

Neuropsychological Assessment: A Valuable Tool in the Diagnosis and Management of Neurological, Neurodevelopmental, Medical, and Psychiatric Disorders

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Abstract: For both children and adults with neurological, neurodevelopmental, medical, or psychiatric disorders, neuropsychological assessment can be a valuable tool in determining diagnosis, prognosis, and functional abilities as well as informing clinical management. This review summarizes the contributions of neuropsychological assessment to clinical care across diagnostic categories, with the goal of helping clinicians determine its utility for individual patients.

Key Words: neuropsychological assessment, diagnosis, neurological disorders, neurodevelopmental disorders, clinical management
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Objective data are crucial to the diagnosis and management of disorders that impact brain function. Clinicians gather these data through clinical interviews, neurological exams, neuroimaging, laboratory testing, neurodiagnostic tests (electroencephalogram, electromyogram, etc.), and neuropsychological assessment. Although the relative value of each type of data varies by disorder, collecting multiple sources of valid, reliable information enhances diagnostic precision and clinical management. This review describes neuropsychological assessment and summarizes its value across diagnostic conditions, to help clinicians determine its utility for individual patients.

Neuropsychological assessment synthesizes data from the patient interview, informant interview, record

review, behavioral observations, and objective tests of cognitive, motor, and emotional function to provide information about diagnosis, prognosis, and functional status for patients with neurocognitive and psychiatric disorders, as well as many medical conditions. The selection of specific neuropsychological tests is guided by the medical history, clinical interviews, and behavioral observations, as well as individual patient characteristics (level of education, premorbid level of functioning, sensory abilities, physical limitations, fatigue level, age, ethnicity) and goals of the evaluation (establishing a diagnosis, measuring treatment effects, etc.).

Neuropsychological tests include object manipulation, inspection of and responses to pictures or patterns, paper-and-pencil and multiple-choice tests, and answering spoken questions. These tests measure:

- General intellect
- Reasoning, sequencing, problem solving, and executive function
- Attention and concentration
- Learning and memory
- Language and communication
- Visual-spatial cognition and visual-motor praxis
- Motor and sensory function
- Mood, conduct, personality, quality of life
- Adaptive behavior (activities of daily living)
- Social-emotional awareness and responsiveness
- Psychopathology (eg, psychotic thinking or somatization)
- Motivation and effort (eg, symptom validity testing)

A report of the neuropsychological assessment is sent to the referring clinician and other providers, and a postevaluation feedback session is held with the patient and, often, the patient's family. A majority of physicians who order a neuropsychological assessment include its findings in the patient's discharge summary.¹

Neuropsychological assessment is highly valid and reliable,^{2,3} with validity measures equaling or exceeding those of medical tests, including neuroimaging.³ Neuropsychological assessment provides unique complementary information that is critical for evaluating higher cortical abilities and function in ways that are not possible with other techniques.⁴⁻⁹ For example, neuropsychological

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assessment is the only means to evaluate the functional impact of localized cortical abnormalities. Although techniques like electroencephalogram can help localize the site of seizure onset, only neuropsychological assessment can quantify the impact on cognitive function and behavior. Similarly, neuroimaging techniques can identify changes in the brain's structural integrity, but the functional impact of these changes cannot be quantified from structural imaging alone. Advances in functional imaging, such as fMRI, have given us a window into the areas of the brain that are activated during specific cognitive tasks. However, not even fMRI can quantify higher cortical function to track the progression of disease.

As outlined in the following sections, neuropsychological assessment allows for precise detection, characterization, and tracking of cognitive function with a sensitivity that is not possible through routine clinical evaluation, mental status examination,^{10,11} or standardized cognitive screening tools (eg, Mini-Mental State Examination).

