

Chapter 1

The Value of Neuropsychological Evaluation in Medical Practice



Michelle M. Braun

Physicians and other healthcare providers are often expected to provide guidance and treatment to patients who are concerned about memory, attention, language, and other aspects of cognitive functioning. Cognitive concerns may present as subjective complaints from the patient and/or family; through difficulty managing the cognitive demands of a previous level of functioning at work or school; as a change evident to a healthcare provider that has followed a patient over time; in the context of known neurological compromise (e.g., stroke, traumatic brain injury, Parkinson's disease, epilepsy, etc.), known medical compromise (e.g., liver failure, human immunodeficiency virus, cardiovascular issues, sleep apnea, etc.), or known psychiatric compromise (e.g., bipolar disorder, schizophrenia, posttraumatic stress disorder, etc.); and in the context of a number of other situations that may impact cognition (e.g., changes in medication, increased stress, alcohol or drug use, post-surgical compromise, toxic exposures, etc.). Because cognitive dysfunction may be symptomatic of multiple coexisting issues, cognitive assessment is a complex process that often requires the use of multiple diagnostic tools.

Common tools in the assessment of cognitive functioning include the neurological exam, structural neuroimaging (computed tomography/CT, magnetic resonance imaging/MRI), neurodiagnostic tests (electroencephalogram/EEG), laboratory measures, and neuropsychological evaluation. Each diagnostic tool has unique ability to inform diagnosis and to direct treatment (see Table 1.1). For example, the neurological examination helps determine whether abnormalities in sensory and motoric functioning contribute to cognitive symptoms. Common neuroimaging

M. M. Braun (✉)

Department of Neurology and Neurosurgery, Ascension/Wheaton Franciscan Healthcare,
Racine, WI, USA

e-mail: Michelle.Braun@ascension.org

Key Point

Although non-neuropsychological measures provide important information about factors that may contribute to cognitive problems, neuropsychological evaluation provides a direct measure of cognitive functioning. Neuropsychological evaluation is a diagnostic procedure that synthesizes standardized comprehensive measures of cognitive functioning, variables that may impact the accuracy of test data (e.g., engagement in the testing process, emotional status), neurobehavioral information, and medical history.

techniques such as MRI and CT provide a measure of brain structure and help to identify whether obvious structural compromise such as stroke, tumor, or atrophy contributes to cognitive changes. However, given the significant structural variability in the normal brain [1], determination of subtle pathological changes with neuroimaging can also be challenging. Furthermore, cognitive functioning may be normal in spite of structural changes or abnormal in spite of normal brain structure. Neurodiagnostic tests such as EEG help to determine whether cortical electrical abnormalities due to seizures, metabolic disturbances, or other causes are contributing to cognitive symptoms. Similarly, laboratory measures help determine whether abnormalities in vitamin levels, metabolic functioning, hematologic functioning, or endocrinologic variables may impact cognitive functioning. Tests of cerebrospinal fluid and urine may also provide information about conditions that may impact cognitive functioning.

Cognitive screening tools are discussed in greater detail in Chap. 4. Computerized testing is another method that has been used to gather cognitive data in some settings, though several considerations should be addressed before using such programs in clinical settings, as discussed in Chaps. 2 and 3.

Key Point

Compared to neuropsychological testing, cognitive screening tools are limited in diagnosing neurocognitive syndromes because:

- (a) They often do not sufficiently take into account variables that impact test interpretation, including the patient's level of education, ethnicity, level of engagement in the evaluation, and sensory abilities.
- (b) Even if data are accurately interpreted, cognitive screening tools, given their brief nature, often do not provide adequate sensitivity or specificity and thus are limited in determining neurocognitive diagnosis.

When conceptualized in aggregate, data from multiple valid diagnostic tools provide a comprehensive understanding of the etiology and prognosis associated with cognitive symptoms [2].

