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**Anita Menon & Nicol Korner-Bitensky**

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# Evaluating Unilateral Spatial Neglect Post Stroke: Working Your Way Through the Maze of Assessment Choices

*Anita Menon and Nicol Korner-Bitensky*

This study identified, using a comprehensive review of the literature, 62 standardized and nonstandardized assessment tools that exist to evaluate unilateral spatial neglect (USN). Each standardized tool was critically appraised according to its purpose (hemispace assessed), psychometric properties, and client appropriateness. The findings on the 28 standardized tools were compiled into a USN Assessment Summary Guide to facilitate clinical decision-making regarding the standardized USN assessments that are appropriate for specific clients at different phases of their recovery post stroke. **Key words:** *assessment tools, evaluation, inattention, psychometric properties, reliability, stroke, unilateral spatial neglect, validity, visual neglect, visual perception*

Approximately 700,000 individuals experience a new or recurrent stroke each year, such that this disease has been identified as the leading cause of serious, long-term disability for adults in the United States.[1] Some patients recover completely post stroke, but approximately 15%–30% of patients are left with permanent functional impairments or disabilities, and 15%–20% require institutional care 3 months post onset.[2] Sequelae post stroke depend on the location of brain involvement and can have an impact on virtually all skills required for functional performance and participation in society. In addition to motor, sensory, and communicative deficits, patients may also experience cognitive and perceptual impairment.[3]

Unilateral spatial neglect (USN) is one of the disabling features of a stroke; it is defined as a failure to report, respond, or orient to stimuli presented to the side opposite a brain lesion.[4] Clinically, the presence of severe USN is apparent when a patient frequently collides into his/her surroundings, ignores food on one side of the plate, and attends to only one side of his/her body.[5] However as noted by several authors,[6,7] severe symptoms of USN are easily observed during basic functional activities of daily living, such as shaving, grooming, or dressing one side of the body. More subtle forms of USN may only appear during highly skilled activities, such that they often go undetected in a hospital setting but are a major concern for client function and safety upon return home to a more dynamic environment.

## What Is USN?

USN is a serious deficit post stroke; its symptoms are often complex and not immediately recognized by a clinician or client. The client is unable to attend to one side of his/her body (personal neglect), the space within reaching distance (near extrapersonal neglect), the space beyond reaching distance (far extrapersonal neglect), or to a combination of these three spaces in the environment.[8,9] Recent neuroimaging studies[10–15] and clinical trials using assessment tools specific to the three hemispaces[16–19] have revealed that separate neural mechanisms are involved in exploring each hemispace, which supports the importance of evaluating each of these spaces with the use of assessment tools. Many terms are used interchangeably in the literature to describe USN, including unilateral neglect, hemi-inattention, visual neglect, and hemispatial neglect.

## Why Is It Critical to Assess USN?

The presence of USN has been associated with

**_Anita Menon, MSc,_** *is a Research Coordinator, School of Physical and Occupational Therapy, McGill University, Montreal, Quebec.*

**_Nicol Korner-Bitensky, PhD,_** *is Associate Professor, School of Physical and Occupational Therapy, McGill University, Montreal, Quebec.*

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an increased risk for injury and with poor functional outcome. Ugur and colleagues studied 293 individuals admitted to a stroke unit and found that those with right hemisphere lesions were more likely to fall during their hospitalization compared to those with left hemisphere lesions (36.6% vs. 24.1%).[20] The authors suggested that the presence of USN might, in part, explain these findings. Kalra and collaborators explored the influence of USN on functional outcomes within a week post stroke by comparing 47 patients with neglect to a matched control group.[21] Both groups had moderate stroke severity as well as similar demographic characteristics, prestroke function, and poststroke motor strength in the affected arm and leg. Patients with neglect were found to have lower median functional scores on the Barthel Index,[22] a scale used to measure basic activities of daily living (ADLs), at both admission and discharge. When 27 individuals were assessed within a week after right hemisphere stroke and were followed over time, there was a positive correlation between recovery from USN, as measured by the Rivermead Behavioral Inattention Test,[23] and improved functional performance on the Barthel Index after 1 month.[24] Improvements in their ability to attend to the neglected hemispace carried over to gains in functional performance during ADLs. These individuals continued to show significant improvement in ADLs up to 3 months post stroke.[24]

The effects of USN extend beyond the basic skills for self-care (bathing, dressing, walking, etc.) to instrumental activities of daily living (IADLs) that are crucial for successful reintegration into community living. These complex activities include performing domestic chores, reading a menu, using a map, dialing a telephone, and ambulating outdoors. Jehkonen and collaborators assessed motor, sensory, and cognitive impairments in 57 patients within 10 days of a right hemisphere stroke. USN as assessed on the Rivermead Behavioral Inattention Test[23] was the strongest predictor of functional recovery at 1-year post stroke on the Frenchay Activities Index,[25] a measure of performance in IADLs. The presence of USN explained 73% of the total variance in IADLs at a 3-month follow-up, 64% at 6 months, and 61% at 1-year post stroke.[26]

### Who Should Be Assessed for USN?

It has long been assumed that perceptual deficits, including USN, are common in individuals with right hemisphere damage (RHD) and that routine screening for this deficit in those with RHD is time well spent. Positron emission tomographic (PET) scan analyses[27] and a systematic review of 17 studies[28] have substantiated the dominance of the left hemisphere in modulating arousal and attention for the right visual field, whereas the right hemisphere controls these processes in both right and left visual fields.[29] This is a plausible explanation for why USN is not typical in persons with left hemisphere damage (LHD); the intact right hemisphere is capable of compensating for perceptual deficits that result from LHD.[29] It also substantiates why individuals with RHD experience more severe and longer lasting symptoms of USN compared to those with LHD.[6,30–38] Persons with USN after LHD can compensate for their deficits with the intact right hemisphere, whereas such compensation does not exist after RHD. However, there is evidence that this finding may be an artifact resulting from a failure to identify USN in persons with LHD: when assessed with the Rivermead Perceptual Assessment Battery,[39] 47% of nonaphasic patients with LHD post stroke were identified as having USN.[40] Once those persons with language deficits were included in the sample, almost every dysphasic patient (97%) with LHD was screened positive for USN within 48 hours post stroke,[40] suggesting that the lack of assessment of those with aphasia may account, in part, for the low incidence of USN reported in those with LHD. In summary, USN continues to be commonly associated with a right stroke, but evidence from the literature suggests that all patients with stroke might benefit from screening.

Various standardized assessment tools (SATs) and nonstandardized assessment tools (NSATs) are available to assess USN at the impairment and activity level in each of the hemispaces. Clinical guidelines for stroke have recommended that it is "best practice" for acute care clinicians to screen for USN post stroke during a routine neurological examination using standardized assessment tools/scales in a more consistent and systematic manner.[41,42] Clinicians have the responsibility to quantitatively document their observations using assessment tools and stroke scales that can evaluate the impairments and disabilities related to USN as well as document any clinical change over time.

Given that persons with USN are at a greater risk for falls and poor functional outcome,[20] and given that recent clinical trials have substantiated the effectiveness of cognitive rehabilitation to improve visual attention and scanning on an impairment level,[43,44] timely and accurate assessment of USN is a critical component of best practice for persons with stroke. Therefore, the objectives of this study were to: (a) identify standardized and nonstandardized assessment tools that exist to assess unilateral spatial neglect; (b) critically appraise the standardized assessment tools according to their purpose, psychometric properties, and client appropriateness; and (c) create a *USN Assessment Summary Guide* for clinicians to facilitate decision-making regarding the standardized USN assessments that are appropriate for specific clients post stroke.