Neuropsychological assessment is particularly helpful in determining whether patients meet a common diagnostic requirement for most cognitive disorders: cognitive decline from a previous level of performance in one or more domains. As such, neuropsychological assessment is the most sensitive and accurate standard by which to detect the clinically meaningful changes in neurocognitive function that define diagnosis.¹¹ Over the last several decades, neurologists and psychiatrists have increasingly relied on neuropsychological assessment to improve diagnostic accuracy in neurocognitive and psychiatric disorders, and to obtain crucial data to guide neurorehabilitation (eg, brain injury and stroke) programs.¹¹

Although neuropsychological assessment may not be indicated for the diagnosis of neurocognitive disorders in clear cases of impairment (eg, advanced degenerative dementia or acquired brain injury with obvious cognitive impairment), there is abundant evidence that neuropsychological assessment increases the validity of diagnosis and the ability to predict functional outcomes for nearly all neuropsychiatric and neurological disorders, including:

- Dementia and mild cognitive impairment (MCI)¹²
- Multiple sclerosis and other demyelinating diseases¹³
- Epilepsy and nonepileptic seizure disorders¹⁴
- Stroke and neurovascular disorders¹⁵
- Parkinson disease and other movement disorders¹⁶
- Traumatic brain injury (TBI) and postconcussion syndrome¹⁷⁻¹⁹
- Brain tumor and other cancers affecting the central nervous system²⁰
- Schizophrenia, depression, anxiety, and other psychiatric disorders²¹
- Developmental disorders, learning disabilities, and other conditions affecting children and adolescents²²⁻²⁴

Beyond its value in diagnosis and predicting functional abilities, neuropsychological assessment informs clinical management by:

- Correlating functional and neurocognitive impairments with findings from other diagnostic studies (eg, radiologic or laboratory tests)^{25,26}

- Objectively tracking, or measuring, cognitive change indicative of disease progression²⁷
- Measuring response to surgical, pharmacological, psychological, or other treatments²⁸
- Distinguishing between true neurocognitive and malingering or factitious disorders²⁹

Indications for neuropsychological assessment include a history of a medical or neurological disorder that compromises cognitive or behavioral function; a congenital, genetic, or metabolic disorder known to be associated with impairment in cognitive or brain development or function; and treatment selection and outcome assessment for procedures such as deep brain stimulation and epilepsy surgery, for which neuropsychological assessment is now considered part of the standard of care.

Neuropsychological assessment is not limited to patients who have evidence of structural brain damage, and clinicians need not have a specific diagnosis in mind when ordering an assessment. There may be a need to clarify suspected neurocognitive involvement or effects; confirm or refine a diagnosis that impacts treatment planning, prognosis, or quality of life; or document impairment in patients with a suspected neuropsychological or neurobehavioral disorder. Assessment is indicated in children and adolescents with developmental delay, suspected learning disabilities, or inability to adapt to changing environmental conditions. Assessment is also the tool of choice for objective documentation of subjective cognitive complaints and for symptom validity testing.

To help clinicians determine the relative value of neuropsychological assessment for individual patients, we review its application across diagnostic categories. For most diagnostic categories, we list the result of a PsycINFO literature search for 1980 through mid-2011, showing the number of peer-reviewed studies that addressed neuropsychological function.

PEDIATRICS

In addition to measuring the neurocognitive consequences of specific central nervous system abnormalities in children, neuropsychological assessment is widely used to evaluate complex learning and behavior problems. Neuropsychological assessment is particularly valuable when a child presents with worsening psychiatric, family, neurodevelopmental, attention, or learning issues. Coexisting learning disabilities or attention deficit disorder can lessen the effectiveness of interventions unless the separate but overlapping conditions are recognized and their management specifically integrated into treatment plans.³⁰ Psychiatric³¹ and complex family issues³² may further complicate the diagnostic picture and render checklist data or school-based psychoeducational evaluation alone ineffective for diagnostic and treatment planning purposes. Particularly when multiple factors affect learning and behavior, a lack of specificity about a child's cognitive strengths and weaknesses limits the utility of traditional school-based psychoeducational

evaluations for treatment planning.³³ Further, the neuropsychological assessment's integrative nature is ideal for explaining the impact of psychiatric and emotional factors on cognitive and academic performance.³⁴