Table 1.1 Comparisons of neurocognitive measures

	NP testing	CT/MRI	Neuro exam	Computer and COG screens
Dx endpoint	Yes	Yes	Yes	Limited
False +/-	Less likely	Less likely	Less likely	Likely
Dx utility	High	High	High	Limited
Detects subtle neurocog function	Yes	No	Limited	Limited
Normed/standardized	Yes	Some	NA	Limited
Directs treatment	Yes	Yes	Yes	Limited

NP neuropsychological testing, *neuro exam* neurological examination, *COG* cognitive, *CT* computed tomography, *MRI* magnetic resonance imaging, *Dx* diagnosis, *false +/-* false positive and negative, *neurocog* neurocognitive (table developed by Karen Sanders, PhD, ABPP)

Indications for Neuropsychological Evaluation

A neuropsychological evaluation can be helpful in determining the etiology and treatment for a wide variety of cognitive symptoms. Although memory complaints are a common referral issue, patients may also complain of problems with word finding, attention, information processing, problem solving, or other cognitive difficulties (see Table 1.2). Neuropsychological evaluations are also helpful in documenting baseline cognitive functioning and/or detecting subtle cognitive changes in patients with chronic medical or neurological disorders that have a likelihood of compromising future cognitive or behavioral functioning (e.g., Parkinson's disease, multiple sclerosis, diabetes). In such cases, baseline neuropsychological evaluations are valuable for early detection of cognitive changes, tracking of cognitive functioning (via comparison of baseline and serial test data), evaluating potential cognitive effects of treatments (e.g., medication, chemotherapy), evaluating and making treatment recommendations for emotional adjustment to cognitive symptoms in the context of chronic disease, connecting patients with supportive resources, and providing strategies to maximize daily cognitive functioning.

As detailed elsewhere [3, 4], neuropsychological evaluations are often a standard part of care for treatment selection and treatment outcome evaluations (e.g., deep brain stimulation, epilepsy surgery) and are the tool of choice when objective documentation of subjective cognitive complaints is indicated. In children, adolescents, and adults, an inability to develop expected knowledge, skills, or abilities required to adapt to new or changing cognitive, social, emotional, or physical demands may trigger a neuropsychological evaluation.

Table 1.2 Common clinical symptoms prompting neuropsychological evaluation

<i>Changes in memory</i>
Frequently loses items
Gets lost easily
Forgetting conversations
<i>Poor attention and concentration</i>
Does not appear to listen
Gets confused in conversations
<i>Changes in language functioning</i>
Aphasia
Word-finding problems
<i>Changes in visuospatial abilities</i>
Difficulty drawing
Difficulty navigating (using a map or understanding directions)
Misperceiving the environment
<i>Impaired executive functioning</i>
Perseverative
Poor judgment
Rigidity in thought
<i>Changes in emotional functioning</i>
Increased anxiety
Increased depression
Psychosis
<i>Fluctuations in mental status</i>
Confusion
Disorientation

Adapted from Kulas and Naugle [3]

Anatomy of a Neuropsychological Evaluation

Key Point

As detailed in other sources [5, 6], the neuropsychological evaluation consists of the following components:

1. Record review
2. Neurobehavioral status examination
3. Test selection
4. Test administration
5. Integration of findings
6. Feedback session

1. *Record review*

The neuropsychologist reviews the medical records and referral question and determines whether a neuropsychological evaluation is appropriate.

2. *Neurobehavioral status examination*

The evaluation begins with a neurobehavioral status examination conducted by the neuropsychologist. The neurobehavioral status examination includes a detailed analysis of the onset, course, and nature of cognitive symptoms. Aspects of history that will be integrated into the case conceptualization are gathered, including medical, academic, occupational, social, substance use, and psychiatric history. The interview of an informant, such as a relative or someone well known to the patient, is often a key part of the neurobehavioral status examination, given that the nature of some cognitive issues (e.g., memory problems) may lead the patient to misperceive the occurrence of cognitive difficulties and/or may impair the patient's ability to provide accurate historical information. The patient and family members may express different aims for the evaluation that can be incorporated into the assessment and recommendations (e.g., connection to community resources, management of problem behaviors, questions about independent living ability, etc.). Clinical behavioral observations are gathered, including analysis of the patient's functional memory (e.g., ability to recall autobiographical history and current information, repetitiveness, etc.), speech production, language comprehension, communication style, emotional functioning, social interaction, and motoric functioning.