## Method

A comprehensive, systematic review of the medical literature was performed covering the period from 1966 to March 2003 using electronic databases (MEDLINE, CINAHL, HealthSTAR, PsychINFO, and Health and Psychosocial Instruments) to search for articles relating to USN assessment tools with the following key terms: neurology, stroke, CVA, cognition, visual-perceptual, visual-inattention, hemi-inattention, unilateral spatial neglect, unilateral neglect, spatial neglect, assessment, evaluation, measurement, screening tools, psychometric properties, neurological examination, psychometrics, reliability, validity, sensitivity. The Cochrane Library[45] was explored for systematic reviews using the same key terms. Reference sections of all journal articles retrieved were reviewed in search of other pertinent articles. All major authors working in the area of USN were also searched according to their citation indexes using the ISI Web of Science[46] database to verify that all publications relevant to the assessment of USN were obtained. Textbooks that pertained to USN were also included in this review. The tools were compiled in a list, categorized as either standardized or nonstandardized, and identified according to the specific hemispace assessed (personal space, near extrapersonal space, and far extrapersonal space). An assessment tool was considered *standardized* (SAT) if it had published procedures for administration, scoring, and interpretation and evidence of reliability or validity to evaluate USN post stroke. Standardized tools specific to USN assessment and standardized tools for visual perception assessment with a USN component were both categorized as standardized tools to evaluate USN. A tool was recognized as *nonstandardized* (NSAT) when it had no or very few published procedures for administration, scoring, and interpretation and had no or very minimal evidence of reliability or validity to evaluate USN post stroke. Nonstandardized tools specific to USN assessment and nonstandardized tools for visual perception assessment with a USN component were both categorized as nonstandardized tools to evaluate USN. "Homegrown" assessment tools developed by clinicians for use within their hospital setting that have no or minimal psychometric properties are included in this classification.

A *USN Assessment Summary Guide* was then developed to provide a user-friendly reference guide that categorized standardized assessment tools for USN according to their purpose (hemispace assessed), psychometric properties (test-retest reliability, inter-rater reliability, internal consistency, construct validity, criterion validity, and responsiveness to clinical change) and client appropriateness (see **Appendix A**). Tools used for the measurement of visual perception or USN should have specific properties including a standardized procedure for administration, proven validity and reliability, and responsiveness to change. One of the aspects of reliability that was included was test-retest reliability, defined as the tool providing the same scoring at two different points in time given that the client being assessed has not changed. Inter-rater reliability looks at the ability of different raters, who are all observing the same behavior, to indicate similar scores.[47] There are a number of elements of validity that were considered in the Guide. Construct validity refers to the extent to which the items of the measure group together to represent an abstract variable or construct.[47] For example, visual perception is an abstract concept that cannot be measured directly. Rather, it is necessary to identify observable manifestations of the construct that can be measured, such as the ability to perform various tasks. Construct validity is demonstrated when the items intercorrelate in the way that is hypothesized.[47] For example, it could be hypothesized that visual-perception items would intercorrelate and form a dimension, as would items specific to the assessment of USN. Criterion validity refers to the extent to which a measure correlates with another measure that is known to be the "gold standard" for the evaluation of the domain in question. In rehabilitation there are few gold standards, but a previously validated instrument is frequently used as the best approximation.[47] There are two forms of criterion validity: *concurrent validity* refers to the extent to which a measure correlates with another measure used at the same point in time; *predictive validity* refers to the ability of the measure to predict an event or health state in the future.[47] Responsiveness of an instrument to change is important if the goal is to identify small increments or decrements in patient performance, for example, to identify the effectiveness of a treatment intervention for USN.[47]

Tools were also grouped according to the hemispace assessed: A-I assessed only personal space, A-II assessed only near extrapersonal space, A-III assessed near and far extrapersonal space, A-IV assessed personal and near extrapersonal space, and A-V assessed all three hemispaces. The psychometric properties of these tools (reliability, validity, and responsiveness) and references to their studies are included in the Guide. Prerequisite abilities of the client that are required in using each tool, other than those specific to visual-perception, are also described. The testing position and time for administration are included to assist clinicians in deciding whether the assessment tool is appropriate based on the client's phase of recovery and the setting.

## Results

A total of 62 published standardized and non-standardized assessment tools that assess USN at the impairment and activity levels were identified. Twenty-eight standardized tools were identified and are summarized in detail in the *USN Assessment Summary Guide* (**Appendix A**): Only two evaluate USN of personal space exclusively; 20 assess near extrapersonal space. Five tools combine the assessment of the two separate hemispaces. Only one tool was found to incorporate the three hemispaces in the assessment, the Catherine Bergego Scale.[48] Tools were generally classified according to their psychometric strength in the order of strong to poor psychometric properties in the *USN Assessment Summary Guide*.

### Screening for USN

Tools were evaluated for their ease of bedside use and speed of administration; the busy clinician may have only short periods of time to screen patients. There were 19 standardized screening tools reviewed in the Guide, of which 15 tools will be briefly discussed in this section. The Comb and Razor Test[19] and the Semi-Structured Scale for the Functional Evaluation of Hemi-inattention in Personal Space[18] screen for USN in the personal space by assessing the client's performance in functional activities, such as using a comb or applying makeup. Although easy to use, these tools have only minimal evidence of reliability and validity.[18,19] The Comb and Razor test has good test-retest reliability to ensure that the scores can be reproduced[19] and that the test can discriminate between persons with and without neglect after right hemisphere stroke, persons with a left hemisphere stroke, and the healthy controls.[18] Although the Semi-Structured Scale for the Functional Evaluation of Hemi-inattention in Personal Space is not responsive to clinical change after rehabilitation interventions and does not correlate with other tests commonly used to detect USN, the items within this test do correlate with each other in that they measure the same construct.[18] Of the two tools, the Comb and Razor Test does have stronger psychometrics, but more testing is required for both assessments prior to clinical use.

To evaluate USN in the near extrapersonal space, there are quite a few tests that are easy to administer by the bedside once the patient is sufficiently alert, able to hold a pencil, and use his/her eyewear. The Line Bisection Test[49] is a quickly administered test that requires the patient to cross through the center of a series of 18 horizontal lines. Numerous authors have evaluated the Line Bisection Test for its test-retest reliability, construct validity, convergent and divergent validity, and criterion validity, resulting in evidence of its strong psychometric properties in comparison to the other paper-and-pencil tests mentioned below.[49–55] The Albert's Test[30] requires the patient to cross through the center of 41 randomly oriented lines arranged on a page, whereas the Single Letter Cancellation Test[56] requires the individual to cross out all "H"s presented on a page with six rows of 52 typed letters. Both these tools have strong psychometric properties, including reliability and validity, in identifying USN in the near extrapersonal space.[50–52,57–59] Yet, in a study of 104 patients with right brain damage who were tested on both the Albert's Test and the Single Letter Cancellation Test, the latter consistently produced higher estimates of USN, possibly because of the higher density of stimuli presented.[59] In contrast, the Albert's Test was more sensitive in detecting clinical change 3 months post stroke as compared to the Single Letter Cancellation Test, and results from this test within 48 hours of admission were predictive of functional outcome at 6 months post stroke.[57] Although the two tests have good psychometric properties, they differentiate in their sensitivity to detect USN and their ability to predict functional outcomes post stroke. The Star Cancellation Test[23] and the Bell's Test[60] are two cancellation tests where the patient is asked to cross out either stars or bells that are interspersed among a random array of distracters. These tests require the patient to visually discriminate the targets from surrounding distracters, which requires recruitment of additional visual perceptual skills. Both assessments have excellent construct and criterion validity,[51,54,55,60–62] however no published data exist on their reliability and responsiveness. The two tests require test-retest reliability prior to their use in clinical practice to ensure that their results can be accurately reproduced when no change has occurred. Finally, the Balloons Test[63] was recently developed as a bedside screening tool for USN. Subtest A requires the client to cross out the 22 target balloons of the 202 circles that appear on a page within the fixed time limit of 3 minutes. In subtest B, the number and position of balloons is exactly reverse from subtest A, where the client is asked to cross out 10 target circles from the 90 balloons that appear on a page within the fixed time limit of 3 minutes. A comprehensive search in the literature found no published studies, other than the author's manual, that examined the psychometric properties of this tool with a USN population, yet the tool has good face validity and may be of interest for clinical use once more information on its psychometric properties becomes widely available.

