

A Primer in Neuropsychological Assessment for Dementia

Neuropsychological assessments can be extremely useful in the detection, diagnosis, and management of dementia syndromes.

By Katya Rascovsky, PhD

Neuropsychological assessments are designed to identify the extent and severity of a patient's cognitive and behavioral impairments. They allow us to determine a pattern of relative cognitive strengths and weaknesses, which indirectly yields information about the structural and functional integrity of a patient's brain. Neuropsychologists use standardized tests to evaluate cognitive abilities such as attention, memory, language, processing speed, visuospatial, and executive functions.¹ These types of comprehensive assessments are time-consuming and not always feasible or necessary in routine clinical practice. For neurologists, brief cognitive screening tasks can provide a quick estimate of a patient's cognitive function and identify those who would benefit from a more detailed cognitive evaluation.

Commonly used cognitive screening tools include the Mini-Mental Status Examination (MMSE)² and the Montreal Cognitive Assessment (MoCA).³ The MMSE is heavily weighed towards orientation and memory, and, as such, may be insensitive to cognitive deficits encountered in non-Alzheimer's disease dementias. The MoCA evaluates a broader range of cognitive abilities, thereby providing higher sensitivity to detect mild cognitive impairment.⁴ Slightly longer and more comprehensive screening tools such as the Addenbrooke's Cognitive Examination,⁵ Dementia Rating Scale,⁶ and the Philadelphia Brief Assessment of Cognition⁷ can be particularly helpful in differential diagnosis given their inclusion of additional cognitive and behavioral domains.

Despite the utility of general cognitive screening instruments, these may not be adequate for all patients. In fact, common cognitive screening tools may have poor sensitivity in highly educated individuals, or classify healthy subjects as impaired given their low educational attainment, primary

language, or cultural background. Referral to a neuropsychologist is warranted in the following cases:

- There is a clear discrepancy between cognitive screening scores and patient or caregiver reports of actual cognitive functioning;
- The patient is younger than 65 years of age;
- The patient presents with a focal impairment that may not be adequately captured by general screening instruments (e.g., visuospatial abilities, behavior);
- The clinician suspects mild cognitive impairment (MCI) and would benefit from a detailed baseline assessment to track longitudinal progression.

This article provides an introduction to formal neuropsychological assessments and their potential uses in the detection and management of dementia syndromes.

BEST USES FOR NEUROPSYCHOLOGICAL EVALUATIONS

Neuropsychological evaluations can be used to address or clarify a wide range of issues related to dementia. These include:

- *Differential diagnosis:* A patient's cognitive profile can help differentiate normal aging from MCI, neurodegenerative disorders from reversible causes of cognitive complaints (e.g. depression), and can aid in the differential diagnosis of dementia due to different etiologies (e.g. Alzheimer's disease (AD) versus Frontotemporal dementia (FTD)).^{8,9}
- *Longitudinal progression:* Cognitive assessments can provide a baseline to track progression of disease or to document the effects of medications or behavioral interventions.
- *Prediction of conversion to dementia:* Impairments in

NEUROPSYCHOLOGICAL ASSESSMENTS: QUALIFICATIONS AND CONSIDERATIONS

Neuropsychologists use standardized tests to assess various cognitive abilities. Scores on individual tests are interpreted by comparing the patient's score to appropriate "norms," that is, a normative sample of healthy individuals with a similar demographic background (i.e., age, education, gender). Scores are also interpreted in the context of a patient's premorbid abilities and expected level of functioning.¹ Therefore, accurate neuropsychological interpretation requires a careful clinical evaluation and the use of adequate tests and norms.

