Comprehensive Assessment

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Abstract

This chapter reviews comprehensive assessment in persons with brain injury in both acute and post-acute settings. A model of assessment is described and the various components of the assessment in the context of this model are reviewed with goal of conducting an evaluation which comprehensively describes functioning and leads to effective rehabilitation planning. The importance of the neuropsychologist conducting assessments as part of a larger rehabilitation team is also reviewed. Finally, a case study is provided which demonstrates the use of this assessment model.

Keywords

Assessment • ICF model • Acute • Post-acute

Introduction

Research continues to demonstrate that even with advances in brain imaging and biomarkers, neuropsychological assessment remains the most robust means of identifying the presence and progression of acquired brain dysfunction [1]. Moreover, unlike other neurodiagnostic techniques, neuropsychological testing is unique in the ability to not simply diagnose, but to also quantify the impact of brain injury on cognitive, behavioral, and adaptive functioning [2]. A recent study found over 1,600 peer-reviewed studies have been published on the relationship of psychological functioning and TBI, making it one of the populations most often encountered and studied by neuropsychologists [3]. Similarly a recent

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survey of practicing clinicians ranked TBI as the first or second most common diagnosis referred for neuropsychological evaluation [4]. This chapter will focus on the role of neuropsychological assessment in both inpatient and outpatient settings by (1) describing its goals and utility, (2) outlining a model of assessment that can be used to better understand the relationship between brain injury and long-term functioning, and (3) highlighting unique considerations for the assessment and treatment of individuals with traumatic brain injury.

Assessment in Acute Settings: (Hospital and Inpatient Rehabilitation Setting)

Individuals with traumatic brain injury present to the acute inpatient setting with a wide variety of clinical presentations and heterogeneous neurobehavioral sequelae [5]. Depending on the type and severity of the sustained injury, assessments of cognitive functioning can be complicated by confusion, posttraumatic amnesia (PTA), and significant emotional and behavioral changes. Acute inpatient assessments are conducted with an appreciation for injury severity and natural recovery trajectories with the goal of (1) describing changes in mental status over time and (2) documenting the nature and level of cognitive and functional impairment resulting from the injury.

Assessing Consciousness, Orientation, and Posttraumatic Amnesia

PTA refers to disruptions in a patient's memory for the events and experiences that occur immediately following a head trauma [6]. Assessments of orientation and PTA are integral in the inpatient setting because they (1) assist in documenting recovery and determining long-term prognosis, and (2) assist neuropsychologists in identifying the optimal timeframe for a patient to undergo a formal neurocognitive evaluation (i.e., after the patient has emerged from PTA).

Table 1 Commonly used inpatient cognitive screening measures

Mental status & posttraumatic amnesia	Brief cognitive screening measures
Galveston Orientation & Amnesia Test (GOAT) [9]	Montreal Cognitive Assessment (MoCA) (www.mocatest.org)
Children's Orientation & Amnesia Test (COAT) [8]	Mini Mental Status Examination (MMSE) [10]
Orientation Log (O-Log) [11]	Kokmen Short Test of Mental Status (STMS) [12]
Agitated Behavior Scale [13]	
Confusion Assessment Protocol [14]	

Determining whether a patient is oriented or has emerged from PTA is most commonly achieved through the administration of standardized measures such as the Galveston Orientation and Amnesia Test (GOAT) and Children's Orientation and Amnesia Test (COAT) [7–9]. Most commonly, emergence from PTA based on GOAT scores is defined by the first day of two consecutive days that GOAT scores of 76 or greater are recorded within a period of 24–72 h. These measures allow for a serial assessment of patients' orientation to person, place, and time and knowledge/recall of the events leading up to and following their brain injury and hospital admission. Screening measures of mental status may also help evaluate the patients' understanding of his/her diagnosis, associated cognitive changes, and their implications on functioning. Table 1 provides a list of commonly used assessments of PTA and cognition in the acute stetting. The reader is referred to the previous chapter by Sherer and Giacino for a more thorough discussion of brief inpatient screening assessments.

Neuropsychologists should avoid conducting neurocognitive evaluations before a patient has cleared from PTA, as testing under these circumstances typically yields unreliable and/or invalid estimates of long-term cognitive capabilities. Furthermore, interpreting neuropsychological test results during this period of time may have serious implications for the patient's future plan of care (e.g., issues related to discharge planning, capacity, etc). If evaluations must be conducted

the neuropsychologist should note that the results represent the patient's mental status during a point in time that is marked by dramatic fluctuations in attention, alertness, and cognition.

Inpatient Neuropsychological Evaluations

Over the last few decades there has been a dramatic decline in the length of acute rehabilitation stays (LOS) from 20 to 12 days [15]. These changes have impacted the role of neuropsychologists in inpatient rehabilitation settings, shifting the focus away from comprehensive assessments toward identifying the severity of cognitive and neurobehavioral sequelae, preparing patients and families for discharge, and the next phase of the patient's rehabilitation. If a patient emerges from PTA during their inpatient rehabilitation stay, a more formal assessment of cognitive functioning is possible and appropriate. The period after emergence from PTA represents an early stage of recovery and assessments must be conducted with an appreciation for the fact that cognition will most likely continue to improve. Subsequent evaluations (inpatient or outpatient) may be necessary in order to generate the most meaningful recommendations for the patient, treatment team, and family.

