Neuropsychological assessment offers a rigorous method of identifying the presence, extent and severity of cognitive impairments. Brief observation and informal interaction can yield valuable information about a patient’s condition, but this level of assessment does not usually provide a sufficient foundation for evaluating the degree or extent of cognitive difficulties, and may mean that subtle or mild difficulties are missed. Therefore, a more systematic approach to assessing patients’ cognitive functioning is often needed. Neuropsychological assessment achieves this aim through the use of standardized tests.

THE USE OF STANDARDIZED TESTS

Standardized tests assess aspects of current functioning in a systematic way, providing results that can be compared with normative data. They are developed with the aim of maximizing reliability and validity; that is, they should provide a consistent measure of the construct of interest. Standardized tests are always administered in the same way, following administration procedures set out in the test manual. Thus, the instructions given to each person taking the test, and all the parameters of the test such as the length of time for which stimuli are presented, are identical. These conditions are exactly the same as those used to obtain data from the reference group or normative sample against which the individual’s test scores will be compared, ensuring a valid comparison. Norms typically take into account the effects of age, providing stratified norms for different age groups, and adjustment may be made for other demographic factors that affect test performance, such as level of education. It follows that familiarity with the test procedures is essential in order to administer the test appropriately. Similarly, familiarity with the scientific basis and technical properties of the test, as well as the ability to consider the complex range of factors that may impact on test performance, is necessary for accurate interpretation of test results. For this reason, use of many standardized tests is restricted to those professionals who can demonstrate either by virtue of their professional education or as a result of further training that they are specifically trained in test administration and interpretation.

Neuropsychological assessment of older people combines two traditions of standardized testing: psychometric testing and clinical neuropsychological assessment. These two approaches have been described as population-based and deficit-oriented, respectively. In practice, the two approaches are typically used alongside one another, with an emphasis on considering patterns of scores across a range of tasks.

Psychometric testing assumes that the ability or factor being tested is normally distributed in the general population, and seeks to establish how the individual’s scores relate to those found in a representative sample of that population; for example, whether scores are close to the average for the reference group, or whether they are exceptionally high or low, and thus unusual. The classic example of this would be the measurement of IQ. Standardized tests of this kind typically include items across the range of difficulty, such that there will be some easy items that just about everyone should be able to do and some very challenging items that hardly anyone will be able to answer. Some tests identify different starting and finishing points for different age groups so that a range of items of appropriate levels of difficulty is administered, and some tests have rules specifying that the task should be discontinued in the event of incorrect answers being given on a specified number of items, on the basis that further, more difficult items would not be expected to be answered correctly. Therefore, these tests are suitable for individuals across the ability range and provide a challenging test for even those individuals with the highest levels of ability.

Clinical neuropsychological assessment sets out to determine whether there is evidence of impairment in a particular ability, such that the individual’s scores are different to what they would have been if illness or injury had not intervened. This may be determined by comparing performance on abilities thought to be affected by the illness or injury with performance in areas thought to remain intact, or may be inferred from a comparison of the individual’s scores with scores obtained by a normative sample, taking into account what would be expected on the basis of the individual’s background. In the latter case, normative data will typically have been used to identify a cut-off score, signifying that scores more extreme than this value are unlikely to occur within the normal range. Standardized tests based on this approach rest on the assumption that the normal population will generally perform well and that poor scores are indicative of neurological abnormality.

Scores on standardized tests may be expressed in a number of ways. Most frequently, raw scores are typically converted to either a standard score or percentile rank, allowing comparison across sub-tests and against norms. The standard scores corresponding to given raw scores on a test are calculated on the basis of normative data collected from a large sample, taking into account the distribution of scores in the sample and the mean level of achievement. Where age is likely to affect performance, the standard scores derived from the raw scores are compared to norms for the relevant age group. The
use of percentile ranks serves a similar purpose, indicating whether a score is in the average range or is very infrequent and therefore unusual. Standard scores provide a consistent scale with a defined mean and standard deviation; for example, in the Wechsler Scale of Adult Intelligence (WAIS-III)\(^3\), a scale with a mean of 100 and a standard deviation of 15 is used. Subtest scores are converted to this scale and overall scores are calculated on the same scale. Scores that are two standard deviations above or below the mean are generally considered exceptional, in that they arise very rarely. Scores of 70 (two standard deviations below the mean of 100) or below occur in approximately 5% or fewer of the population. Some tests use a mean of 10 and a standard deviation of 3; in this case, scores of 5 or below occur only in 5% or fewer of the population.