Neuropsychological assessments aim to probe independent cognitive domains thought to be subserved by distinct neuroanatomical structures. In practice, most cognitive tasks are not "pure," and rely on a combination of cognitive processes and distributed neural networks. When using neuropsychology in the differential diagnosis of dementia, it is important to keep several things in mind:

First, no single neuropsychological test can differentiate between dementia groups.⁴⁵ Rather, clinicians must look at the overall cognitive profile. For instance, a neuropsychological profile of executive deficits in the context of relatively preserved memory and visuospatial functions discriminates between autopsy-confirmed FTD and AD,²³ while disproportionate visuospatial deficits in the context of relatively preserved recognition memory may differentiate between AD and DLB.²²

Second, when using cognitive performance in differential diagnosis, clinicians should be mindful of both pattern and chronology of deficits. For example, patients presenting with severe visuospatial deficits may warrant a diagnosis of PCA, but such deficits would be expected in advanced stages of most neurodegenerative syndromes.

Finally, the ability to detect differences between dementia groups may be enhanced or attenuated by the particular choice of neuropsychological tests. For example, given that frontal lobe dysfunction can confound testing results in other cognitive domains, care must be taken to choose neuropsychological tests that minimize executive demands.

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neuropsychological tests can be predictive biomarkers of progression to AD and other dementias.^{10,11}

- **Function:** A thorough cognitive and functional assessment can reveal areas of daily functioning where the patient may need assistance (e.g., remembering appointments, medications, etc.).¹² These results can guide intervention strategies to ameliorate cognitive deficits and maximize independence (e.g., referral to speech therapy,

use of day planners, assistive technologies).

- **Competence:** Performance on neuropsychological tests can aid clinicians and families determine a patient's competence in areas such as driving, medical, financial and legal decision-making.
- **Research:** Quantifying behavior and cognition allows us to correlate patient scores to structural and functional images of the brain, thereby providing insights into the brain networks involved in particular functions. Cognitive tests are also used as sensitive outcome measures in clinical trials for disease modifying agents.

FORMAL NEUROPSYCHOLOGICAL ASSESSMENTS

A formal neuropsychological assessment for dementia will usually evaluate the following domains:

Attention and Processing Speed. Attention and concentration are necessary for adequate performance on any cognitive task. Formal tests of attention and working memory include digit span forwards and backwards (WMS-IV Digit Span¹³) and tests of vigilance and sustained attention.¹⁴ Fluctuating attention is characteristic of Dementia with Lewy Bodies (DLB), but this variation may be hard to capture in a single testing session. Processing speed is often measured by timed tasks such as the Trail Making Test - A¹⁵ and WAIS-IV Symbol Search Test.¹⁶ Disruption of fronto-subcortical circuits can result in slowed processing speed in Parkinson's disease,¹⁷ Progressive Supranuclear Palsy,¹⁸ and patients with small-vessel vascular disease.¹⁹

Memory. Identifying distinct profiles of memory breakdown can be very helpful in differential diagnosis. Memory is formally divided into declarative / explicit (i.e., conscious recollection of facts and information) or non-declarative / implicit (memory for skills and procedures). Episodic memory is further divided into episodic memory (e.g., what you had for dinner last night) and semantic memory (e.g., what is a barometer).

Common memory tests evaluate different components of episodic memory. These include:

- **Encoding:** Ability to consolidate new information
- **Retention:** Ability to retain this information over time
- **Retrieval:** Ability to recall information after a delay or interference

Retrieval can be assessed using free recall (no assistance), cued recall (e.g., semantic cues) or a recognition format (discrimination of targets from distractors). There are several ways to probe episodic memory including word list learning tasks (e.g., California Verbal Learning Test,²⁰ Free and Cued Selective Reminding Test²¹), recall of stories (e.g., WMS-IV Logical Memory¹³), Verbal Paired Associates¹³ and recall of complex geometric figures (see next page).

Episodic memory impairment is the earliest and most prominent feature of AD, and heralds progression of disease

in patients with amnesic MCI.⁹⁻¹¹ This pattern of performance is characterized by impaired encoding, recall and recognition, and is associated with the early hippocampal pathology typical of AD.²² Memory is often impaired in fronto-subcortical dementias but performance follows a pattern of poor retrieval with significant improvement in cued recall and recognition.²² A relative sparing of episodic memory in bvFTD has been demonstrated in both verbal and visuospatial modalities, and can be of use in differential diagnosis.²³⁻²⁵