Given the numerous patient-factors (e.g., neurofatigue, reduced tolerance for testing, aphasia, sensory/perceptual difficulties) and institutional limitations (i.e., requirements by insurance/national carriers that patients participate in several hours of therapy daily to justify payment), even more comprehensive inpatient neuropsychometric assessments are typically relatively brief. Such assessments should attempt to estimate a patient's pre-injury level of intellect and functioning and provide a screening of their capabilities across a number of cognitive domains. While a comprehensive assessment of attention, language, visuoperception, learning and memory, and executive functioning may be ideal, these domains are typically evaluated using abbreviated (and if possible, repeatable) measures such as the Repeatable Battery for Assessment of Neuropsychological Status (RBANS) [16]. An alternative approach may also involve the selective administration of tests/subtests from lengthier test batteries. Inpatient assessments, which are conducted for the purposes of discharge and treatment planning, are most useful when they include a thorough examination of learning, memory, and executive functioning, since these domains have been widely associated with long-term functional outcomes (i.e., return to work and productivity) following TBI [17, 18].

Assessments of Mood, Adjustment, and Coping

In addition to cognitive sequelae, it is common for individuals in the acute phase of recovery from TBI to experience changes in emotion and behavior. Inpatient neuropsychologists are uniquely qualified to assess mood, coping, and adjustment and determine the potential implication of these factors on the recovery process. As improvement occurs and patients emerge from PTA, survivors often begin to develop a better appreciation of what has happened to them. Assessment of mood and adjustment during this phase of recovery may include a clinical interview with the patient and family, the use of standardized mood questionnaires (e.g., Beck Depression/Anxiety Inventories, Patient Health Questionnaire-9, Generalized Anxiety Disorder-7 item), and consultation with other members of the inpatient care team. Standardized mood measures also provide a means of tracking patients' distress levels/symptoms and providing patients and their families with feedback about changes in mood symptoms over time.

A clinical interview should be used to evaluate a patient's current mood symptoms, psychiatric and substance abuse history, awareness of the nature/severity of their injury and functional limitations, adjustment to the hospitalization and inpatient therapies, family/support network, and coping strategies. An understanding of past psychiatric and substance abuse difficulties is important in determining whether or not a patient is at greater risk for developing mood

symptoms post injury, or relying on maladaptive coping strategies (e.g., substance use) in the post-acute period. Likewise, assessments of family and social support (e.g., friends, religion/faith, community involvement, etc.) help in identifying positive resources the patient can rely on as they transition from the acute to post-acute phase of recovery.

Patients in early recovery may have difficulty articulating their emotions and rating their own mood states. These difficulties can be further complicated by an incomplete awareness of the extent and implications of their injuries. These patients' mood can often be best assessed by direct observation. Observing the patient while they are involved in therapies or interacting with family members can be one of the most useful means of understanding the patient's current mood state. Moreover, this approach provides a more naturalistic setting that allows the neuropsychologist to communicate practical recommendations to other team members and the patient's family.

Since occupational, speech, and physical therapists typically spend significantly more time with patients than neuropsychologists (even in a well-staffed inpatient rehabilitation unit), these professional colleagues may have observed a richer and more extensive sampling of patient behavior. Similarly, given their interactions with patients for up to 12 h at a time, nurses can provide information about episodes of emotional dysregulation (i.e., tearfulness, anger) or signs of emotional distress (e.g., anxiety) during medical procedures and changes in behavior over time. Other team members are likely to have useful insights regarding an individual's general disposition, engagement, and frustration tolerance during challenging therapeutic exercises. To provide individualized recommendations for treatment, an inpatient neuropsychologist must regularly interact with other team members. By joining the rehabilitation team, speaking in a common language, and working in a truly collaborative manner with the patient and family, neuropsychologists will be well-suited to provide accurate and useful information that facilitates improved treatment outcomes [19].

Assessment in Post-acute Settings (Residential- and Clinic-Based)

Recovery following traumatic brain injury extends long past a patient's discharge from an inpatient rehabilitation unit and often continues for months to years. Given reduced lengths of stay and the artificial nature of the hospital setting, the majority of rehabilitation now takes place in outpatient settings during the post-acute period. With the initiation of outpatient rehabilitation comes a greater need for determining the patient's level of functioning within the family, social network, and community at large. As a result, neurocognitive assessments in this phase of recovery gradually evolve from describing changes in functioning over time to assessing the impact of ongoing symptoms on an individual's daily activities and community participation. Outpatient rehabilitation practices are highly individualized and informed by the ongoing neurocognitive sequelae as well as needs of the persons being served.

Traditionally, neuropsychological assessment has focused on correlating brain dysfunction with behavioral changes. Clinically, this often means (1) diagnosing the presence of underlying brain pathology (e.g., learning disability, dementia), and/or (2) describing the level and pattern of impairment associated with a known cause of brain dysfunction (e.g., stroke or TBI). In the post-acute rehabilitation setting there is often little question regarding the cause or etiology of the brain dysfunction. Neuropsychological testing conducted in this setting is often done for a different purpose, which include quantifying or predicting the degree of limitations an individual will experience in everyday life and assisting him/her with learning to compensate for residual limitations. This can be quite challenging given that the pattern of neurocognitive impairment can vary widely as a function of type/severity of injury and associated physical and emotional sequelae. Nonetheless, neuropsychologists are well-suited to (1) assess the cognitive, neurobehavioral, and environmental factors important to recovery, (2) evaluate levels of functioning within

larger social contexts, and (3) outline treatment plans that facilitate return to community participation following TBI.