With tests that use population-based norms, the fact that a score is unusual does not in itself indicate that there is an impairment. The observed score may simply reflect the individual’s long-standing ability level; the individual may be one of the 5% of the population who score very poorly on the task. Therefore, information about the expected level of performance is needed in order to interpret the results. If the individual’s performance is widely discrepant from what would be expected for that individual, this suggests there may be a difficulty or impairment resulting from illness or injury. In practice, expectations about likely performance are usually based on consideration of a number of factors such as the individual’s educational and occupational background and level of achievement. For a very high-achieving individual, a score that is in the low average range may reflect a significant decline from previous, superior performance levels. However, in some cases, tests are available that can provide an estimate of expected performance levels. For example, in the English language, the ability to read irregularly-spelled words can be tested with the Wechsler Test of Adult Reading (WTAR)\(^4\) or the National Adult Reading Test (NART)\(^5\). Since this is considered a ‘crystallized’ ability, and fairly resistant to many forms of brain injury as well as the very early signs of dementia, scores on this task can be converted to obtain a predicted score on the WAIS-III\(^3\). If comparing this predicted score with the observed score yields a significant discrepancy, with the observed score lower than the predicted score, this is suggestive of a decline in overall intellectual functioning. Similarly, a comparison might be made between the WAIS IQ score and the Wechsler Memory Scale (WMS-III)\(^6\) score; normative data are available to indicate whether or not a discrepancy in scores is large enough, and unusual enough, to be considered a significant indicator of an impairment in memory relative to what would be expected on the basis of the IQ score.

With deficit-oriented tests, a score that would be unusual in the reference group is generally considered to provide an indication of impairment, given that the poor score cannot be explained by other, contextual factors. The 5th percentile often provides in effect a cut-off for identifying impairment. Scores at or below the 5th percentile in the normal population may be defined as falling into the impaired range. An example of a test using this approach is the Visual Object Perception Battery\(^7\). For tests using standard scores, as noted above, a score at or below the 5th percentile approximately translates into a score of 70 or below (on the scale with a mean of 100 and standard deviation of 15) or a score of 5 or below (on the scale with a mean of 10 and standard deviation of 3). Some tests use their own classifications, indicating whether a particular score is ‘impaired’, ‘poor’, or ‘normal’. An example of a test using this approach is the Rivermead Behavioural Memory Test\(^8\). Some tests reflect tasks that should be achievable by anyone with normal functioning and thus the presence of errors in itself reflects likely impairments; for example, the Behavioural Inattention Test\(^9\) identifies scores as impaired if they are below those of the lowest performing normal controls.

 Provision of appropriate test norms is not straightforward, and this is especially the case with older age-groups (for a fuller discussion of this issue, see Busch et al\(^2\)). Where tests were initially developed for younger adults, norms for older people may be unavailable, or may relate to a restricted age range. They may be based on more limited sample sizes than those for younger age groups, or may have drawn upon a non-representative sample containing only those highly motivated to assist with research. Some measures have only one set of norms available, while other frequently used measures offer numerous sets of norms among which the clinician can select those that are most appropriate for the patient and for the questions being addressed in the assessment. Details of many of these can be found in the compendium compiled by Strauss et al\(^10\). Cultural differences may mean that the available norms are not directly appropriate for the individual; for example, an individual who has grown up in a developing country and immigrated to the United Kingdom or United States as an adult will have had different formative and educational experiences from the indigenous population, and thus norms based on a United Kingdom or United States indigenous population may be inappropriate. This in itself does not necessarily preclude the use of the test, but the lack of appropriate norms will place constraints on the interpretation of results. Availability of neuropsychological tests in languages other than English is limited, and use of interpreters during testing is unsatisfactory, especially where these are family members. Translation of tests is a highly skilled and complex task and cultural, as well as linguistic, equivalence must be established. For a fuller discussion of cultural issues in assessment, see the review by Manly\(^11\).

Comparison with test norms provides an indication of the degree to which the observed score would be infrequent or unusual in a healthy population of the same age. In some cases, this is sufficient to clarify the presence of an impairment in a particular area. However, as noted above, the situation is not always clear-cut. Furthermore, individual test scores elicited on a given occasion may be affected by a range of factors. Some of these relate to the individual, for example low mood, anxiety about being tested, physical health problems, pain, drug effects or fatigue. Some relate to the testing environment, for example uncomfortable seating, inadequate lighting or high levels of noise. Other factors relate to the tests used, for example the extent to which they require dexterity or mobility, whether stimuli are in large enough print to be easily visible, and so forth. The extent to which the assessor is able to build rapport with the individual, and respond to any emotional reactions to the assessment, may influence motivation and willingness to engage. Therefore, individual scores must be interpreted in the context of the overall situation. The neuropsychologist’s observations of the individual during testing, and comments on the testing situation, will form an important part of the picture when drawing conclusions based on the test results.

