquired brain injury. The Society for Cognitive Rehabilitation, Inc. (pp. 1–57).

Mateer, C.A., Raskin, S. (1999) Cognitive rehabilitation. In Rosenthal, M., Griffith, E., Kreutzer, J.S., Pentland, B. (eds.): *Rehabilitation of the Adult and Child with Traumatic Brain Injury*. Philadelphia: FA Davis, pp. 254–270.

Mateer, C.A., Sira, C.S., O'Connell, M.E. (2005) Putting humpty dumpty back together again: The importance of integrating cognitive and emotional interventions. *Journal of Head Trauma Rehabilitation* 20(1):62–75.

Mittenberg, W., Patton, C., Canyock, E.M., Condit, D.C. (2002) Base rates of malingering and symptom exaggeration. *Journal of Clinical and Experimental Neuropsychology* 24:1094–1102.

Moritz, S., Ferahli, S., Naber, D. (2004) Memory and attention performance in psychiatric patients: Lack of correspondence between clinician-rated and patient-rated functioning with neuropsychological test results. *Journal of the International Neuropsychological Society* 10:623–633.

National Academy of Neuropsychology. (2001) NAN definition of a clinical neuropsychologist.*Official Position of the National Academy of Neuropsychology.*

National Academy of Neuropsychology. (2002) Cognitive rehabilitation. *Official Statement of the National Academy of Neuropsychology.*

National Academy of Neuropsychology. (2003) Informed consent in clinical neuropsychology practice. *Official Statement of the National Academy of Neuropsychology.*

National Institutes of Health. (1998, October 26–28) Rehabilitation of persons with traumatic brain injury. *NIH Consensus Statement 1998* 16(1):1–41.

Odhuba, R.A., Van der Broek, M.D., Johns, L.C. (2005) Ecological validity of measures of executive functioning. *British Journal of Clinical Psychology* 44:269–278.

Park, N.W., Ingles, J.L. (2001) Effectiveness of attention: Rehabilitation after an acquired brain injury: A meta-analysis. *Neuropsychology* 15(2):199–210.

Prigatano, G.P. (1999) *Principles of Neuropsychological Rehabilitation*. New York: Oxford University Press.

Prigatano, G.P. (1999). The outcome of neuropsychological rehabilitation programs that incorporate cognitive rehabilitation and psychotherapeutic intervention. In Prigatano, G.P., (ed.): *Principles of Neuropsychological Rehabilitation*. New York: Oxford University Press, pp. 244–262.

Randolph, C., Tierney, M.C., Mohr, E., Chase, T.N. (1998) The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS): Preliminary clinical validity. *Journal of Clinical and Experimental Neuropsychology* 20:310–319.

Rappaport, M., Dougherty, A.M., Kelting, D.L. (1992) Evaluation of coma and vegetative states. *Archives of Physical Medicine and Rehabilitation* 73:628–634.

Reitan, R.M., Wolfson, D. (1993) *The Halstead-Reitan Neuropsychological Test Battery: Theory and clinical interpretation,* 2nd ed. South Tucson, AZ: Neuropsychology Press.

Richards, L.G., Latham, N.K., Jette, D.U., Rosenberg, L., Smout, R.J., De Jong, G. (2005) Characterizing occupational therapy practice in stroke rehabilitation. *Archives of Physical Medicine and Rehabilitation* 86(2):S51–S60.

Ricker, J.H. (1998) Traumatic brain injury rehabilitation: Is it worth the cost? *Applied Neuropsychology* 5:184–193.

Rotondi, A.J., Sinkule, J., Sprig, M. (2005) An interactive web-based intervention for persons with tbi and their families. Use and evaluation by female significant others. *Journal of Head Trauma Rehabilitation* 20(2):173–185.

Royall, D.R., Mahurin, R.K., Gray, K.F. (1992) Bedside assessment of executive cognitive impairment: The executive interview. *Journal of the American Geriatrics Society* 40:1221–1226.

Salazar, A.M., Warden, D.L., Schwab, K., Spector, J., Braverman, S., Walter, J., Cole, R., Rosner, M.M., Martin, E.M., Ecklund, J., Ellenbogen, R.G. (2000) Cognitive rehabilitation for traumatic brain injury: A randomized trial. *The Journal of the American Medical Association* 283(23):3075–3081.

Sander, A. (2005) Interventions for Caregivers. In High Jr., W.M., Sander, A.M., Struchen, M.A., Hart, K.A. (eds.): *Rehabilitation for Traumatic Brain Injury*. New York: Oxford University Press. pp. 156–175.

Santa Clara Valley Medical Center (2006). *The Center for Outcome Measurement in Brain Injury.* http://www.tbims.org/combi.

Schanke, A.K., Sundet, K. (2000) Comprehensive driving assessment: Neuropsychological testing and on-road evaluation of brain injured patients. *Scandinavian Journal of Psychology* 41:113–121.