3. *Test selection*

Information from medical records, the neurobehavioral interview, and behavioral observations is integrated to guide the selection of specific neuropsychological tests. The selection of tests is a strategic process that varies due to patient characteristics (level of education, premorbid level of functioning, sensory abilities, physical limitations, fatigue level, age, ethnicity) and the goals of the evaluation (establishing a diagnosis, measuring treatment effects, etc.).

4. *Test administration*

Tests are either administered directly by the neuropsychologist or by a trained technician supervised by the neuropsychologist. Test administration is a fluid process, such that different tests may be utilized or omitted as the data from tests completed earlier in the evaluation help to clarify the patient's abilities and difficulties. For example, impairments on measures of naming may lead to a more in-depth assessment of other language-related abilities such as spelling or arithmetic, or a shorter memory measure may be substituted for a longer measure based on patient fatigue. Neuropsychological tests are often presented in question-and-answer format and often involve object manipulation and responses to pictures or patterns. Paper-and-pencil or multiple-choice measures may also be utilized.

Core cognitive and behavioral domains are listed in Table 1.3. A small sampling of commonly utilized measures in each domain is included, given that an exhaustive list of tests in each domain would be lengthy. *Because most neuropsychological tests simultaneously measure the functions of multiple cognitive*

Table 1.3 Common neuropsychological measures of core cognitive and behavioral domains

• General intellectual ability
– Wechsler Adult Intelligence Scale—IV
– Wechsler Test of Adult Reading
• Reasoning, sequencing, problem-solving, and executive function
– Delis-Kaplan Executive Function System
– Wisconsin Card Sort
– Tower of London
• Attention and concentration
– Continuous Performance Test
– Digit Span
• Learning and memory
– Wechsler Memory Scales—IV
– California Verbal Learning Test
• Language and communication
– Boston Naming Test
– Multilingual Aphasia Examination
• Visual-motor praxis
– Trails A
– Coding
• Motor and sensory function
– Finger Tapping
– Grooved Pegboard
– Reitan-Klove Sensory-Perceptual Examination
• Mood, conduct, personality, quality of life, psychopathology
– Beck Depression Inventory—II
– Minnesota Multiphasic Personality Inventory
– Personality Assessment Inventory
• Adaptive behavior (activities of daily living)
– Independent Living Scales
– Clinical Dementia Rating Scale
– Adaptive Behavior Assessment—II
• Motivation and effort (e.g., performance validity testing)
– Various measures that are self-standing and embedded

and behavioral domains, meaningful integration of results requires intra- and inter-domain analysis. It is the disease-specific, multivariable integration of test data across cognitive domains, in the context of clinical information and data from other diagnostic measures, that is the heart of specialty training and practice in neuropsychology.

5. Integration of findings

The neuropsychological evaluation includes an integration of findings from the neurobehavioral interview, record review, and neuropsychological testing and provides a variety of deliverables that are designed to guide clinical

management, as noted below. This information is sent to the referring physician or other healthcare provider and is often given to the patient and/or patient's caregivers.

Key Point

Typical Deliverables from the Neuropsychological Evaluation

1. Objective, norm-referenced test results for each cognitive domain (see Chap. 2 for more information on norm-referenced measures)
2. Diagnostic and etiological impressions
3. Recommendations for neurodiagnostic studies or other workup to assist in clarifying etiology, if needed
4. Recommendations for repeat neuropsychological testing, if needed
5. Connections to support organizations to enhance clinical outcome and quality of life (e.g., Alzheimer's Association, Aging and Disability Resource Center)
6. Recommendations to address any psychiatric issues that may have been detected
7. Customized cognitive strategies to enhance future cognitive functioning (e.g., use of specific memory strategies based on cognitive profile)
8. Behavioral strategies to enhance future cognitive functioning under the direction of a healthcare provider (e.g., enhancements in sleep, exercise, diet)
9. Strategies to manage difficult behaviors, if needed
10. Information on functional abilities and optimal living environment, if needed
11. Determination of the capacity to make healthcare decisions, if needed