The neuropsychological assessment provides a profile of the individual’s strengths and difficulties. This profile may be used to contribute to problem identification or diagnosis, to inform decisions about treatment or management, or to monitor change over time. In so doing, information from the neuropsychological assessment must be considered alongside information obtained from other sources\(^12\). The pattern of scores on neuropsychological tests is only one part of the picture, and needs to be considered alongside the medical history.
AIMS AND SCOPE OF NEUROPSYCHOLOGICAL ASSESSMENT

Usually a neuropsychological assessment will be indicated where information about the cognitive profile will assist in answering a specific question or set of questions. Perhaps the most common situation is the need to distinguish between normal ageing, mild cognitive impairment and the early stages of dementia, or to identify whether cognitive difficulties are the result of depression or mental health issues or an indication of early-stage dementia, or to distinguish between different subtypes of dementia or help identify the precise nature of the progressive neurological condition involved (see also Chapters 42 and 62). An assessment might be required in order to identify the presence and nature of cognitive difficulties following a stroke or in the context of other conditions such as Parkinson’s disease. In some cases, information from the neuropsychological assessment may be needed to contribute to decisions about ability to continue driving or about the extent to which the individual has capacity to make specific decisions and choices regarding, for example, medical treatment, financial affairs, or where to live.

When conducting neuropsychological assessment with older people, it is important to have a sound knowledge of the profile of cognitive changes arising as a part of normal ageing, including the underlying neuroanatomy, as well as the diagnostic profiles of the range of relevant neurological and psychiatric disorders and their behavioural presentation in older people, and an understanding of the potential impact on cognition of neurological injury (for a fuller discussion of these issues, see by Potter and Attix16). Special considerations arise with regard to particular groups of older people, such as those with lifelong intellectual disability or those with long-term mental illness, where the availability of suitable tests may be limited and change may be especially difficult to detect (e.g.17). It is also necessary to be aware of the way in which neuropsychological factors relate to abilities such as driving or to definitions of capacity (for a fuller discussion, see pp. 175–87 in Zarit and Zarit1).

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While we typically think of cognitive functions as somewhat discrete entities, such as memory, attention or language, in practice these functions are closely interrelated. Changes in one may be mistaken for problems with another; for example an impairment in attention may mean that information is not encoded, giving the appearance of a problem with memory. Furthermore, if the assessment is contributing to a diagnostic process, sampling just one cognitive function will be inadequate; for example, a diagnosis of Alzheimer’s disease requires impairment in memory and at least one other cognitive domain. In most cases, it will be necessary to sample a broad range of cognitive functions. Generally it is the pattern of results across domains that is most informative.

The questions that will be asked are first whether there is an overall decline in cognitive functioning; second whether there are impairments in specific domains and processes; and third, if the answer to either of these is affirmative, whether there are any factors other than neurological impairment that could account for the poor performance. Where neurological impairments are identified, this leads to the questions of what the pattern of impairments suggests, what are the implications for the individual’s daily life, and for the family where appropriate; and whether intervention is indicated. If there are factors other than neurological impairment that may be affecting performance, such as depression, then these may be treated prior to reassessment. It is also worth noting that some patients may not show any objective impairment, and in such cases it is necessary to consider the reasons for the expressed concern and how best to respond.

In gathering the necessary information, various approaches can be taken. An extensive standard battery of tests can be applied to every individual, or tests can be selected on an individual basis for each new patient. Most commonly, clinicians use a combination of these two methods. A comprehensive selection of tests that covers the essential cognitive functions and is likely to help in answering the most important kinds of questions can be supplemented by the selection of particular tests that are appropriate for the particular questions raised by the individual patient’s profile and that make it possible to follow up on particular hypotheses that the clinician may have developed based on the initial test responses. For example, if initial testing suggest an impairment in language, attention or executive function, further tests can be selected to provide a more detailed profile. It is important to tailor the selection of tests to the level of functioning of the individual patient and the aims of the assessment. Thus, an assessment aimed at identifying very subtle difficulties that might constitute the earliest signs of dementia in a 65 year old would require a challenging and extensive set of tasks, while it would be more appropriate to test a patient who showed more obvious signs of impairment, or who was very frail, with a briefer neuropsychological screening battery, perhaps supplemented by one or two brief tasks.