Model for Conceptualizing Factors to Be Assessed in the Post-acute Setting

To assist with the conceptualization of physical and mental changes caused by known medical conditions (such as brain injury) and associated changes in functioning, the World Health Organization developed the International Classification of Functioning, Disabilities, and Health [20]. This model classifies the sequelae of brain injury into (1) body functions and structures, (2) activity, and (3) participation. Body functions and structures are measured by the presence of normal or abnormal (impaired) physical or mental functions. Activity limitations are defined by an individual's inability to complete an activity due to impairments or changes in body functions and structures (e.g., inability to recall appointments, to follow a recipe while cooking, recall a medication regimen, balance a checkbook, etc.). Activity limitations focus on limitations in specific individual activities, in contrast to participation restrictions which involve societal level role fulfillment. Participation restrictions represent a loss or change in social roles due to changes in body functioning and associated activity limitations (e.g., loss of a job or inability to attend college). Participation is typically assessed through patient or family report and measured by the degree to which an individual is (1) an active, productive member of society, and (2) well integrated into family and community life. In other words, participation restrictions reflect whether individuals are limited in their ability to run a household and maintain a network of friends and family, as well as their involvement in productive activities such as employment, education, and volunteer activities.

In the ICF model, there is a dynamic interplay among changes in body functions and structures (physical and cognitive), activity limitations, and the participation restrictions that impact the person's reintegration into the community. The most recent iteration of the ICF model [21, 22] has shifted its emphasis from solely a medical model to a model which includes a consideration of the environmental and personal factors that impact long-term outcomes. See Fig. 1 for a graphical illustration of the ICF model.

In our view the ICF model provides clarity regarding the role of neuropsychological testing in post-acute settings and a model for identifying the factors that should be considered and assessed as part of any comprehensive evaluation of individuals with TBI. We find this model particularly useful for several specific reasons.

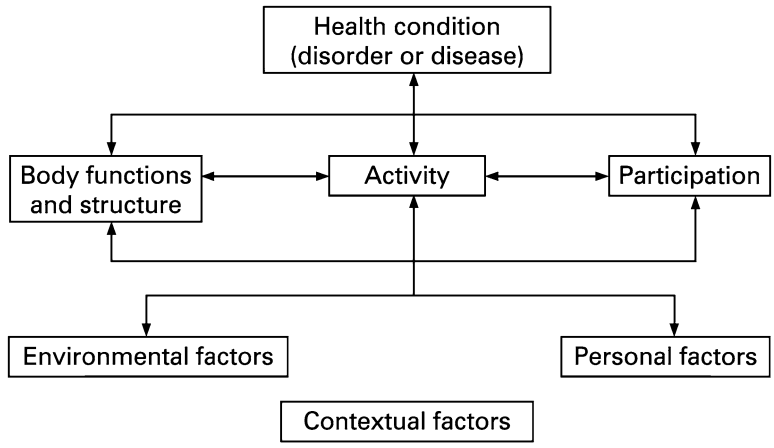

Fig. 1 The international classification functioning (ICF) model

As described above, neuropsychological assessment measures impairments (or the lack thereof) in cognitive abilities. While assessment of the presence and degree of cognitive impairment is important in understanding common symptoms following TBI, in most instances it does not directly assess limitations in activity. For example, a patient who is impaired (below the fifth percentile) in the acquisition and retention of items from a word list might be expected to have difficulty correctly learning and implementing a new medication regimen following TBI. While it would be easy to assume that these cognitive impairments would prevent the patient from engaging effectively in this task, our traditional neuropsychological measures do not directly assess an individual's ability to follow a medication regimen. Nor do they assess other environmental or personal factors that may facilitate or interfere with this process.

According to the ICF model, environmental or situational moderators/factors that may obstruct or facilitate successful completion of an important activity of daily living (i.e., managing medications) need to be considered in order to make truly accurate predictions about functioning. Such factors may include personal history/experience with medication management, the use of compensatory strategies, or environmental supports (i.e., pillbox along with a pager or alarm system). Even when done comprehensively, testing focused solely on measurement of cognitive impairment without considering these other relevant factors, may not accurately predict whether an individual can perform important day-to-day activities.

The ICF model also provides an important tool for understanding the values and mechanism of action for interventions such as cognitive rehabilitation following TBI. There is an ever-growing literature that supports the value of cognitive rehabilitation in helping to diminish the level of activity limitations and participation restrictions after brain injury [23]. These interventions are effective largely because they facilitate the development of behaviors which compensate for changes in mental and cognitive status. In other words, persons undergoing cognitive rehabilitation may experience improvement in functioning without necessarily experiencing any measureable diminution in cognitive impairment. As such, an intervention is successful if it results in improved real world behaviors and increased independence, whether or not there have been changes in neuropsychological performances [2, 24].

Components of the Comprehensive Outpatient Assessment in the Post-acute Phase of Recovery Following TBI

Using the ICF model as a template, we will outline an approach for comprehensive assessment at the post-acute stage of recovery and rehabilitation. In order to obtain such a wide breadth of information, a comprehensive outpatient neuropsychological assessment should include information obtained from a review of the patient's medical record and history (i.e., focused on assessing degree of severity and other aspects of the injury; see Table 2), an interview with the patient and family members/caregivers, and standardized measures of cognitive and overall psychological functioning. We have provided a detailed outline of these important components of the neuropsychological assessment in Table 2.