6. *Feedback session*

A post-evaluation feedback session with the patient and family members is a customary part of the neuropsychological evaluation [7]. The feedback session includes the following components, as detailed by Dr. Karen Postal in Section III of this book:

- (a) Discussion of the relationship between neuropsychological test results, diagnosis, and prognosis.
- (b) Explanation of treatment recommendations. In addition to those recommendations that are directly managed by the physician (e.g., changes in medication), patients are often provided with tailored behavioral strategies to maximize daily cognitive functioning, recommendations for nonpharmacological interventions, and connections to community resources to enhance quality of life and daily functioning.
- (c) Communication of results to family members is often provided and can help enhance compliance with treatment and behavioral recommendations. Feedback with family members may also have a significant impact on clinical treatment. For example, individuals with dementia may be able to live in their home for an average of 18 months longer when caregivers are provided with education and connected to caregiver resources [8].

The Value of Neuropsychological Testing

In a survey of physicians who utilize neuropsychological services, physicians indicated that they most often referred patients for diagnostic purposes and that information from neuropsychological evaluations was incorporated into their discharge summaries a majority of the time [9]. It is also noted that neuropsychology feedback is highly valued by patients [10] and significantly improves clinical outcomes and treatment satisfaction in individuals with traumatic brain injury [11]. In addition, as reviewed elsewhere [4], neuropsychological assessments predict functional abilities across a variety of neurocognitive disorders. With changes in healthcare reform, there has been an increased interest in demonstrating the cost-effectiveness of neuropsychological evaluations. A recent study of veterans showed decreased incidence and length of hospitalization in the year following a neuropsychological evaluation, as compared to the year prior, and decreased utilization of emergency room visits [12]. Additional research into the cost-effectiveness of neuropsychological evaluations is ongoing through grants from the American Academy of Clinical Neuropsychology Foundation and other sources.

Describing Neuropsychological Testing to Patients

Patients often ask referring physicians to describe what the neuropsychological evaluation process is and why it is necessary, especially given that some patients are unfamiliar with the term “neuropsychology” and assume it means they are being asked to complete a “psychological” evaluation. If a cognitive screening measure has been performed, it can be helpful to inform the patient that a neuropsychological evaluation is similar to an in-depth version of a cognitive screen that provides greater precision in measuring and diagnosing potential cognitive problems. Some patients benefit from learning that a neuropsychological evaluation is a “detailed test of memory and other thinking skills” that will help inform their treatment. Patients may also benefit from understanding that neuroimaging such as a head CT or Brain MRI “measures brain structure but not brain function” and that neuropsychological assessment directly measures brain function (i.e., the “software” of the brain). Patients who are nervous about the process may benefit from knowing that most previous patients report during the feedback session that they found the process to be engaging, beneficial, and worth the investment of time (typical evaluation time ranges from 2 to 4 hours, though can be longer for younger or more complicated patients). Patients also appear to value receiving brief written information about the evaluation process. To this end, the American Psychological Association Division of Neuropsychology (Division 40) has developed a brochure that provides information about the neuropsychology evaluation and is freely available [13]. Sharing these brochures with patients prior to the assessment can help provide additional information about the process of neuropsychological evaluation.

Neuropsychology Training

Patients and physician colleagues often inquire about the training of the neuropsychologist. A neuropsychologist typically holds a master's degree and doctoral degree (PhD or PsyD) in clinical psychology or neuropsychology from a graduate program or professional school that is accredited by the American Psychological Association (APA) or the Canadian Psychological Association (CPA). Completion of a master's thesis and doctoral dissertation are typically required. On average, neuropsychology training involves 8 years of post-baccalaureate course work and clinical supervision. Graduate school typically lasts 4–5 years and includes extensive didactics and clinical training in neuropsychology and clinical psychology, supplemented with training in neuroscience, functional neuroanatomy, behavioral neurology, research methods, statistics, psychotherapy, ethics, and tailored areas of specialization. A 1-year neuropsychology internship is completed after graduate school and is often followed by a 2-year neuropsychology fellowship. Components of graduate training, internship training, and the postdoctoral fellowship ideally follow the Houston Conference guidelines, which were developed to provide quality and consistency in neuropsychology training [14]. Professional organizations in neuropsychology are involved in ongoing effort to develop entry level practice competencies in neuropsychology.