There are a number of tools that require the patient to draw in order to detect USN; however, therapists must be cautious because the presence of apraxia, aphasia, motor deficits, and other visual perception deficits can falsify the results of these tools. The Draw-A-Man Test[62] and the Rey Complex Figure Test[64] are well-known psychological assessments that are reliable and valid in evaluating perceptual organization, visual memory, and visual motor skills post stroke.[58,65–67] When scoring procedures specific to USN were developed for the Draw-A-Man Test, it was found to have good test-retest reliability and its scores correlated with ADL performance on the Klein-Bell Scale.[67] The Rey Complex Figure Test also has good test-retest reliability and accurate detection, however its strong psychometrics properties are generalized to visual perception and are not specific to USN. Furthermore, this tool requires that the client be seated in front of a table when the tool is administered. The Clock Drawing Test (CDT),[68] a quick paper-and-pencil task where the patient is asked to place numbers inside a circle to make a face of a clock, has received mixed reviews for its construct and criterion validity.[51,68,69] It is shown to be the least sensitive of a number of tools, detecting only 55.3% of persons with USN as compared to other traditional tests such as Line Bisection or Albert's Test.[69] A possible explanation for this poor sensitivity is that the constructs measured with the CDT, similar to the Rey Complex Figure Test, are generalized to visual perception or cognition and not to USN. However, when a structured scoring procedure was used, more accurate and consistent scoring of the CDT has been shown.[70]

There are two additional tools, the NIH Stroke Scale[71] and the Hemispheric Stroke Scale,[72] that quantitatively measure motor, sensory, perceptual, and speech impairments, with one item involving the assessment of USN for the personal space and near extrapersonal space. Both tools require less than 10 minutes to administer and have no evidence for reliability, although they do vary in terms of their psychometric strength. Scores on the NIH Stroke Scale are predictive of CT-scan results at 7 days[73] and are responsive to clinical change after rehabilitation,[74] whereas scores on the Hemispheric Stroke Scale are only shown to correlate significantly with the Barthel Index,[22] a 10-item scale of performance in activities of daily living scale.[72]

A functional measure to assess USN in the near extrapersonal space exclusively, the Baking Tray Task,[75] requires that the patient pick-up 16 "buns" and spread them as evenly as possible on a board. The tool strongly correlates with the Star Cancellation Test and the Line Bisection Test and is sensitive in detecting USN,[55] but there is no published evidence of its test-retest reliability. Finally, there are two functional assessments that combine the near and far extrapersonal space when evaluating USN: the Semi-Structured Scale for the Functional Evaluation of Hemi-inattention in Extrapersonal Space[18] and the short version of the Rivermead Behavioral Inattention Test (RBIT).[76] The Semi-Structured Scale for the Functional Evaluation of Hemi-inattention in Extrapersonal Space is a tool comprised of four subtests: serving tea, card dealing, picture description, and environment description. The client is asked to perform these activities with objects that are provided on a table. The short version of the RBIT involves three conventional subtests (line crossing, Star Cancellation Test, and figure copying) and five behavioral subtests (scanning a picture, reading a menu, eating a meal, reading an article, and sorting coins). Both of these functional tests are quick to administer at the bedside and have some evidence of reliability and validity.[18,77] They are also responsive to clinical changes that occur spontaneously or after rehabilitative intervention.[18,77] Although these tools can be quickly administered in a busy acute care unit and can be used for reassessment after treatment in a rehabilitation setting, they do require additional skills such as writing, reading, letter recognition, visual memory and discrimination, and visual perception. It may be challenging for clients to perform these high-level activities soon after stroke, however these functional assessments become more useful as the client approaches discharge from acute care.

**In-depth assessment of USN**

When a client is medically stable or has been screened positive for the presence of USN, an in-depth evaluation is critical to identify the specific deficits that require intervention. There were nine standardized assessments reviewed in the Guide, of which seven will be briefly discussed in this section. Most tools available to identify USN solely in the personal space[18,19] are used for screening and as such are not as responsive to change, nor do they provide the detailed evaluation required for treatment planning.

In the assessment of near extrapersonal space, the Raven Colored Progressive Matrices[78] is a visually administered test that requires picture matching, pattern completion, and analogical reasoning. Although numerous studies have documented the strong validity of this tool for evaluating USN and its responsiveness to clinical change,[79–81] this review found no published evidence for its reliability. The Wundt-Jastrow Illusion Test[82] is a well-known psychological assessment tool where pairs of circular sections or "fans" are presented in 10 different sizes, two orientations (upward-downward convexity), and two directions (leftward-rightward), and the patient is asked to identify which of the two fans is larger. Although this tool has normative data to identify persons with USN in the near extrapersonal space, only minimal validity has been documented[82] and no reliability studies have been published for the stroke population. Therefore, these two tools require further psychometric testing prior to their use to assess USN in a clinical setting.

The Rivermead Perceptual Assessment Battery (RPAB)[39] and the Motor-Free Visual Perception Test (MVPT)[83] have recently been examined for their psychometric properties to assess visual perception post stroke. Both assess the various components of visual perception, such as figure ground discrimination, visual discrimination, and spatial relations including visual spatial scanning, in a formal testing environment. The RPAB requires that the patient hold a pencil and read sentences during functional activities, whereas the MVPT only involves vision without any other movements or practical skills. The MVPT has normative data to identify USN[83] and has some evidence of validity for detecting perceptual deficits in general.[84] The RPAB has more published data regarding the strength of its reliability,[39] construct validity,[85,86] and responsiveness to change after treatment for USN.[21,87] However, the shortened version of the RPAB[76] with selected subtests such as copying words and shapes, cube copy, 3-D copy, cancellation, figure ground, sequencing pictures and body image has not been evaluated for the detection of USN specifically but can accurately identify perceptual impairments in general.[88] In summary, the MVPT and the RPAB are useful tools to detect USN, but they require a number of additional skills from the client.

The Rivermead Behavioral Inattention Test (RBIT)[23] detects USN in the near and far extrapersonal space at the level of impairment and activity. This tool is comprised of six conventional subtests (line crossing, Single Letter Cancellation Test, Star Cancellation Test, figure/shape copying, Line Bisection Test, and representational drawing) and nine behavioral subtests (picture scanning, telephone dialing, menu reading, article reading, telling and setting time, coin sorting, address and sentence copying, map navigation, and card sorting). Scores for each subtest are summed to provide a score for the total test, as well as overall scores for the conventional and behavioral subtests. Maximum and cutoff scores have been published to indicate the presence of USN.[23] It is widely used in clinical studies to assess USN and has demonstrated excellent test-retest reliability, internal consistency, and construct validity.[23,24,28,89] This tool is developed specifically to assess USN, such that its constructs address the various components of this impairment. It is therefore not surprising that this tool can predict functional outcome on the Frenchay Activities Index at 3-month, 6-month, and 12-month intervals post stroke.[26] There was a strong correlation of the RBIT scores and Barthel scores at 1-month post stroke.[24] It requires 30 minutes to administer and involves additional skills such as writing, reading, recognizing letters, holding a pencil, visual memory and discrimination, along with unilateral voluntary movement and control of the upper limb. However, these skills are important for successful reintegration into the community, such that this tool is recommended for a thorough, in-depth assessment of USN.