Clinical Interview

In the interview with a patient and family members, it is particularly important to gather information from the following areas: the patient's current psychological functioning, pre-injury psychiatric and substance abuse history, coping strategies, availability of social support and resources, premorbid level of functioning, and current use of compensatory strategies to facilitate independence.

Table 2 Components of a comprehensive outpatient assessment following TBI

Component	Source	Information to be obtained
Injury-related data	1. Record review	1. Information gathered through admission records and EMT report regarding injury causing conditions: GCS, length of PTA, type and site of injury, anoxia, other physical injuries
		2. Concurrent medical conditions impacting cognition and functioning
		3. Imaging: CT, MRI, EEG
Past medical psychiatric history	1. Record review	1. Premorbid medical conditions, substance abuse, and treatment history
	2. Patient & family interview	2. Psychiatric disorders, past hospitalizations, mental health treatment
Psychosocial assessment	1. Record review	1. Current mood, adjustment difficulties, self-awareness
	2. Patient & family interview	2. Presence of current psychiatric disorders/situational stressors
	3. Self-report measures of emotional & personality functioning	3. Current and past coping strategies (active vs. passive, negative vs. positive)
	4. Behavioral observations	4. Underlying personality traits
Cognitive functioning	1. Neuropsychological testing	1. Areas of strength and weakness compared to (1) baseline, (2) normative data, (3) intra-individually
		2. Insight and level of awareness of post-injury changes in cognition and function
Functioning in community	1. Record review	1. Level of education, history of academic difficulties, need for special education services
	2. Patient & family interview	2. Type of previous employment and consistency of employment
	3. School & work history	
Use of compensatory strategies	1. Patient & family interview	1. Frequency and type of compensatory strategies used at home, school, college, and work prior and after the injury (calendar system, personal assistive devices, cue cards, environmental supports)
Social support & resources	1. Patient & family interview	1. Size of social network, patient and family's understanding of injury and its impact on functioning, capacity to provide assistance
		2. Financial resources
		3. Patient's willingness to accept and ask for help

Psychiatric and Substance Abuse History

As delineated in the ICF model, past history of substance use and psychiatric history impact the recovery trajectory of a person with TBI. As such, it is important to assess in detail past history of substance use, its frequency, types of substances used, and the typical settings in which these substances were used (i.e., to cope with stress, alone, socially, etc.) both prior to and since the injury. Obtaining a thorough assessment of psychiatric and substance use history is crucial to any assessment, since it is meant to provide an accurate and complete evaluation of functioning and to lead to appropriate treatment recommendations.

Moreover, past psychiatric or substance abuse conditions may be contributing to cognitive impairments which are identified on testing and may in turn be a factor impacting a patient's current level of functioning. Premorbid substance and psychiatric histories can also identify those patients who are at increased risk for maladaptive coping or emotional difficulties following TBI. Assessing for these premorbid conditions is best done in the context of a thorough clinical interview

of the patient, including information obtained from a reliable collateral source such as a family member. Brief alcohol disorders screening questionnaires such as the CAGE (Cut down, Annoyed, Guilty, Eye opener) [24], MAST (Michigan Alcoholism Screening Test) [25], or AUDIT (Alcohol Use Disorders Identification Test) [26] may also help with this process.

Assessment of Awareness and Psychosocial Functioning

Historically, the assessment of awareness, personality, motivation, and other psychological factors was considered important only to the extent to which they interfered with the validity of the psychometric evaluation [27]. However, evaluations with such a narrow focus have been criticized as not providing sufficient information for conceptualizing the whole individual and have been replaced with more comprehensive evaluations of functioning. This broadening of the scope of neuropsychological evaluations is even reflected in changes between the third and fourth edition of Lezak's classic text on neuropsychological assessment, which now highlights emotional factors as integral components of a neuropsychological evaluation [28] (see Table 3). This change may be largely due in part to the movement of the field into rehabilitation settings and the consequent need to describe not only cognitive functioning but also how psychological factors may impact "real-world" situations.

Research has shown that psychosocial morbidity is often associated with increased long-term disability [29], unemployment [30, 31], and poorer rehabilitation treatment outcomes [32, 33] after TBI. Furthermore, impaired self-awareness is a common symptom of severe brain injury and is a strong predictor of long-term functional outcomes and employment [34, 35]. Crosson and colleagues argue that to be truly effective, clinical interventions in the post-acute phase of recovery need to incorporate an accurate assessment of self-awareness into specific treatment interventions [36].

Given the aforementioned correlations among awareness, mood and psychosocial disability, and long-term outcomes following TBI, it is important to address these psychosocial variables when conducting a comprehensive neuropsychological evaluation in the post-acute setting. One of the most valuable services provided by a neuropsychological assessment may be to correctly identify the presence of substance abuse or mood disorder, the nature and extent of their impact on functioning, and make appropriate referrals to qualified providers. Data regarding mood and psychosocial functioning may be best acquired through the patient and family interview, but may also be obtained through the use of standardized measures of mood, coping, awareness, and personality functioning. Specifically, measures such as the Beck Depression Inventory-II (BDI-II) [37], Beck Depression Inventory-Fast Screen (BDI-FS) [38], Beck Anxiety Inventory (BAI) [39], Patient Health Questionnaire (PHQ-9) [40], and Generalized Anxiety Disorder (GAD-7) [41] have been found to be useful adjunctive tools in neuropsychometric assessments. Such measures can easily be incorporated into the clinical interview or administered at the time of the neuropsychological assessment to assist the clinician with conceptualizing the patients' level of emotional functioning, associated needs, and assessing their capacity to benefit from rehabilitation interventions.