A comprehensive assessment will usually include an evaluation of general intellectual functioning (IQ). The most widely used test for
this purpose is the WAIS-III\(^3\). This includes seven tests of verbal ability (e.g., vocabulary, comprehension, digit span) and seven tests of performance ability (e.g., block design, picture arrangement, matrix reasoning). The full test is lengthy to administer but an overall score can be obtained by administering selected sub-tests or by using the Wechsler Abbreviated Scale of Adult Intelligence\(^18\). Alongside this, a test that predicts lifelong optimal level of intellectual functioning, such as the WTAR\(^4\), is usually administered. As discussed above, a significant discrepancy between predicted and current IQ would indicate a decline in current functioning. Several specific cognitive domains will also be assessed, typically visuo-spatial perception, language, attention, executive function (the capacity for abstract thinking, planning, problem-solving and inhibition), and memory. For a full discussion of these areas and of the tests that can be used to assess them, see books by Lezak \textit{et al.}\(^19\) and Strauss \textit{et al.}\(^10\).

Memory assessment will usually cover both long-term memory, comprising episodic memory (memory for personally experienced events) and semantic memory (memory for factual information) and working memory. It may also cover prospective memory (ability to remember future intentions) and autobiographical memory. As well as these types of memory, assessment should consider the processes that constitute memory and learning: registration and encoding of information, storage of information and recall of information. Memory should be tested in various ways including recognition, immediate recall and delayed recall, and in various modalities including visual and verbal. Where there has been a discrete injury or insult, such as a closed head injury or stroke, it is useful to consider whether memory difficulties relate to information acquired before the injury (retrograde) or since the injury (anterograde). One of the most widely used memory assessments is the WMS-III\(^6\), which includes 11 subtests providing scores for general memory, working memory, immediate memory, auditory immediate memory, visual immediate memory, auditory delayed memory, auditory reception delayed and visual delayed memory. As with the WAIS-III\(^3\), the WMS-III is a lengthy test and in some cases it may be appropriate to use only a selection of subtests. Many other tests are available to assess specific aspects of memory, for example the Rey-Osterrieth Auditory Verbal Learning Test (RAVLT)\(^10\) or California Verbal Learning Test (CVLT-II)\(^20\). The Rivermead Behavioural Memory Test\(^8\) focuses on everyday uses of memory, testing memory through the kinds of activities that require memory skills in daily life.

Visual perception can be assessed with subtests from the Visual Object and Space Perception Battery\(^7\), with figure drawing using the Rey-Osterrieth Complex Figure Test\(^10\), or with the clock drawing test\(^10\). Language is often assessed through tests of naming such as the Boston Naming Test\(^21\) or Graded Naming Test\(^22\). Attention can be assessed with subtests from the Test of Everyday Attention, and executive function with subtests from the Delis-Kaplan Executive Function System (D-KEFS)\(^23\), which include trail-making and verbal fluency.

As noted above, neuropsychological screening batteries can be employed where patients have obvious impairments or are unable to complete a full assessment. An example of the latter is the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)\(^24\). This includes 12 subtests, providing scores in five categories: immediate memory, delayed memory, attention, language and visuo-spatial/constructional ability. The availability of parallel versions of equivalent difficulty is an advantage where repeated testing is indicated. For people with very marked impairments, the Severe Impairment Battery\(^25\) assesses various aspects of cognition using a range of simple tasks.

### THE PROCESS OF NEUROPSYCHOLOGICAL ASSESSMENT

The process of conducting a neuropsychological assessment will be influenced by whether the neuropsychologist works as part of a multidisciplinary team or receives referrals as an individual professional. If working as part of a team, information about medical history and factors such as mental state and mood may be available from the psychiatric examination. These areas may therefore require less extensive evaluation as part of the neuropsychological assessment, although some investigation will still usually be made, and standard questionnaires such as the Hospital Anxiety and Depression Scale\(^26\) or Geriatric Depression Scale\(^27\) (see Chapter 29) may be used. The advantage of teamwork lies in drawing together the results of the neuropsychological assessment with the findings from other aspects of the assessment, including for example functional assessments conducted by an occupational therapist.