Finally, there is one assessment tool that evaluates USN in all three hemispaces: the Catherine Bergego Scale.[48] It requires direct observation of a client post stroke with mild impairments in 10 everyday activities such as dressing, grooming, eating, mouth cleaning, personal belongings, safe mobility, gaze orientation, auditory attention, spatial orientation, and knowledge of left limbs. This scale can also be administered as a questionnaire to assess how the patient self-evaluates his/her neglect during ADLs using the same scoring system, thereby evaluating the extent of anosagnosia. This tool strongly correlates with the paper-and-pencil tools specific to USN,[48,90] such as the Albert's Test and Bell's Test, along with performance in functional activities as measured by the Barthel Index. It is also responsive to clinical change following the use of spatio-motor cueing in clients with USN post stroke.[91] Although this tool requires control of both the upper and lower limbs in various testing positions and at least 30 minutes to administer, its constructs specifically address the various components of USN. Currently, there is no published evidence of its test-retest reliability.

**Discussion**

Unilateral neglect is a common deficit post stroke that leaves clients at a greater risk for falls and poor functional outcome, warranting the early detection and treatment of USN. It presents as a complex constellation of symptoms that can occur in three distinct hemispaces, such that the discriminating choice of standardized tools to detect and accurately measure this specific range of deficits is important. In a recent publication, Bailey and Riddoch reviewed eight tools that are commonly used to assess USN.[92] In the current study, we identified 62 published tools for the assessment of USN, leading to the creation of the *USN Assessment Summary Guide* that categorizes the 28 standardized tools according to their purpose, psychometric properties, and client and environmental factors. It is anticipated that the Guide will facilitate clinical decision-making regarding the best assessment tools for clinicians to use in evaluating USN in clients post stroke.

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## REFERENCES

1. American Stroke Association. *About stroke.* Available at: http://216.185.112.7/presenter.jhtml?identifier=11402. Accessed October 2002.
2. American Stroke Foundation. *Stroke—by the numbers.* Available at: http://216.185.112.7/presenter.jhtml?identifier=3011374. Accessed October 2002.
3. Riddoch MJ, Humphreys GW, Bateman A. Cognitive deficits following stroke. *Physiotherapy.* 1995;81:465–473.
4. Heilman KM, Watson RT, Valenstein E. Neglect and related disorders. In: Heilman KM, & Valenstein E, eds. *Clinical Neuropsychology.* New York: Oxford University Press; 1993:243–294.
5. Wyness A. Perceptual dysfunction: nursing assessment and management. *J Neurosurg Nurs.* 1985; 17:105–110.
6. Mesulam MM. Attentional networks, confused states and neglect syndromes. In: Mesulam MM, ed. *Principles of Behavioral Neurology.* New York: Oxford University; 2000:173–256.
7. Cherney LR, Halper AS, Kwasnica CM, Harvey RL, Zhang M. Recovery of functional status after right hemisphere stroke: relationship with unilateral neglect. *Arch Phys Med Rehabil.* 2001;82:322–328.
8. Bisiach E, Perani D, Vallar G, Berti A. Unilateral neglect: personal and extra-personal. *Neuropsychologia.* 1986;24:759–767.
9. Pierce SR, Buxbaum LJ. Treatments of unilateral neglect: a review. *Arch Phys Med Rehabil.* 2002;83: 256–268.
10. Vallar G. The anatomical basis of spatial hemineglect in humans. In: Robertson IH, Marshall JC, eds. *Unilateral Neglect: Clinical and Experimental Studies.* Hove: Lawrence Erlbaum; 1993:27–59.
11. Vallar G. Left spatial hemineglect: an unmanageable explosion of dissociations? No. *Neuropsychological Rehabil.* 1994;4:209–212.
12. Vallar G. Spatial hemineglect in humans. *Trends Cognitive Sci.* 1998;2:87–97.
13. Vallar G. The methodological foundations of human neuropsychology: studies in brain-damaged patients. In: Boller F, Grafman J, eds. *Handbook of Neuropsychology.* Amsterdam: Elsevier; 2000:305–344.
14. Heilman KM, Valenstein E, Watson RT. The what and how of neglect. *Neuropsychological Rehabil.* 1994;4:133–139.
15. Bisiach E, Vallar G. Unilateral neglect in humans. In: Boller F, Grafman J, eds. *Handbook of Neuropsychology.* Amsterdam: Elsevier; 2000:459–502.
16. Pizzamiglio L, Judica A, Razzano C, Zoccolotti P. Toward a comprehensive diagnosis of visual-spatial disorders in unilateral brain damaged patients. *Psychological Assess.* 1989;5:199–218.
17. Zoccolotti P, Judica A. Functional evaluation of hemineglect by means of a semi-structured scale: personal, extrapersonal differentiation. *Neuropsychological Rehabil.* 1991;1:33–44.
18. Zoccolotti P, Antonucci G, Judica A. Psychometric characteristics of two semi-structured scales for the Functional Evaluation of Hemi-inattention in Extrapersonal and Personal Space. *Neuropsychological Rehabil.* 1992;2:179–191.
19. Beschin N, Robertson IH. Personal versus extrapersonal neglect: a group study of their dissociation