DEMENTIA

Neuropsychological assessment significantly increases diagnostic accuracy in dementia, even after a clinical evaluation by a physician specialist,^{35,36} and provides crucial data for differential diagnosis.³⁷⁻³⁹ As described by the American Academy of Clinical Neuropsychology,⁴⁰ most neuropsychological tests have superior positive predictive value and are therefore of greater utility than brief cognitive screens.⁴¹ Neuropsychological assessment can distinguish among normal aging, depression, MCI, and various dementia subtypes,⁴²⁻⁴⁷ and can accurately predict conversion to Alzheimer disease not only in large epidemiologic samples after 5 and 10 years,⁴⁸ but also in individual patients. In contrast, cognitive screening measures possess relatively weak sensitivity and specificity, particularly when used in individuals of high premorbid baseline intellectual ability, individuals from ethnic or linguistic backgrounds that are not represented in the normative sample for the tests, patients in the earliest phases of illness, and patients with atypical degenerative disease.⁴⁹⁻⁵³ Repeat neuropsychological assessment is highly sensitive in detecting even subtle changes in cognitive function and in determining treatment response to memory-enhancing medications, even in individuals with severe Alzheimer disease.⁵⁴

The differential diagnosis of dementia has been shown to be important to predicting functional abilities^{5,55,56} and guiding medication management.⁵⁷ Accurate differential diagnosis of memory problems is especially important when greater diagnostic precision might affect treatment, for example, in Lewy body dementia (antipsychotic medication is contraindicated to treat hallucinations), frontotemporal dementia (donepezil [Aricept] can lead to a worsening of symptoms⁵⁸), delirium (the underlying cause must be determined quickly), depression (correct treatment is crucial to recovery), and normal aging (no medication is needed). In addition to the clinical benefits of neuropsychological assessment, a 2009 cost study showed a savings of \$100,000 per patient when Alzheimer disease was detected early.⁵⁹

Our PsycINFO literature search showed > 3000 peer-reviewed studies on neuropsychological function in dementia published between 1980 and 2011. In addition to distinguishing normal aging from dementia, and aiding in the differential diagnosis of dementia, neuropsychological assessment informs treatment planning and prognosis in established cases of dementia. For example, neuropsychological assessment directly informs medication management by providing statistically based information on dementia severity, and may guide the use of memory medications, for example, an acetylcholinesterase inhibitor with or without an N-methyl-D-aspartate-

receptor antagonist when dementia progresses from the mild to moderate and/or severe stage.⁶⁰

MCI

MCI is differentiated from normal aging by subtle cognitive deficits that may progress to dementia over time.⁶¹⁻⁶³ Because certain subtypes of MCI are more likely to progress to dementia,⁶² early detection and delineation are important for treatment and prognosis. Neuropsychological assessment can detect MCI when cognitive deficits are mild and have not yet impacted daily function, and are thus generally not verifiable by other clinical methods such as interview or neuroimaging. Literature search showed more than 375 peer-reviewed studies on neuropsychological function in MCI, with several finding that neuropsychological assessment is particularly sensitive in discriminating among different MCI subtypes,⁶⁴⁻⁶⁶ determining different conversion rates to different types of dementia,⁶⁷⁻⁷⁰ and detecting individuals with pre-MCI memory complaints (subjective cognitive impairment) who eventually progressed to MCI.⁷¹ The precision of neuropsychological assessment in detecting MCI is highlighted in studies that have correlated assessment results with hippocampal volumes,⁷¹ cerebrospinal fluid,⁷¹ MRI,⁷² and positron emission tomography.⁶⁸ Early detection of MCI impacts clinical management by informing decisions about medications (eg, more aggressive treatment of vascular risk factors in MCI of vascular etiology), providing prognostic data, predicting stroke risk,⁷³ determining functional abilities,⁷⁴ and guiding the development of compensatory behavioral strategies to improve functional cognitive abilities.