Functioning in the Community: Premorbid and Current

Estimating pre-injury functioning is an important part of neuropsychological evaluation. In order to determine the optimal long-term outcome and the patient's ability to return to pre-injury level of functioning and to work, we first need to determine their pre-injury level of functioning. Lezak et al. [28] noted that accurately assessing the individual's educational and work history is crucial as it is one of the best predictors of post-injury level of functioning. Prior occupational history and the nature of pre-injury jobs are associated with post-injury employability 2–5 years post injury [42].

Vocational functioning following brain injury has key economic and clinical effects on

Table 3 Cognitive domains examined during neuropsychological evaluation

Adapted from Lezak (1995)	Adapted from Lezak (2004)	Typical neuropsychological battery
1. Orientation and attention[a]	1. Mental activity[b]	WAIS-III/IV Working Memory Factor
	• Consciousness[b]	WAIS-III/IV Cognitive Speed Factor
	• Activity rate/speed of processing	Continued Performance Test of Attention
	Attention	Trail Making Test (TMT) A and B
		Stroop Test
2. General cognitive abilities	2. General cognitive abilities	Wechsler Adult Intelligence Scale (WAIS-III/ IV)
	• Intellectual functioning	
3. Perception[a]	3. Receptive functions[b]	WMS-III Orientation Subtest
	• Sensory reception/perception	Benton Visual Form Discrimination
	• Orientation	Judgment of Line Orientation
	• Awareness	Rey-Osterrieth Complex Figure Test (Copy)
	• Recognition/discrimination/patterning	WAIS-IV Visual Puzzles
4. Memory	4. Memory	WMS III/ IV Logical Memory I and II
	• Declarative/explicit	WMS III/IV Visual Reproductions I and II
	• Non-declarative/implicit memory	Rey Auditory Verbal Learning Test (AVLT)
5. Verbal and language functions	5. Expressive functions	Boston Naming Test
	• Language	COWAT
	• Constructional disorders	Category Fluency
		BDAE Complex Ideational Material
6. Construction[a]	6. Executive functions	Frontal Systems Behavioral Scale (FrsBe)
7. Concept formation and reasoning[a]	• Cognitive flexibility	Wisconsin Card Sorting Test (WCST)
	• Concept formation/abstract reasoning	DKEFS Tower Test
	• Planning/organization	
	• Goal-directed behavior[b]	
8. Executive functions	7. Personality/emotional variables[b]	Beck Depression Inventory (BDI-II)
9. Motor/sensory abilities[a]	• Emotional lability/dullness/euphoria	Beck Anxiety Inventory (BAI)
	• Disinhibition/impulsivity	Minnesota Multiphasic Personality Inventory (MMPI-2)
	• Reduced/increased social sensitivity	Personality Assessment Inventory
	• Depression/anxiety	

[a]Cognitive domains listed in the third edition of Neuropsychological Assessment textbook but removed in the fourth edition of the textbook [28]
[b]Cognitive domains added to the fourth edition of Neuropsychological Assessment textbook [28]

reintegration to life and is important to consider when examining predictors of participation restrictions in individuals with brain injury. While often overlooked, inquiring about past involvement in volunteer activities can also provide useful information. This can help to (1) identify skills an individual may have beyond those which they use on the job, and (2) determine the extent to which they value work in an unpaid setting. Many skills used in volunteer settings may be very similar to those used in paid employment. Volunteering after brain injury has also been shown to be associated with enhanced psychological well-being and may also provide an important step towards community-based employment [43].

Information on educational history, employment history, and volunteering should all be a standard part of the clinical interview. This would include specific inquiries about any challenges faced in academic settings (i.e., tutoring, need for special education services, repeating grades), accommodations on the job, and a history of any difficulty with maintaining steady employment. Knowledge of on-the-job difficulties prior to the TBI, such as history of frequent conflicts with coworkers or charges of sexual harassment, can be extremely helpful in developing plans for post-injury return to work. It should always be kept in mind that what appears to be problematic behavior directly related to the effect of brain injury may actually be a pattern of behavior which long predates the brain injury. Failure to obtain an accurate history of pre-injury functioning in the work place may lead to incomplete plans for return to work. Patients may be unwilling to disclose unpleasant aspects of their history, which only serves to reinforce the need for additional sources of information such as family members, former employers, or coworkers.

Instrumental Activities of Daily Living

As mentioned above, traditional neuropsychological tests do not directly assess daily activity limitations. However, daily activity limitations are the core difficulties that significantly impact a person's ability to return to or sustain pre-injury levels of functioning and independence [44, 45].

Table 4 Common ADLs and IADLs

Instrumental activities of daily living (IADL)-complex skills required to live independently	Activities of daily living (ADL)-basic self-care skills learned in early childhood
Telephone use	Feeding
Using public transportation	Toileting
Shopping	Grooming
Cooking/preparing meals	Bathing
Driving	Walking and transferring (e.g., from bed to chair)
Housework	Selecting proper clothing
Medications management	Dressing
Finance management	Maintaining continence

Functional abilities are typically divided into two subgroups: Instrumental activities of daily living (IADLs) and basic activities of daily living (ADLs). Given that discussion of ADLs may not be common focus for many neuropsychologists, we have listed many common IADLs and ADLs in Table 4. Neuropsychologists working in outpatient rehabilitation settings typically focus on IADLs that encompass activities that allow individuals to function independently in everyday life including shopping, communication, driving, managing finances and medications, cooking, and transportation.