Similar to physician practice, board certification is increasingly required by hospitals and other clinical care organizations to verify that a neuropsychologist has met practice competencies and achieved professional credentialing. The American Board of Professional Psychology (ABPP) is the primary organization for specialty board certification in psychology, and it facilitates specialty boarding in neuropsychology and subspecialty boarding in pediatric neuropsychology through the American Board of Clinical Neuropsychology (ABCN). Board certification through ABCN is a four-step process. The first step involves a credential review to ensure adequate specialty training in neuropsychology at the graduate and postgraduate levels. The second step involves successful completion of a written examination on neuropsychology, basic and clinical neuroscience, psychometrics, behavioral neurology, and clinical psychology. The third step requires peer-reviewed acceptance of two work/case samples. The fourth step involves successful completion of a three-part oral examination that requires the examinee to provide a diagnosis and recommendations for a clinical case through a “fact-finding” exercise, defend the previously submitted work samples, and pass an ethics examination. Other organizations offering neuropsychology board certification include the American Board of Professional Neuropsychology (ABN) and the American Board of Pediatric Neuropsychology (ABPdN).

Neuropsychological Evaluation Myths

There are several clinical myths associated with the process of neurocognitive diagnosis and neuropsychological evaluation that are helpful to clarify:

Myth #1: Patients and their family members are accurate in reporting cognitive symptoms.

Clarification #1: The report of patients and family members is subjective and often does not coincide with objective data. For example, patients and family members may lack insight into the existence of cognitive impairment, falsely attributing it to “normal aging,” stress, medication effects, or other variables. This may lead to late diagnosis, missed treatment opportunities, and delayed ability to plan for future needs. Alternatively, patients may unknowingly pathologize normal age-related changes and become convinced they have a neurocognitive syndrome even though test data are normal, resulting in unnecessary treatment in the absence of neuropsychological data. In other situations, a patient may be motivated by external incentives to falsely report cognitive symptoms. Without the use of neuropsychological testing with embedded measures of validity (“performance validity testing”/PVT, as detailed in Chap. 2), unnecessary diagnosis and utilization of services may occur.

Myth #2: Cognitive screening tools are sufficient to diagnose neurocognitive syndromes.

Clarification #2: Interpretation of scores on cognitive screening tools may not sufficiently take into account variables that impact interpretation, including the patient’s age, level of education, ethnicity, and sensory abilities. Even if data are accurately interpreted, cognitive screening tools, given their brief nature, often do not provide adequate sensitivity or specificity and thus are limited in informing neurocognitive diagnosis. Cognitive screening tools are discussed in greater detail in Chap. 2.

Myth #3: Neurocognitive syndromes can be adequately diagnosed with neuroimaging.

Clarification #3: Most neuroimaging does not measure cognitive functioning, which is necessary for the diagnosis of many neurocognitive syndromes. In addition, some neurocognitive conditions may have no associated structural findings (e.g., attention deficit disorder, learning disability, concussion, mild cognitive impairment). In addition, structural findings are often not helpful in neurocognitive differential diagnosis (e.g., determination of Lewy body dementia vs. Parkinson’s dementia), cognitive symptoms may precede structural abnormalities [15], and cognitive functioning may be normal in the context of abnormal structural findings.

Myth #4: Neuropsychological evaluation involves a straightforward interpretation of test data.

Clarification #4: Interpretation of neuropsychological evaluation data requires extensive knowledge of the psychometric properties of each measure and expert analysis of test data based on years of clinical training and experience with multiple neurological, medical, and psychiatric populations. Similar to how physicians may interpret lab data differently based upon clinical presentation and other existing data, neuropsychologists interpret neuropsychological test data differentially based on clinical presentation and various premorbid and testing-related variables.