In planning a neuropsychological assessment, the first consideration will be to ensure that sufficient time is available. A comprehensive assessment may require several hours’ contact with the patient and may need to be conducted over more than one visit. Even a brief assessment using a neuropsychological screening battery may take 1.5–2 hours. The neuropsychologist will require sufficient information to select an appropriate set of tests. It is particularly important for the neuropsychologist to be made aware of any factors that would influence the selection of tests, including illiteracy, sensory impairment, restricted mobility and likelihood of fatigue. It is essential that patients are asked to bring with them reading glasses and hearing aids if they use these. Cultural factors should also be considered. In particular, if English is not the patient’s first language, this will place constraints on the assessment. Even if the patient speaks very good English, comparison with norms derived from native speakers is unlikely to be appropriate.

On meeting the patient, the neuropsychologist will be concerned to establish a good rapport and ensure that the patient fully understands the nature and aims of the assessment process. At this stage informal discussion can help to elicit the patient’s views about his or her difficulties, about the assessment and about the reasons for attending. If an informant is available, the neuropsychologist will want to talk with him or her individually as well as together with the patient. Patients are often anxious about being tested and worried about giving the wrong answers. It can be helpful to explain to them that the tests are designed to challenge everyone, so there is no expectation that anyone would get all the answers right, and the important thing is just to do the best they can. There is no doubt that patients, especially those in the older age groups, often find the neuropsychological assessment a strange process, but there is no need for it to be aversive if the neuropsychologist is able to develop a good rapport and show sufficient sensitivity. Throughout the assessment the neuropsychologist must be attentive to signs of fatigue and to expressions of frustration or distress. The former can be alleviated by suggesting a short break and offering refreshments, while the latter can be addressed by sequencing tasks so that tests which the patient finds difficult are followed by tasks that can be completed more easily. The neuropsychologist will also carefully observe the patient’s reactions and behaviour during the session in order to gain

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**References**

2. Strauss et al. (1994).
4. WTAR, Wechsler Test of Adult Reading.
7. VOSP, Visual Object and Space Perception Battery.
8. RBANS, Repeatable Battery for the Assessment of Neuropsychological Status.
9. CVLT-II, California Verbal Learning Test - II.
10. RAVLT.
11. CVLT-II.
13. RAET, Rey-Osterrieth Complex Figure Test.
15. RAVLT.
16. CVLT-II.
22. Graded Naming Test.
25. Severe Impairment Battery.
26. Hospital Anxiety and Depression Scale.
27. Geriatric Depression Scale.
an impression of the patient’s level of motivation and awareness, and identify any factors that may have affected performance.

Following the assessment, the neuropsychologist will calculate the patient’s scores on the various tests administered, a process which can be quite time-consuming, and will usually prepare a concise but comprehensive report detailing the results of the assessment. This will typically contain the following sections: background to the referral and any relevant history, and the reasons for the assessment; outline of the neuropsychologist’s observations of the patient’s behaviour and responses during testing; details of the tests administered; profile of results for each domain of cognitive functioning assessed; any additional data such as findings from questionnaires assessing mood; summary and recommendations. In the summary and recommendation section, the neuropsychologist will usually comment on the profile of results and what this implies; for example, he or she may comment that the profile is, or is not, consistent with a diagnosis of Alzheimer’s disease. This section will also contain any practical recommendations that the neuropsychologist is able to make regarding how to assist or support the patient and family, or improve management of the patient’s condition.

The neuropsychologist will generally aim to meet with the patient, and if appropriate the family as well, to provide feedback on the results of the assessment. Feedback should be tailored to the needs and concerns of the patient and family. In the team context this meeting may be jointly arranged with another professional such as the psychiatrist. In some cases it may be necessary to convey unwelcome news such as the diagnosis of dementia. Diagnostic disclosure should be ‘patient led’ and based on the individual situation. The process should be conducted sensitively and sufficient time should be allowed to ensure that discussion is not rushed and that the patient and family are able to ask questions. A single meeting may not be adequate and it may be advisable to arrange a follow-up discussion. Emphasis should be placed on linking the patient and family with appropriate support networks and on identifying any possible treatment approaches.

Finally, it is important to emphasize that the scope of the neuropsychological assessment is not restricted to assisting in reaching a diagnosis. Ideally, and perhaps particularly so in the case of older people, the knowledge gained about the patient’s strengths and difficulties in cognitive functioning as a result of the neuropsychological assessment will form a basis for offering information and advice about managing the patient’s condition or informing the development of a treatment plan based on principles of neuropsychological rehabilitation.

REFERENCES