Outpatient neuropsychological evaluations should assess the past and current level of activity limitations through clinical interviews. Interviewing family members or other persons who have been able to directly observe the patient's function in day-to-day life can also be helpful with this assessment. When considered in the context of outpatient rehabilitation, which typically focuses on increasing a patient's activity and participation through the implementation of compensatory strategies rather than by remediating cognitive impairments, the utility of assessing IADLS becomes quite apparent.

Use of Compensatory Strategies

The development and application of compensatory strategies such as a use of a planner/calendar in therapy has been demonstrated to be an effective means of improving functioning and diminishing

the impact of cognitive impairment on day to day life. While we know of no specific scale available to measure compensatory strategy use at present, direct inquiry as to the type and frequency of compensatory strategy use should be included as part of any comprehensive assessment. Assessing baseline compensatory strategy use is particularly relevant since research has shown that the exact frequency of compensatory strategy use may be associated with the level of independence in patients after acquired brain injury [46].

Our research has shown that successful completion of an internet-based cognitive rehabilitation program was more strongly correlated with baseline compensatory strategy use than cognitive impairment [47]. Moreover, we also found that improved functioning after treatment was associated with greater level of compensatory strategy use. Inquiring about attitudes toward compensatory strategies may further elucidate the discrepancy between a patient's current and predicted performance levels solely based on the measurement of cognitive impairment. It can also provide a means of determining the degree to which a patient will be open to, or capable of adopting, a treatment program suggested by their rehabilitation team members.

Neuropsychometric Testing

Symptom Validity and Measuring Objective Effort

In recent years there has been substantial growth in assessment of symptom validity as a part of routine neuropsychological evaluations. Inclusion of such measures in forensic evaluations is considered important to reach an accurate assessment of cognitive functioning. For persons working in clinical settings in which patients are referred for reasons of clinical need and not medical legal issues, true malingering is rare in our experience. However, poor performance on symptom validity testing still occurs in clinical settings. Discussion of effort testing and malingering in the TBI population is beyond the scope of this chapter and is discussed in more detail elsewhere in this book. However, we would briefly like to highlight some of the factors that should be considered when individuals presenting to a brain injury rehabilitation setting fail objective measures of effort. Possible factors which may account for suboptimal effort may include, but are not limited to, (1) the effects of comorbid medical/physical or sensory impairments, (2) the effect of pain, fatigue, or emotional distress on the patient's ability to engage in the evaluation, (3) communicating a cry for help, or (4) the effect of cognitive self-schemas and appraisals about the impact of the brain injury [48].

Behavioral Observations

Beyond actual test performance, the emotional and physical reaction to undergoing testing can provide very useful information. Behavioral observations from the examiner and/or psychometrist are often quite valuable and may provide insight into a patient's frustration tolerance, reactions to success and failures, and the effect of fatigue on performance over the course of the evaluation. These behaviors may mirror many of the difficulties which individuals with brain injuries experience in challenging daily situations. If the focus of the assessment is on test performance alone, this potentially valuable information will be missed. By conducting an assessment that comprehensively measures psychological and cognitive functioning and qualitative aspects of performance during and after testing, neuropsychologists are better suited to integrate information from the clinical interview and assessment and develop a more sophisticated and comprehensive understanding of the individual with TBI.

Cognitive Functioning

It is beyond the scope of this chapter to provide a detailed discussion of test selection when conducting an assessment, but a sampling of tests that address each component of the neuropsychological

evaluation in a post-acute rehabilitation setting are included in Table 3. Many other texts describe the merits of specific tests and issues to be attended to more generally concerning test selection, administration, and interpretation [28]. While any neuropsychological assessment should comprehensively assess cognitive domains [28], some areas of cognitive functioning are stronger correlates of long-tern functional outcome than others. Executive functioning tests—including measures of cognitive flexibility and planning, speed of processing information, attention, and memory—have been shown to better predict psychosocial outcome both at 1-year and 10-years post injury, as compared to general measures of intellectual functioning and verbal fluency [49–52]. At the same time, measurement of executive functioning within limits imposed by the artificial and controlled nature of the testing environment is quite challenging. Consequently, family/significant other ratings of specific behaviors associated with executive dysfunction, such as the Behavior Rating Inventory of Executive Functioning (BRIEF) or Frontal Systems Behavior Scale (FrSBe), are a helpful addition to any assessment.

Successful Integration of Neuropsychology into the Outpatient Rehabilitation Team

In outpatient brain injury rehabilitation settings, team treatment and assessment are viewed as the gold standard of clinical service [53–55]. The challenge of a truly interdisciplinary approach to assessment and rehabilitation is working together in a manner in which each discipline compliments the role of the other as a result of joint commitment to the same patient population [56]. Practicing in such a setting, in which a neuropsychological assessment is an integral part of an overall team evaluation, can be extremely rewarding both professionally and clinically. It can also present a host of challenges due to working with disciplines whose approaches to assessment often differ from that typically conducted by neuropsychologists.