For example, a memory score at the 10th percentile may reflect a pathological change in some individuals and not in others. Interpretation is also dependent on the integration of performance validity tests (PVTs), which validate the accuracy of test data and are covered in greater detail in Chap. 2.

Myth #5: Neuropsychological assessment is a soft science that is not as valid as medical methods.

Clarification #5: Neuropsychological assessment is highly reliable and valid [16, 17]. Validity measures are equal to or stronger than medical tests, including neuroimaging [17].

Summary

Patients frequently request assistance from physicians in understanding and treating cognitive symptoms. Given that subjective reports of cognitive symptoms from patient and family members may under- or over-estimate actual cognitive ability, and given that cognitive screening devices provide limited diagnostic assistance and are often not sensitive to subtle cognitive deficits, a comprehensive neuropsychological assessment is often needed. Common neuroimaging techniques measure brain structure but do not measure cognitive functioning, and an objective assessment of cognitive functioning is often required to arrive at a neurocognitive diagnosis.

The neuropsychological evaluation is a highly valid, reliable, comprehensive assessment process that provides referral sources with diagnostic impressions, prognostic information, and tailored treatment recommendations for patients with cognitive symptoms and helps to tease apart multiple interacting variables that can impact cognitive functioning (e.g., underlying neurocognitive or medical disorders, medication effects, mood and stress issues, insufficient sleep, etc.). The interpretation of neuropsychological test results is not a straightforward process and is tailored to unique patient variables including age, education level, gender, ethnicity, medical status, sensory abilities, and emotional functioning. Neuropsychological evaluations also assess whether the obtained data are valid, based on measures of patient engagement in the evaluation. The neuropsychological evaluation is a valuable component of a multifaceted examination of cognitive symptoms and directly impacts medical management.

Specialty training in neuropsychology involves obtaining a master's and doctoral degree in psychology and requires an average of 8 years of education following receipt of the undergraduate degree, including completion of a neuropsychology internship and 2-year neuropsychological postdoctoral fellowship. Board certification is an increasing requirement for practice in hospitals and other clinical organizations and signifies competency in the discipline. Research suggests that physicians value neuropsychological evaluations and incorporate neuropsychological findings into discharge summaries a majority of

the time. The cost-effectiveness of neuropsychological evaluations has been demonstrated through data showing reduced frequency and length of rehospitalizations following neuropsychological evaluation. There is ongoing research to investigate other aspects of cost-effectiveness and value.

Chapter Review Questions

1. A 78-year-old female with a master's degree reports increasing memory problems. Laboratory workup was normal, a brain MRI showed mild small vessel ischemia, and her score on the Mini-Mental State Examination (MMSE) was 28/30. Which would be the best course of action to take in response to her complaints?
 - A. Reassure her that her cognitive complaints are likely due to normal aging, given her normal MMSE and laboratory workup.
 - B. Inform her that although there are no serious concerns with her MMSE performance, a neuropsychological evaluation would provide a more sensitive measure to assess her cognitive functioning and potentially detect any subtle changes.
 - C. Recommend a repeat brain MRI in 1 year to reassess her cognitive functioning.
 - D. Inform her that individuals with higher educational levels are often sensitive to normal age-related cognitive changes and report memory problems that do not bear out on testing, so no further testing is needed, and she should follow up in 1 year.
2. A neuropsychological evaluation involves the following components:
 - A. Test administration, interpretation, and report writing.
 - B. Neurobehavioral interview, testing, and report writing.
 - C. Neurobehavioral interview, record review, testing, interpretation, report writing, and feedback.
 - D. Neurobehavioral interview, testing, interpretation, report writing, and feedback.
3. Which is typically not assessed in the neuropsychological assessment?
 - A. Memory, attention, and executive functioning.
 - B. Mood.
 - C. Motivation and effort (e.g., performance validity testing).
 - D. Cranial nerve function.

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