STROKE

Literature search showed >1700 peer-reviewed studies on neuropsychological function after stroke. Post-stroke rehabilitation planning is strongly aided by neuropsychological assessment results, which offer detailed information about cognitive and functional abilities,⁷⁵ inform rehabilitation treatments,⁷⁶⁻⁷⁸ and predict functional outcome.⁷⁹⁻⁸⁵ The predictions remain accurate even 5 years poststroke.⁸⁶

TBI

Literature search showed >1680 peer-reviewed studies on neuropsychological function and TBI. Neuropsychological assessment adds incremental value in predicting clinical outcome, beyond what can be ascertained from such clinical variables as injury severity and functional ability.^{87,88} There is robust evidence that neuropsychological status predicts functional improvement after TBI, and is important in designing postinjury interventions.⁸⁹⁻⁹⁵ Some research shows that neuropsychological status is the most prominent factor in predicting functional recovery after TBI.⁹⁶ Neuropsychological assessment is especially important in distinguishing the unique patterns of impairments that older adults exhibit after TBI.^{97,98}

EPILEPSY

Literature search showed >1680 peer-reviewed studies on neuropsychological function and epilepsy. Neuropsychological assessment is well established as a critical variable in the evaluation and treatment of epilepsy, particularly refractory epilepsy when surgery is being considered.

As noted earlier, fMRI cannot quantify the higher cortical functions that help track disease progression. Neuropsychological assessment is the only tool that can map the locations of cognitive functions to inform surgical decisions,^{99,100–102} predict postsurgical cognitive and functional outcomes,^{103,104} measure postsurgical cognitive function,^{105,106} track medication regimens by measuring the impact of antiepileptic medications on cognitive function,^{107,108} and integrate all these components into a program for cognitive remediation.

PARKINSON DISEASE

Literature search showed >1400 peer-reviewed studies on neuropsychological function and Parkinson disease. Neuropsychological assessment uniquely enhances treatment planning for patients with Parkinson disease by measuring cognitive strengths and weaknesses,¹⁰⁹ predicting outcome after surgery,^{110–112} measuring postsurgical cognitive outcomes,^{113,114} and informing the use of medications and prognosis by differentiating among different syndromes that cause parkinsonian symptoms but are not necessarily consistent with Parkinson disease (eg, Lewy body dementia, Parkinson-plus syndromes).

OTHER CENTRAL NERVOUS SYSTEM DISORDERS

There is a strong scientific basis for the use of neuropsychological assessment to detect cognitive impairment and guide treatment planning in other central nervous system disorders such as multiple sclerosis, Huntington disease, hydrocephalus, amyotrophic lateral sclerosis, brain tumors, and intracranial aneurysms. Neuropsychological assessment guides treatment planning by detecting subtle cognitive deficits that emerge before motor symptoms in Huntington disease,¹¹⁵ measuring postsurgical cognitive function in hydrocephalus,¹¹⁶ assessing cognitive impairment after encephalitis,¹¹⁷ and, for multiple sclerosis, helping with identification¹¹⁸ and predicting functional outcome.¹¹⁹ Neuropsychological assessment also helps in predicting function and designing interventions for individuals with mental retardation and other intellectual disabilities,¹²⁰ measuring the cognitive effects of surgical treatment in individuals with glioma¹²¹ or intracranial aneurysms,¹²² and providing prognostic information in amyotrophic lateral sclerosis.¹²³