First and foremost, other practitioners within the rehabilitation discipline may not necessarily view a neuropsychological evaluation as offering any added value to the treatment process. This is particularly true if the neuropsychologist providing assessment services is not an actual member of the treatment team, but provides assessments in the role of an outside consultant. This lack of perceived value in the role of the neuropsychologist is often due to a lack of knowledge about the unique information which a neuropsychological evaluation can provide and/or having team members who experienced working with neuropsychologists who conduct evaluations which are narrowly focused on "impairment." Among typical rehabilitation team members, neuropsychologists have unique expertise in relating patterns of cognitive dysfunction with brain lesions and understanding the impact of factors such as mood, psychiatric history, personality style, and effort on cognitive functioning.

Within the context of a rehabilitation team, neuropsychologist's expertise can also be used to help strengthen the findings and assessments conducted by other team members. If done with professional respect and deference, promoting the value of a neuropsychological assessment can help enhance the reputation of the neuropsychologist on the team, increase the value of the findings of the assessments of other team members, and most importantly yield results that holistically describe the patient and their current situation.

Blair and Gorman [19] outlined the following common challenges that neuropsychologists face in rehabilitation settings: (1) the need to join the system (rather than simply consulting it), (2) deferring to other rehabilitation team members, and (3) helping other disciplines integrate what on the surface may appear to be disparate findings. For instance, examples of confusing and often contradictory behavior (e.g., having difficulty with initiation in one setting, versus being extremely disinhibited in another) may actually be examples of a common underlying problem (e.g., frontal systems dysfunction). By becoming actively involved with the team and practicing active listening, the neuropsychologist can uniquely integrate the opinions and findings of other team members, help with

behavioral management, and lead to an assessment which is much more than simply the sum of its collective parts.

Providing Feedback to Patients, Families, Caregivers, and Other Rehabilitation Providers

Even a well-done comprehensive neuropsychological assessment is of no real value if the results are not conveyed to the persons being served. Only when these persons truly are assisted to understand, digest, and use this information, will the assessment have the intended impact upon the patient's situation. In our view, the work of the neuropsychologist conducting the evaluation is not entirely complete until feedback has been provided.

By giving feedback to the referral source, the neuropsychologist has the opportunity to provide more than information on changes in cognition and behaviors following brain injury. By incorporating the ICF model and including key categories of information which we have described here, the neuropsychologist can convey the important message that functioning may be understood only when the focus of the assessment goes beyond level of impairment. This may help a referral source understand why an individual with a long history of being an overachiever, and whose sense of self is tied to their professional productivity and ability to "do it all," seems disproportionately impacted by what seem to be very minimal changes in cognitive functioning on formal testing. Alternatively, providing feedback to a referral source may allow a neuropsychologist to explain why an individual with notable cognitive impairment but an established pattern of compensation strategies may be able to live in the community with minimal support. Providing this feedback and education is particularly important when the referral source is someone who is not familiar with rehabilitation and issues related to functioning. In other words, the neuropsychologist can highlight the idea that issues beyond level of impairment in mental skills determine level of functioning and, consequently, provide valuable service beyond the referral question.

Most neuropsychologists report that they commonly provide feedback directly to patients and that this information is viewed as helpful and positive by the vast majority [57]. Given the potential impact, direct feedback to the patient should be framed in a manner that is understandable and therapeutic. The challenge in giving feedback to persons with impaired cognitive function and minimal appreciation of their various limitations is in conveying this information in a meaningful and applicable-to-daily-life manner. The key point to remember is that the person receiving feedback may have cognitive difficulties that interfere with the ability to understand, remember, and process the information and how the findings would impact his/her daily functioning. As such, it is most important to involve key family members, caregivers, or other interested parties in the feedback session.

Correlating specific test results with examples of problems in everyday living, as well as using analogies and even metaphors for the problem being discussed, can be more palatable [58]. Frequent use of pauses, clarifications, and having the patient restate what they have learned can also be helpful. If the patient is scheduled to return for follow-up therapy, then further sessions may help patients in developing strategies to address problems. Finally, the feedback session should be followed-up with a letter summarizing the discussion.

While the assessment is focused on the patient, family and caregivers are also commonly experiencing significant emotional stress associated with adapting to the complex behavior and personality changes that occur after TBI. A majority of caregivers for persons with TBI report increased stress [59] and almost half of persons living with a loved one with TBI endorse symptoms that meet criteria for one or more psychiatric diagnoses [18]. Addressing the well-being of caregivers and family members can facilitate the rehabilitation and recovery of the family member with TBI [60]. Providing feedback to family members can validate their perceptions of the major issues which are impacting the survivor's

functioning and provide additional insights which can lead to better methods of dealing with common challenges.

The feedback session also provides a venue for the discussion of issues that may predate the injury, but which the family had been unwilling or unable to confront previously. A family who is reluctant to discuss mental health issues or who has a permissive attitude about substance use can be provided with information that facilitates their understanding of how these factors impact the recovery and treatment of brain injury. By understanding how these issues impact recovery from brain injury, family members may be empowered to help their loved one seek out treatment for a problem which has existed for some time.

While feedback regarding assessment results to the patient and their family is obviously important, it is also important to provide feedback to rehabilitation team members who will ultimately provide treatment to address the various challenges described in the assessment. As we have described earlier, this information will be better received and utilized if the neuropsychologist providing the assessment is also functioning as part of the treatment team. Such an arrangement provides the obvious advantage of the opportunity to revisit concerns raised in the assessment as the team continues to work with the patient. Providing test feedback during one or more therapy sessions provided by key team members can be a very powerful means of increasing the chance that test results will be incorporated into treatment. For neuropsychologists who function in a consulting role, it is important that they find a forum in which the information is not simply relayed to treatment team members, but in which there is an active dialogue in which questions can be answered. This can best be done by participating in a regular team meetings and patient care conferences.