using a reliable clinical test. *Cortex.* 1997;33: 379–384.
20. Ugur C, Gucuyener D, Uzuner N, Ozkan S, Ozdemir G. Characteristics of falling in patients with stroke. *J Neurol Neurosurg Psychiatry.* 2000; 69:649–651.
21. Kalra L, Perez I, Gupta S, Wittink M. Influence of visual neglect on stroke rehabilitation. *Stroke.* 1997;28:1386–1391.
22. Mahoney F, Barthel DW. Functional evaluation: the Barthel Index. *MD State Med J.* 1965;14:61–65.
23. Wilson B, Cockburn J, Halligan P. Development of a behavioral test of visuospatial neglect. *Arch Phys Med Rehabil.* 1987;68:98–101.
24. Cassidy TP, Bruce DW, Lewis S, Gray SG. The association of visual field deficits and visuospatial neglect in acute right hemisphere stroke patients. *Age Ageing.* 1999;28:257–260.
25. Holbrook M, Skilbeck CE. An Activities Index for use with stroke patients. *Age Ageing.* 1983;12:166–170.
26. Jehkonen M, et al. Visual neglect as a predictor of functional outcome one year after stroke. *Acta Neurologica Scandinavica.* 2000;101:195–201.
27. Corbetta M, Miezen FM, Shulman GL, Petersen SE. A PET study of visual spatial inattention. *J Neurosci.* 1993;11:1202–1226.
28. Bowen A, McKenna K, Tallis R. Reasons for variability in the reported rate of occurrence of unilateral spatial neglect after stroke. *Stroke.* 1999;30: 1196–1202.
29. Feinberg TE. Ipsilateral extinction in the hemineglect syndrome. *Arch Neurol.* 1990;47:802–804.
30. Albert ML. A simple test of visual neglect. *Neurology.* 1973;23:658–664.
31. Costa LD, Vaughan HG, Horwitz M, Ritter W. Patterns of behavioral deficit associated with visual spatial neglect. *Cortex.* 1969;59:242–263.
32. Gainotti G. Emotional behavior and hemispheric side of lesion. *Cortex.* 1972;8:41–55.
33. Herman, E. Spatial neglect: new issues and their implications for occupational therapy practice. *Am J Occup Therap.* 1992;49:507–516.
34. Webster J, Roades L, Morrill B. Assessment of patients with unilateral spatial neglect. In: Horton AM, Weddingi A, Webster J, eds. *The Neuropsychology Handbook: Vol. 1 Foundation and Assessment,* 2nd ed. New York: Springer; 1997:469–502.
35. Halligan PW, Marshall JC. Toward a principled explanation of unilateral neglect. *Cogn Neuropsychol.* 1997;11:167–206.
36. D'Esposito M. Specific stroke symptoms. In: Mills VM, Cassidy JW, Katz DI, eds. *Neurologic Rehabilitation: A Guide to Diagnosis, Prognosis, and Treatment Planning.* Malden, MA: Blackwell Science; 1997:59–103.
37. Heilman KM, Watson RT, Valenstein E. Nelgect: clinical and anatomic aspects. In: Fineberg TE, Farah MJ, eds. *Behavioral Neurology and Neuropsychology.* New York: McGraw-Hill; 1997:309–317.
38. Denes G, Semenza C, Stoppa E, Lis A. Unilateral spatial neglect and recovery from hemiplegia: a follow-up study. *Brain.* 1982;105:543–552.
39. Whiting SE, Lincoln NB, Bhavnani G, Cockburn J. *Rivermead Perceptual Assessment Battery.* London, England: NFER-Nelson Publishing Co.; 1985.
40. Barer DH, Edmans JA, Lincoln NB. Screening for perceptual problems in acute stroke patients. *Clin Rehabil.* 1990;4:1–11.
41. Agency for Health Care Policy and Research (AHCPR). *Clinical Guide to Post Stroke Rehabilitation (Archived Clinical Practice Guidelines),* 1995. Available at: http://hstat.nlm.nih.gov/. Accessed October 2002.
42. Royal College of Physicians (RCP) London. *National Clinical Guidelines for Stroke,* 2002. Available at: http://www.rcplondon.ac.uk/pubs/books/stroke/ceeu_stroke_clinical08.htm. Accessed August 2002.
43. Cicerone K, Dahlberg C, Kalmar K, Langenbahn DM, Malec JF, Bergquist TF. Evidence-based cognitive rehabilitation: recommendations for clinical practice. *Arch Phys Med Rehabil.* 2000;81:1596–1615.
44. Bowen A, Lincoln NB, Dewey M. Cognitive rehabilitation for spatial neglect following stroke. *The Cochrane Library.* Oxford: Update Software; 2002.
45. Cochrane Collaboration. *Cochrane Library,* 2003. Available at: http://www.cochranelibrary.com/collaboration/. Accessed March 2003.
46. ISI Web of Knowledge. *ISI Web of Science,* 2003. Available at: http://isi6.isiknowledge.com/portal.cgi. Accessed March 2003.
47. Streiner DL, Norman GR. *Health Measurement Scales: A Practical Guide to Their Development and Use,* 3rd ed. Oxford: Oxford University; 2003.
48. Azouvi P, et al. Functional consequences and awareness of unilateral neglect: study of an evaluation scale. *Neuropsychol Rehabil.* 1996;6:133–150.
49. Schenkenberg T, Bradford DC, Ajax ET. Line bisection and unilateral visual neglect in patients with neurological impairment. *Neurology.* 1980;30: 509–517.
50. Chen-Sea MJ, Henderson A. The reliability and validity of visuospatial inattention tests with stroke patients. *Occup Ther Int.* 1994;1:36–48.
51. Agrell BM, Dehlin OI, Dahlgren CJ. Neglect in elderly stroke patients: a comparison of five tests. *Psychiatry Clin Neurosci.* 1997;51:295–300.
52. Egelko S, et al. Relationship among CT scans, neurological exam, and neuropsychological test performance in right-brain-damaged stroke patients. *J Clin Exp Neuropsychol.* 1988;10:539–564.
53. Friedman PJ. Spatial neglect in acute stroke: the Line Bisection Test. *Scand J Rehabil Med.* 1990;22:101–106.
54. Marsh NV, Kersel DA. Screening tests for visual neglect following stroke. *Neuropsychological Rehabil.* 1993;3:245–257.
55. Bailey MJ, Riddoch MJ, Crome P. Evaluation of a test battery for hemineglect in elderly stroke patients for use by therapists in clinical practice. *NeuroRehabilitation.* 2000;14:139–150.
56. Diller L, Ben-Yishay Y, Gertsman LJ, Goodkin R,

Gordon W, Weinberg MS. *Studies in Cognition and Rehabilitation in Hemiplegia.* New York: New York University Medical Center; 1974. Rehabilitation Monograph n. 50.
57. Fullerton KJ, McSherry D, Stout RW. Albert's test: a neglected test of perceptual neglect. *Lancet.* 1986;22:430–432.
58. Gordon WA, Ruckdeschel-Hibbard M, Egelko S, Diller L, Simmens S, Langer K. *Single Letter Cancellation Test in Evaluation of the Deficits Associated with Right Brain Damage: Normative Data on the Institute of Rehabilitation Medicine Test Battery.* New York: New York University Medical Center; 1984.
59. Zoccolotti P, Antonucci G, Judica A, Montenero P, Pizzamiglio L, Razzano C. Incidence and evoluation of the hemi-neglect disorder in chronic patients with unilateral right brain damage. *Int J Neurosci.* 1989;47:209–216.
60. Gauthier L, Dehaut F, Joanette Y. The Bells Test: a quantitative and qualitative test for visual neglect. *Int J Clin Neuropsychol.* 1989;11:49–54.
61. Vanier M, et al. Evaluation of left visuospatial neglect: norms and discrimination power of the two tests. *Neuropsychologia.* 1990;4 :87–96.
62. Ferber S, Karnath HO. How to assess spatial neglect—Line Bisection or Cancellation Tests? *J Clin Expl Neuropsychol.* 2001;23:599–607.
63. Edgeworth J, Robertson I, McMillan T. *Balloons Test.* United Kingdom: Thames Valley Test Company/TVTC; 1998.
64. Goodenough FL. *Measurement of Intelligence by Drawing.* Chicago: World Book; 1926.
65. Lincoln NB, Drummond AER, Edmans JA, Yeo D, Willis D. The Rey Figure Copy as a screening instrument for perceptual deficits after stroke. *Br J Occup Ther.* 1998;61:33–35.
66. Carr EK, Lincoln NB. Inter-rater reliability of the Rey Figure Copying Test. *Br J Clin Psychol.* 1988;27: 267–268.
67. Chen-Sea MJ. Validating the Draw-A-Man Test as a personal neglect test. *Am J Occup Ther.* 2000;54: 391–397.
68. Ishiai S, Sugishita M, Ichikawa T, Gono S, Watabiki S. Clock-drawing test and unilateral spatial neglect. *Neurology.* 1993;43:106–110.
69. Maeshima S, et al. Factor analysis of the components of 12 standard test batteries, for unilateral spatial neglect, reveals that they contain a number of discrete and important clinical variables. *Brain Inj.* 2001;15:125–137.
70. South MB, Greve KW, Bianchimi KJ, Adams D. Interrater reliability of three clock drawing test scoring systems. *Appl Neuropsychol.* 2001;8:174–179.
71. Adams H, Davis P, Torner J, Grimsman K, Berg JV. *NIH Stroke Scale.* Iowa City, Iowa: University of Iowa Health Care; 1998.
72. Adams RJ, Meador KJ, Sethi KD, Grotta JC, Thomson DS. Graded neurologic scale for use in acute hemispheric stroke treatment protocols. *Stroke.* 1987;18: 665–669.
73. Brott T, et al. Measurements of acute cerebral infarction: a clinical examination scale. *Stroke.* 1989;20:864–870.
74. Orgogozo JM. Advantages and disadvantages of neurological scales. *Cerebrovascular Dis.* 1998;8:2–7.
75. Tham K, Tegner R. The Baking Tray Task: a test of spatial neglect. *Neuropsychol Rehabil.* 1996;6:19–25.
76. Stone SP, Wilson B, Rose FC. The development of a standard test battery to detect, measure and monitor visuo-spatial neglect in acute stroke. *Int J Rehabil Res.* 1987;10:110.
77. Stone SP, et al. The assessment of visual spatial neglect after a stroke. *J Neurol Neurosurg Psychiatry.* 1991;54:345–350.
78. Raven JC. *Guide to Using the Colored Progressive Matrices.* New York: Psychological Corporation; 1965.
79. Sunderland A, Wade DT, Langton Hewer RL. The natural history of visual neglect after stroke. *Int Disabil Stud.* 1987;9:55–59.
80. Sundet K, Goffeng L, Hofft E. To drive or not to drive: neuropsychological assessment for driver's license among stroke patients. *Scand J Psychol.* 1995;36:47–58.
81. Blake H, McKinney M, Treece K, Lee E, Lincoln NB. An evaluation of screening measures for cognitive impairment after stroke. *Age Ageing.* 2002;31:451–456.
82. Massironi M, Antonucci G, Pizzamiglio L, Vitale M, Zoccolotti P. The Wundt-Jastrow illusion in the study of spatial hemi-inattention. *Neuropsychologia.* 1988;26:161–166.
83. Bouska MJ, Kwatny E. *Manual for Application of the Motor-Free Visual Perception Test to the Adult Population.* Philadelphia: Temple University Rehabilitation Research and Training Center; 1983.
84. Cate Y, Richards L. Relationships between performance on tests of basic visual functions and visual-perceptual processing in persons after brain injury. *Am J Occup Ther.* 2000;54:326–334.
85. Donnelly SM, Hextell D, Matthey S. The Rivermead Perceptual Assessment Battery: its relationship to selected functional activities. *Br J Occup Ther.* 1998; 61:27–32.
86. Matthey S, Donnelly SM, Hextell DL. The clinical usefulness of the Rivermead Perceptual Assessment Battery: statistical considerations. *Br J Occup Ther.* 1993;56:365–370.
87. Friedman PJ, Leong L. Perceptual impairment after stroke: improvements during the first 3 months. *Disabil Rehabil.* 1992;14:136–139.
88. Lincoln NB, Edmans JA. A shortened version of the Rivermead Perceptual Assessment Battery? *Clin Rehabil.* 1989;3:199–204.
89. Hartman-Maier A, Katz N. Validity of the Behavioral Inattention Test: relationship with functional tasks. *Am J Occup Therap.* 1995;49:507–516.
90. Azouvi P, Olivier S, De Monety G, Samuel C, Louis-Dreyfus A, Tesio L. Behavioral assessment of unilateral neglect: a study of the psychometric properties of the Catherine Bergego Scale. *Arch Phys Med Rehabil.* 2003;84:51–57.
91. Samuel C, Louis-Dreyfus A, Kaschel R.