Schretlen, D.J., Buffington, A.L.H., Meyer, S.M., Pearlson, G.D. (2005) The use of word-reading to estimate "premorbid" ability in cognitive domains other than intelligence. *Journal of the International Neuropsychological Society* 11:784–787.

Schoenberg, M.R., Duff, K., Scott, J.G., Adams, R.L. (2003) An estimation of the clinical utility of the OPIE-3 as an estimate of premorbid WAIS-III FSIQ. *Clinical Neuropsychology* 17:308–321.

Sherer, M., Nakase-Thompson, R., Yablon, S.A., Gontkovsky, S.T. (2005) Multidimensional assessment for acute confusion after TBI. *Archives of Physical Medicine and Rehabilitation* 86:896–904.

Silver, C.H. (2000) Ecological validity of neuropsychological assessment in childhood traumatic brain injury. *Journal of Head Trauma Rehabilitation* 15:973-988.

Slick, D.J., Hoop, G., Strauss, E. (1995) *The Victoria Symptom Validity Test*. Odessa, FL: Psychological Assessment Resources.

Slick, D.J., Hoop, G., Strauss, E., Spellacy, F. (1996) Victoria symptom validity test: Efficiency for detection of feigned memory impairment and relationship to neuropsychological tests and MMPI-2 validity scales. *Journal of Clinical and Experimental Neuropsychology* 18:911–922.

Slick, D.J., Sherman, E.M.S., Iverson, G.L. (1999) Diagnostic criteria for malingered neurocognitive dysfunction: Proposed standards for clinical practice and research. *The Clinical Neuropsychologist* 13:545–561.

Slick, D.J., Tan, J.E., Strauss, E.H., Hultsch, D.F. (2004) Detecting malingering: A survey of experts' practices. *Archives of Clinical Neuropsychology* 19:465–473.

Sohlberg, M.M., Mateer, C.A. (1987) Effectiveness of an attentional training program. *Journal of Clinical and Experimental Neuropsychology* 9:117–130.

Strauss, E., Sherman, E.M.S., Spreen, O. (2006) *A Compendium of Neuropsychological Tests: Administration, Norms and Commentary*, 3rd ed. New York: Oxford University Press.

Sweet, J.J., Nelson, N.W., Moberg, P.J. (2006) The TCN/AACN 2005 "Salary Survey": Professional practices, beliefs, and incomes of U.S. neuropsychologists. *The Clinical Neuropsychologist* 20:325–364.

Teasell, R.W., Foley, N.C., Bhogal, S.K., Speechley, M.R. (2003). An evidence-based review of stroke rehabilitation. *Topics in Stroke Rehabilitation* 10(1):29–58.

Tiersky, L.A., Anselmi, V., Johnston, M.V., Kurtyka, J., Roosen, E., Schwartz, T., Deluca, J. (2005) A trial of neuropsychologic rehabilitation in mild-spectrum traumatic brain injury. *Archives of Physical Medicine and Rehabilitation* 86:1565–1574.

Tombaugh, T.N. (1996) *Test of Memory Malingering (TOMM)*. North Tonawanda, NY: Multi Health Systems.

Tombaugh, T. (1997) Test of Memory Malingering (TOMM): Normative data from cognitively intact and cognitively impaired individuals. *Psychological Assessment* 9:260–268.

Uzzell, B.P. (2000) Neuropsychology and vascular dementia. *Topics in Stroke Rehabilitation* 7(3):29–37.

Uzzell, B.P. (2000). Neuropsychological rehabilitation. In Christensen, A.-L., Uzzell, B.P. (Eds.): *International Handbook of Neuropsychological Rehabilitation*. (pp. 353–369). New York: Kluwer Academic/Plenum Publishers.

Warden, D.L., Salazar, A.M., Martin, E.M., Schwab, K.A., Coyle, M., Walter, J. (2000) A home program of rehabilitation for moderately severe traumatic brain injury patients. *Journal of Head Trauma Rehabilitation* 15(5):1092–1102.

Whelihan, W.M., DiCarlo, M.A., Paul, R.H. (2005) The relationship of neuropsychological functioning to driving competence in older persons with early cognitive decline. *Archives of Clinical Neuropsychology* 20:217–228.

Wilson, B.A. (1997) Cognitive rehabilitation: How it is and how it might be. *Journal of the International Neuropsychological Society* 3:487–496.

Wilson, B.A., Alderman, N., Burgess, P.W., Emslie, H., Evans, J.J. (1996) *Behavioral Assessment of the Dysexecutive Syndrome.* Bury St. Edmunds, England: Thames Valley Test Company.

Wilson, B.A., Cockburn, J., Baddeley, A., Hiorns, JR. (2003) *The Rivermead Behavioral Memory Test-II Supplement Two.* Bury St. Edmunds, England: Thames Valley Test Company.

World Health Organization. (2002) *International Classification of Functioning, Disability and Health.* Geneva, Switzerland: World Health Organization.