Visuospatial and constructional abilities. Visuospatial tasks assess visual perception and interpretation of simple and complex visual stimuli (e.g., Visual Object and Space Perception Battery,²⁶ Judgment of Line orientation²⁷). Constructional abilities can be evaluated by asking the patient to copy simple line drawings, assemble blocks or copy complex geometrical figures (e.g., Rey Osterrieth Figure Copy,¹ WAIS-IV Block Design,¹⁶ Benson Figure²⁸). Visuospatial functions are differentially affected in neurodegenerative syndromes. For example DLB patients may exhibit a disproportionate impairment in visuospatial / constructional abilities in the context of relatively spared memory recognition.²² Severe impairments in visual perception may point to a diagnosis of Posterior Cortical Atrophy (PCA), while significant apraxia and constructional deficits may be associated with Corticobasal Degeneration (CBD).²⁹

Language. Neuropsychological assessments can offer detailed language profiles that can be used for diagnosis and adequate behavioral interventions. Neuropsychological testing routinely evaluates spontaneous speech (e.g., BDAE Cookie Theft Scene³⁰), confrontation naming (e.g., Boston Naming Test,³¹ Multilingual Naming Test³²), semantic knowledge (e.g., Pyramids and Palm Trees Test³³), grammar (e.g., forced-choice sentence picture matching task,³⁴ Northwestern Anagram Test³⁵), reading of regular and irregular words, and repetition of words and sentences.

Language profiles can be extremely helpful in differential diagnosis, particularly when Primary Progressive Aphasia (PPA) is suspected.³⁶ Patients with non-fluent/agrammatic PPA (naPPA) present with non-fluent speech and agrammatism in the context of spared single-word comprehension and object knowledge. In contrast, patients with Semantic Variant PPA (svPPA) present with fluent, empty speech, prominent anomia, and difficulty understanding the meaning of words. Although generally associated with underlying AD pathology, the logopenic variant of PPA (lvPPA) is often confused with the non-fluent and semantic PPA variants commonly linked to frontotemporal degeneration. Patients with lvPPA show profound anomia and deficits in sentence repetition in the context of spared motor speech, grammar, single-word comprehension and object knowledge.

Executive functions. Executive functioning is an overarching

term that encompasses a wide range of abilities traditionally linked to the integrity of the frontal lobes. Assessment of executive functions often includes word generation tasks (e.g., Controlled Oral Word Association Test¹), planning (e.g., D-KEFS Tower Test³⁷) inhibition (Stroop and Hayling Tests¹), abstraction (Wisconsin Card Sorting Test³⁸) and mental flexibility (Trail Making Test - B¹⁵).

Executive impairments are typical of bvFTD and are common in syndromes with prominent fronto-subcortical dysfunction such as Progressive Supranuclear Palsy, Parkinson's disease, and vascular dementia.⁹ The presence of dysexecutive errors such as concrete thought, perseverations, rule-violations and poor organization may be particularly useful in the differential diagnosis of behavioral variant Frontotemporal dementia (bvFTD).^{25,39}

Mood and Behavior. Subjective self-report scales can be used to measure a patient's level of depression and anxiety (e.g., Geriatric Depression Scale⁴⁰). Many clinicians rely on informant-based behavioral scales to assess behavioral disturbances in dementia, due to the lack of introspection characteristic of certain etiologies. These scales assess symptoms such as hallucinations, delusions, disinhibition, apathy and agitation. Common behavioral scales include the Neuropsychiatric Inventory,⁴¹ Frontal Behavioral Inventory,⁴² and the Cambridge Behavioral Inventory.^{43,44}

CONCLUSION

Neuropsychological assessments can be extremely useful in the detection, diagnosis, and management of dementia syndromes. A patient's cognitive profile can help differentiate normal aging from MCI and can aid in the differential diagnosis of dementia due to different etiologies. Cognitive assessments can also provide a baseline to track progression of disease or to document the effects of medications or behavioral interventions. Finally, performance on neuropsychological tests can reveal areas of daily functioning where the patient may need assistance, thus guiding intervention strategies to ameliorate cognitive deficits and maximize independence. ■

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