Case Study

Jan is a 46-year-old female who was involved in a motor vehicle crash while driving to work, when her car slid off of the road one January morning and struck a tree. She was a restrained driver, the only person in the car, and no other vehicles were involved in the accident. She may have had some loss of consciousness, although there were no observations of that at the scene. Within minutes after the accident, she was found by a passing motorist who described her as being groggy but awake and talking in a somewhat nonsensical manner. Emergency responders were called and she was brought to the local hospital emergency department, where work-up including imaging studies of the brain were found to be negative.

She has no memory for the car crash or for events occurring an hour before or after, and incomplete memory for events for up to 24 h after the crash. She also suffered a fractured left femur for which she underwent orthopedic surgery. Her hospital stay lasted for several days, during which time her mental status quickly improved. Because of her femur fracture, she was for a time transferred to an extended care facility and ultimately returned home. She later went on to receive physical therapy once her weight bearing status was improved. Due to the rapid improvement in her mental status, no complaints of changes in her cognition, and the fact that she did relatively well on screening exams of her mental status within a few days of hospital admission, no further therapy was ordered to address cognitive issues.

At the time of her crash, Jan was employed as a full professor in humanities at a private religious-affiliated college. She had become a full professor just several years before and was quite accomplished and well published in her field. She is a single parent of three children and has primary responsibility for raising the children. Her children range from upper high school to upper grade school level. She was described by others as someone who is able to handle a variety of responsibilities and quite gifted at multitasking. In addition to her full time work and her responsibilities as a parent, she also was involved in a community singing group which performed throughout the region.

As her physical recovery improved, Jan attempted to return to work, but found this quite difficult. This included managing her teaching

load, her writing responsibilities, and other professional organizations in which she participated. She felt overwhelmed by her work, was increasingly frustrated, and even became despondent to the point of concern for possible depression. She was ultimately referred to a specialized brain rehabilitation program approximately 6 months after her injury. She underwent workup, including neuropsychological evaluation, which found some mild slowing in her speed of cognition and marginally poor performance in selected aspects of executive functioning (e.g., conceptual reasoning ability), but otherwise generally average, or in most cases, above average performance. She initiated a program of cognitive rehabilitation. Prior to her injury, Jan had made limited use of compensation strategies, such as a planner, and prided herself on her ability to keep track of her own schedule and that of her children and other tasks quite well "in her head."

Further conversation with her indicated that she is someone, who when growing up, received limited reinforcement and encouragement for her many achievements from her parents in their attempts to not treat her differently than her siblings who were not as accomplished as she was. As a result, in order to obtain some sense of acknowledgment from her parents, she developed a strong focus on achievement which also was her principle means of developing any sense of self-worth and acknowledgment. She also admitted she enjoyed "doing it all," and pushing herself to the limit of her abilities. At such times, she felt as though she was accomplishing something and felt good about herself.

Initial attempts by her therapy team to help her develop compensation strategies and organizational strategies were met with a great deal of opposition and frustration, given that she could no longer "do it all in her head." She felt that having to write things down and rely on strategies to help her organize, retain information, and plan ahead for activities, was a reflection of the loss of ability that she had suffered and diminished her sense of self-esteem and self-worth. Further exacerbating her stress was the fact that many individuals who knew her were perplexed as to why she did not go back to work, and many even suggested that she could return to work if she really tried harder. In fact, several attempts to return to work early in her recovery had only caused her greater frustration and seemingly increased her difficulties with organizational ability, diminished fatigue, and increased irritability. In seemed to her that the harder she tried to function, the worse she ended up doing. To address these significant emotional and interpersonal issues, she was seen for psychotherapy in coordination with her cognitive rehabilitation, with the primary aim of maximizing the effectiveness of her treatment.

This case points out the need to go beyond traditional neuropsychological testing, focused as it is on cognitive impairment, and understand: the demands of the environment in which the individual was functioning previously and towards which they would like to return; historical, emotional, and psychosocial factors that may be impacting this individual at present, particularly aspects of personality style which impact interpretation of the changes associated with their history of traumatic brain injury; current use of compensation strategies and receptiveness to further developing such strategies.

Summary

The neuropsychological assessment provides a unique means of describing the many factors which impact functioning in the person with brain injury. In the acute phase of recovery, evaluation typically focuses on assessment of fluctuations in mental status, emotional adjustment, and neurobehavioral sequelae. In the post-acute phase of recovery, the focus of assessment changes to examining factors which together explain the challenges a patient faces in everyday life and making treatment recommendations. This type of assessment requires a change in focus from traditional neuropsychological assessment, with its emphasis on documenting level of cognitive impairment, to a model that appreciates and accounts for differences between changes in mental and body structures, activity limitations, and participation restrictions. Such a model also examines the various individual

and environmental factors that impact recovery, rehabilitation, and long-term outcomes. When a neuropsychologist becomes an integral part of the rehabilitation treatment team, it (1) ensures that the results of the assessment are provided to patients, their families, and referral sources, (2) provides results of the assessment as a means of understanding challenging cognitive and behavioral issues, and (3) increases the likelihood of treatment success, independence, and improved quality of life.

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