NONCENTRAL NERVOUS SYSTEM MEDICAL CONDITIONS

Because cognitive dysfunction from a variety of medical conditions is increasingly an issue in the elderly, but is still poorly recognized, especially in primary care, neuropsychological evaluation is critical to management.^{124–128} There is a strong scientific basis for the use of neuropsychological assessment to detect cognitive impairment and guide treatment planning in many noncentral nervous system conditions, including acute respiratory distress syndrome, cancer, chronic kidney disease, chronic obstructive pulmonary disease, cardiac disorders, hypertension, obesity (for bariatric surgical candidates), obstructive sleep apnea, and type II diabetes.¹²⁹ For example, literature search showed >300 peer-reviewed studies on neuropsychological function in cardiac compromise. Neuropsychological assessment is used to inform treatment planning in cardiac disorders by quantifying cognitive impairment in patients with myocardial infarction,¹³⁰ a low ventricular ejection fraction,¹³¹ heart failure,^{132,133} cardiovascular disease,^{127,128} moyamoya,¹³⁴ and a low cardiac index,¹³⁵ and to predict functional capacity in cardiovascular disease¹³⁶ and heart failure.¹³⁷ In patients with sickle cell disease or vasculopathies, brain function can be impaired because of hypoperfusion, anemia, ischemia, or infarct.^{138,139} Neuropsychological assessment sensitively detects the presence, nature, and severity of brain dysfunction in these conditions, and helps guide clinical management (eg, the introduction of new medications or procedures such as chronic transfusion in patients with sickle cell disease). Neuropsychological assessment results also guide recommendations for and implementation of rehabilitation strategies such as speech therapy or training in activities of daily living when functional disabilities interfere with independent living or work productivity.^{137,140}

Neuropsychological assessment also helps treatment planning by quantifying cognitive compromise in pulmonary disease^{141,142} and hepatic encephalopathy,¹⁴³ classifying disease progression in lupus,¹⁴⁴ predicting functional level in human immunodeficiency virus,^{145,146} and predicting medication adherence and functional abilities following kidney transplant.¹⁴⁷ Neuropsychological assessment provides a sensitive measure of cognitive impairment in individuals with glucose abnormalities that are subthreshold for type II diabetes¹⁴⁸ and for individuals with overt diabetes,¹⁴⁹ and predicts functional limitations in diabetes.¹⁵⁰ Neuropsychological assessment is also of general use in measuring postoperative cognitive dysfunction.^{151,152}

PSYCHIATRIC DISORDERS

Neuropsychological deficits are a cardinal symptom in many so-called “functional” disorders, such as schizophrenia, bipolar disorder, and depression, and are often a direct result of brain changes related to these disorders. The nature and severity of neuropsychological dysfunction (eg, impaired reasoning or communication, lack of insight,

distractibility and impulsivity, problems with memory or planning) vary among individuals with major psychiatric disorders. Many patients are referred for neuropsychological assessment to evaluate the nature and severity of cognitive dysfunction, especially as this information relates to medical decision making and independent living. Clinical management is often guided by information about neuropsychological status, regardless of an individual's legally defined "competence." Neuropsychological assessment also predicts function for individuals with psychiatric disorders such as schizophrenia,^{153,154} bipolar disorder,^{155–157} and depression.¹⁵⁸

LEGAL PERSPECTIVES

In addition to the empirical support for neuropsychological evaluation of patients presenting with known or suspected neurological impairment, courts have long recognized the medically necessary contribution of neuropsychologists to essential medical care (*Simmons v. Mullen*¹⁵⁹). The medical profession reasonably relies upon neuropsychologists' diagnostic formulations and treatment plans, and courts have gradually adopted that trend by increasingly recognizing neuropsychologists' expertise. For example, Kaufmann¹⁶⁰ noted a 6% average rate of annual growth in Lexis cases referencing neuropsychology from 2005 to 2009, and an unprecedented 20% increase in 2010.

SUMMARY

Neuropsychological assessment is a valuable clinical tool that provides unique information about diagnosis, prognosis, and clinical management for nearly all neurocognitive and psychiatric disorders as well as many medical conditions. Incorporating neuropsychological assessment into the clinical care of individuals with cognitive dysfunction can help to identify cognitive, emotional, and functional variables that cannot be determined with other tools, and can contribute to enhanced clinical management and outcomes.

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