Rehabilitation of very severe unilateral neglect by visuo-spatio-motor cueing: two single-case studies. *Neuropsychol Rehabil.* 2000;10:385–399.
92. Bailey MJ, Riddoch MJ. Hemineglect. Part 1. The nature of hemineglect and its clinical assessment in stroke patients: overview. *Phys Ther Rev.* 1999;4: 67–75.
93. Weintraub S, Mesulam MM. Visual hemispatial inattention:stimulus parameters and exploratory strategies. *J Neurol Neurosurg Psychiatry.* 1985; 51:1481–1488.
94. Rey A. *Le test de copie de figure complexe.* Paris: Editions Psychologique appliquée; 1959.
95. Wechsler D. *Wechsler Adult Intelligence Scale.* New York: Psychological Corporation; 1981.
96. Henley S, Pettit S, Todd-Pokropek A, Tupper A. Who goes home? Predicitve factors in stroke recovery. *J Neurol Neurosurg Psychiatry.*1985;48:1–6.
97. Gianutsos R, Glosser D, Elbaum J, Vroman GM. Visual imperfection in brain-injured adults: multifaceted measures. *Arch Phys Med Rehabil.* 1983;64:456–461.
98. Piasetsky E. A study of pathological asymmetries in visual-spatial attention in unilaterally brain-damaged stroke patients. Unpublished doctoral dissertation. New York: University of New York City; 1981.

# APPENDIX A
## UNILATERAL SPATIAL NEGLECT ASSESSMENT SUMMARY GUIDE

**Table A-I.** Personal space

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Comb and Razor Test*<br><br>(Beschin & Robertson, 1997[19]) | Patient is asked to demonstrate the use of two common objects for 30 seconds each: comb, razor, and powder compact. Each object is placed at the patient's midline.<br><br>**Scoring:** The number of strokes with the razor, comb, or powder compact that are performed on the left, right, or ambiguously is recorded to calculate a mean percentage score for the three categories. A score less than 0.35 indicates USN. | **Test-retest:**<br>$r = 0.94$<br>(Beschin & Robertson, 1997[19])<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Known groups: Significant differences in mean scores between those with neglect and a right stroke, no neglect and a right stroke, left stroke and controls (Beschin & Robertson, 1997[19])<br><br>**Criterion validity:**<br>No evidence<br><br>**Responsiveness:**<br>No evidence | **Skills:**<br>Unilateral voluntary movement and control of shoulder, elbow, and fingers<br><br>**Testing position:**<br>Supine in bed or seated<br><br>**Time:** 5 min<br><br>**Concern:** Rule out apraxia |
| *Semi-Structured Scale for the Functional Evaluation of Hemi-inattention in Personal Space*<br><br>(Zoccolotti, Antonucci, & Judica, 1992[18]) | Patient is asked to demonstrate the use of three common objects: comb, razor/powder compact, eyeglasses. The objects are placed at the patient's midline.<br><br>**Scoring:** Normal = 0, slight asymmetry = 1, clear omissions = 2, significant reduction in space explored = 3. Max. score = 9. A score greater than the cut-off of 1 indicates USN. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>$r = 0.88$<br><br>**Internal consistency:**<br>$r = 0.57–0.62$<br><br>(Zoccolotti et al., 1992[18]) | **Construct validity:**<br>*Convergent validity:*<br>All correlations with Line Cancellation Test, Letter Cancellation Test, Wundt-Jastrow Area Illusion Test, and Sentence Reading Test were negligible and non-significant (Zoccolotti et al., 1992[18]).<br><br>**Criterion validity:**<br>No evidence<br><br>**Responsiveness:**<br>Not responsive to clinical change following rehabilitation<br>(Zoccolotti et al., 1992[18]) | **Skills:**<br>Unilateral voluntary movement and control of shoulder, elbow and fingers<br><br>**Testing position:** Supine in bed or seated<br><br>**Time:** 5 min<br><br>**Concern:** Rule out apraxia |

**Table A-II.** Near extrapersonal space

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Line Bisection*<br><br>(Schenkenberg, Bradford, & Ajax, 1980[49]) | Patient is asked to place a mark with a pencil through the center of a series of 18 horizontal lines on an 11 x 8.5-in. page.<br><br>**Scoring:** Absolute mean millimeter deviation from center. A deviation of more than 6 mm from the midpoint indicates USN. Omission of two or more lines on one half of the page indicates USN. | **Test-retest:**<br>$r = 0.84–0.93$<br>(Schenkenberg et al., 1980[49])<br>$r = 0.93$<br>(Chen-Sea & Henderson, 1994[50])<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Correlated with mean CT-scan damage ($r = -0.44$) and CT-scan damage of temporal lobe ($r = -0.59$), parietal lobe ($r = -0.37$), and occipital lobe ($r = -0.42$)<br>(Egelko et al., 1988[52])<br><br>Correlated with poor functional outcome, as measured by the Barthel Index (ADL), walking speed and discharge provenance, at discharge, 1 month, 3 months post stroke (Friedman, 1990[53])<br><br>*Convergent validity:*<br>$r = 0.85$ with Albert's Test<br>Correlated with Star Cancellation Test: $r = -0.33$<br>(Agrell, Dehlin, & Dahlgren, 1997[51])<br><br>*Divergent validity:*<br>$r = 0.44$ (right vs. left stroke) (Chen-Sea & Henderson, 1994[50])<br><br>**Criterion validity:**<br>Sensitivity: 76.4% (when compared with other cancellation tests) (Bailey, Riddoch, & Crome, 2000[55])<br><br>**Responsiveness:** No evidence | **Skills:**<br>Hold a pencil<br><br>**Testing position:**<br>Supine in bed or seated<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |

**Table A-II:** Near extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Albert's Test*<br><br>(Albert, 1973[30]) | Patient is asked to place a mark with a pencil through the center of 41 randomly oriented lines 2 cm long arranged in six rows on an 11 x 8.5-in. page. The page is placed at the patient's midline. The five central lines are used for demonstration.<br><br>**Scoring:** No. of lines left uncrossed on each side of the sheet. If any lines are left uncrossed, and more than 70% of uncrossed lines are on the same side as the brain lesion, USN is indicated. | **Test-retest:**<br>$r = 0.79$<br>(Chen-Sea & Henderson, 1994[50])<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>*Convergent validity:*<br>$r = 0.85$ with Line Bisection<br>Correlated with Star Cancellation Test: $r = 0.63$ (Agrell, Dehlin, & Dahlgren, 1997[51])<br><br>*Divergent validity:*<br>$r = 0.36$ (right vs. left stroke)<br>(Chen-Sea & Henderson, 1994[50])<br><br>**Criterion validity:**<br>*Predictive validity:*<br>Test scores on this tool within 48 hours of admission were strongly associated with functional outcome at 6 months post stroke (as measured on a 4-point crude scale) (Fullerton, McSherry, & Stout, 1986[57])<br><br>**Responsiveness:** No evidence | **Skills:**<br>Hold a pencil<br><br>**Testing position:**<br>Supine in bed or seated<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |
| *Single Letter Cancellation Test (SLCT)*<br><br>(Diller et al., 1974[56]) | Patient is asked to look at an 11 x 8.5-inch page with six rows of 52 typed letters and to place a mark with a pencil through each H. The page is placed at the patient's midline.<br><br>**Scoring:** No. of letters crossed with a maximum score of 105. USN can be inferred by calculating the frequency of errors to the left or right of the center of the page. Normative data has been established for this population (Gordon et al., 1984[58]). | **Test-retest:**<br>$r = 0.63$<br>(Gordon et al., 1984[58])<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Correlated with extent of CT-scan damage:<br>$r = -0.35$ (Egelko et al., 1988[52])<br><br>Correlated with other visuo-spatial tests (Albert's Test, Sentence Reading Test, Wundt-Jastrow Area Illusion Test), $r = 0.36–0.69$, and was most sensitive among these tests in detecting USN (4.1% to 25%) (Zoccolotti et al., 1989[59])<br><br>**Criterion validity:** No evidence<br><br>**Responsiveness:** No evidence | **Skills:**<br>Recognize letters, hold a pencil<br><br>**Testing position:**<br>Supine in bed or seated<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |

**Table A-II.** Near extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Star Cancellation*<br><br>(Wilson, Cockburn, & Halligan, 1987[23]) | Patient is asked to place a mark with a pencil through all the small stars on an 11 x 8.5-in. page containing 56 small stars, 52 large stars, 13 letters, and 10 short words. The two small stars in the middle are used for demonstration. The page is placed at the patient's midline.<br><br>**Scoring:** Max. points = 54, and the cutoff is <44 indicating USN. A Laterality Index or star ratio is calculated from the ratio of stars cancelled on the left of the page to the total number of stars cancelled. Scores between 0 and 0.46 indicate USN in the left hemispace. Scores between 0.54 and 1 indicate USN in the right hemispace | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>*Convergent validity:*<br>With ADL scores: $r = 0.55$<br>With Line Crossing: $r = 0.68$<br>With Line Bisection Test: $r = -0.40$<br>(Marsh & Kersel, 1993[54])<br><br>Correlated with Barthel Index (ADL): $r = 0.48$<br>(Agrell, Dehlin, & Dahlgren, 1997[51])<br><br>**Criterion validity:**<br>Sensitivity: 100% (when compared with other cancellation tests) (Marsh & Kersel, 1993[54])<br><br>Sensitivity: 76.4% (when compared with other cancellation tests) (Bailey, Riddoch, & Crome, 2000[55])<br><br>**Responsiveness:** No evidence | **Skills:**<br>Hold a pencil, visual discrimination<br><br>**Testing position:**<br>Supine in bed or seated<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |
| *Bell's Test*<br><br>(Gauthier, Dehaut, & Joanette, 1989[60]) | Patient is asked to circle with a pencil all the 35 bells embedded within the 264 distracters on an 11 x 8.5-in. page. The page is placed at the patient's midline.<br><br>**Scoring:** An omission of 6 or more bells on the right or left half of the page indicates USN. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>38.3% of patients were diagnosed with USN using the Bell's Test, compared with 10.6% with the Albert's Test (Vanier et al., 1990[61])<br><br>*Known groups:* Difference in scores between right CVA and left CVA is statistically significant (Gauthier et al., 1989[60])<br><br>**Criterion validity:**<br>A significantly higher percentage of omitted targets compared to other cancellation tests (Star Cancellation Test and Line Crossing) (Ferber & Karnath, 2001[62])<br><br>**Responsiveness:** No evidence | **Skills:**<br>Hold a pencil,<br>visual discrimination<br><br>**Testing position:** Supine in bed or seated<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |

**Table A-II.** Near extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Double Letter Cancellation Test (DLCT)*<br><br>(Diller et al., 1974[56]) | Patient is asked to look at an 11 x 8.5-in. page with six rows of 52 typed letters and to place a mark with a pencil through both letters C and E. The page is placed at the patient's midline.<br><br>**Scoring:** No. of letters crossed with a maximum score of 105. USN can be inferred by calculating the frequency of errors to the left or right of the center of the page. Normative data has been established for this population (Gordon et al., 1984[58]) | **Test-retest:**<br>$r = 0.62$<br>(Gordon et al., 1984[58])<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Correlated with extent of CT-scan damage:<br>$r = -0.35$<br>(Egelko et al., 1988[52])<br><br>**Criterion validity:** No evidence<br><br>**Responsiveness:** No evidence | **Skills:**<br>Recognize letters, hold a pencil, mental flexibility<br><br>**Testing position:** Supine in bed or seated<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |
| *Verbal and Non-Verbal Cancellation Tests*<br><br>(random or structured array of either letters or shapes—4 tests)<br><br>(Weintraub & Mesulam, 1985[93]) | Patient is asked to look at an 11 x 8.5-in. page with a random or structured array of over 300 letters or shapes and to place a mark with a pencil through each target letter/shape. There are 60 targets, 30 on the right half and 30 on the left half of the page. The page is placed at the patient's midline.<br><br>**Scoring:** Number of targets omitted with a maximum score of 60. More than 4 omitted on the right or left half of the page indicates USN. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>No evidence<br><br>**Criterion validity:**<br>A significantly higher percentage of omitted targets on Random Letter Cancellation test compared to other cancellation tests (Bells Test, Star Cancellation Test, and Line Crossing) (Ferber & Karnath, 2001[62])<br><br>**Responsiveness:** No evidence | **Skills:**<br>Recognize letters, hold a pencil<br><br>**Testing position:** Supine in bed or seated<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |
| *Rey Complex Figure*<br><br>(Rey, 1959[94]) | Patient is asked to draw a Rey figure from memory.<br><br>**Scoring:** There are 18 components of the drawing. One or two points are given to each component according to their placement and shape. If the component is absent, a score of 0 is given. The cutoff score of less than 16 indicates perceptual deficits. | **Test-retest:**<br>$R = 0.62$<br>(Gordon et al., 1984[58])<br><br>**Inter-rater:**<br>$r = 0.99$ and 90% of discrepancies between raters were within two points (Carr & Lincoln, 1988[66])<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>No evidence<br><br>**Criterion validity:**<br>Sensitivity = 81%<br>Specificity = 83%<br>(against the Rivermead Perceptual Assessment Battery as "gold standard")<br><br>Good screening tool that is sensitive to perceptual impairments but not specific to USN (Lincoln, Drummond, Edmans, Yeo, & Willis, 1998[65])<br><br>**Responsiveness:** No evidence | **Skills:**<br>Hold a pencil, visual memory<br><br>**Testing position:** Seated at a table<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |

**Table A-II.** Near extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Draw-A-Man Test*<br><br>(Goodenough, 1926[64]) | Patient is given a blank piece of paper (8.5 x11) entitled "Draw an Entire Man" and a pencil and is asked to draw an entire man from memory<br><br>**Scoring:** Drawings with homogenous unilateral body parts are categorized as USN. Those with homogenous bilateral body parts are considered normal. | **Test-retest:**<br>$R = 0.62$<br>(Gordon et al., 1984[58])<br><br>**Inter-rater:**<br>95.45% for controls, 100% for stroke patients (Chen-Sea, 2000[67])<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Significant correlations with poor ADL performance on Klein-Bell ADL Scale (Chen-Sea, 2000[67])<br><br>**Criterion validity:** No evidence<br><br>**Responsiveness:** No evidence | **Skills:**<br>Hold a pencil, visual memory<br><br>**Testing position:**<br>Supine in bed or seated at a table<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |
| *Wechsler Adult Intelligence Scale-revised Block Design*<br><br>(Weschler, 1981[95]) | Patient is asked to arrange colored cubes to copy certain patterns as illustrated on 2-dimensional cards.<br><br>**Scoring:** See test manual for scoring procedures (Weschler, 1981[95])<br><br>Max. score = 48 | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>*Convergent validity:* When using factor analysis, WAIS-2r loaded significantly with tests of similar construct (Raven Colored Progressive Matrices and Letter Cancellation Test) (Sundet, Goffeng, & Hofft, 1995[80])<br><br>**Criterion validity:**<br>*Predictive validity:* High scores of this tool were strongly associated with good outcome at 2 weeks post stroke (as measured on a 4-point crude scale) (Henley, Pettit, Todd-Pokropek, & Tupper, 1985[96])<br><br>**Responsiveness:** No evidence | **Skills:**<br>Voluntary movement and control of elbow and fingers. Cognition (problem-solving). Spatial relations<br><br>**Testing position:** Seated at a table<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |

**Table A-II.** Near extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Clock Drawing Test*<br><br>(Ishiai, Sugishita, Ichikawa, Gono, & Watabiki, 1993[68]) | Patient is asked to place numbers inside a printed circle 8 cm in diameter to make a face of a clock.<br><br>**Scoring:** Max. score = 4, where 1 point is given for each correctly placed 3,6,9 relative to that of 12, and one point for the correct placement of other numbers with appropriate spacing.<br>No cutoff score indicating USN was provided. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Poor correlation with: Line cancellation ($r$ = -0.102), Line bisection ($r$ = 0.045), Copying ($r$ = 0.034), and performance WAIS-r subtests ($r$ = 0.217)(Ishiai et al., 1993[68])<br>Significant correlation with WAIS-r Block Design ($r$ = 0.391) and all verbal subtests of the WAIS-r ($r$ = 0.745)(Ishiai et al., 1993[68])<br>Correlated with Star Cancellation Test ($r$ = -0.47) and Line Bisection Test ($r$ = -0.34) (Agrell, Dehlin, & Dahlgren, 1997[51])<br><br>**Criterion validity:**<br>Sensitivity: 55.3%<br>CDT was least sensitive to detect USN, compared to the cancellation tests, copying and drawing tasks, and reading tests. (Maeshima et al., 2001[69])<br>Sensitivity: 42% when compared to Star Cancellation Test, Albert's Test, and Line Bisection Test (Agrell et al., 1997[51])<br><br>**Responsiveness:** No evidence | **Skills:**<br>Hold a pencil, visual memory<br><br>**Testing position:**<br>Supine in bed or seated at a table<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |
| *Search-A-Word (SAW)*<br><br>(Gianutsos, Glosser, Elbaum, & Vroman, 1983[97]) | The patient is asked to search 13 x 13 letter arrays typed on an 8.5 x 11-in. sheet for one specific target word at a time.<br><br>**Scoring:** Median search times are compared for targets on the right and the left. Cutoff is 2 *SD* from the mean of the normal control group.<br>Score >1.26 = left USN<br>Score <1.62 = right USN | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>*Known groups:* Group difference in scores of normal, right strokes, left strokes, and bilateral strokes were statistically significant ($p < .05$) (Gianutsos et al. , 1983[97])<br><br>*Convergent validity:* Items that measured left-sided scanning using SAW loaded significantly in a factor analysis with the SRWL (0.85) (Gianutsos et al., 1983[97])<br><br>**Criterion validity:** No evidence<br><br>**Responsiveness:** No evidence | **Skills:**<br>Reading<br><br>**Testing position:** Supine in bed or seated<br><br>**Time:** ≈30 min<br><br>**Concern:** Rule out aphasia |

**Table A-II.** Near extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Speeded Reading of Word Lists (SRWL)*<br><br>(Gianutsos, Glosser, Elbaum, & Vroman, 1983[97]) | Randomized sequences of high frequency monosyllabic nouns are presented on a screen of a 21-in. video monitor. The patient is asked to read the words aloud in each of the three parts of the test. The three parts vary according to presentation duration and layout.<br><br>**Scoring:** Cutoff scores for the 3 parts are 2 *SD* from the mean of the normal control group | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>*Known groups:* Group difference in scores of normal, right strokes, left strokes, and bilateral strokes were statistically significant ($p < .05$) (Gianutsos et al., 1983[97])<br>*Convergent validity:* Items that measured left-sided scanning using SRWL loaded significantly in a factor analysis with the SAW (0.83) (Gianutsos et al.,1983[97])<br><br>**Criterion validity:** No evidence<br><br>**Responsiveness:** No evidence | **Skills:**<br>Reading<br><br>**Testing position:**<br>Seated at a table in front of a video monitor<br><br>**Time:** ≈ 30 min<br><br>**Concern:** Rule out aphasia |
| *Lateral Asymmetry in Visual Spatial Attention Test*<br><br>(Piasetsky, 1981[98]) | This picture match test consists of a structured series of common, easily labeled objects and an unstructured series of geometric shapes not easily labeled. On each page a target in top center position is matched to one of the six figures below.<br><br>**Scoring:** Max. score = 48 | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Correlated with mean CT-scan damage:<br>$r = -0.37$<br>(Egelko et al., 1988[52])<br><br>**Criterion validity:** No evidence<br><br>**Responsiveness:** No evidence | **Skills:**<br>Visual discrimination<br><br>**Testing position:**<br>Seated at a table<br><br>**Time:** ≈ 30 min |
| *Wundt-Jastrow Area Illusion*<br><br>(Massironi et al., 1988[82]) | Pairs of circular sections or "fans" are presented in 10 different sizes (ranging from 6° to 58°), 2 orientations (upward-downward convexity), and 2 directions (leftward-rightward) for a total of 40 trials. Two fans of identical shape and size that create an illusory effect are presented and the patient is asked to identify which of the two fans is larger.<br><br>**Scoring:** "Expected responses" (consistent for normals) and "unexpected responses" (those in the opposite direction) are computed. Those with USN have unexpected responses where fans are oriented toward the left. Laterality is calculated where the difference of unexpected responses when the two fans are oriented toward the left or right is computed over the total number of correct responses for both sides. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Convergent validity with Albert's Test:<br>$r = 0.64$; $p = .001$<br>(Massironi et al., 1988[82])<br><br>**Criterion validity:**<br>Criterion validity $r = 0.83$ when correlated with clinical exam of a neuropsychologist (Massironi et al., 1988[82])<br><br>**Responsiveness:** No evidence | **Skills:**<br>Visual discrimination<br><br>**Testing position:**<br>Seated at a table<br><br>**Time:** <5 min |

**Table A-II.** Near extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Raven Colored Progressive Matrices*<br><br>(Raven, 1965[78]) | This 36-item visually administered test requires picture matching, pattern completion, and analogical reasoning. The patient is asked to select one of the six patterns to complete the picture.<br><br>**Scoring:** Proportion of right and left answers is calculated using the formula (R-L)/(R-L) x 100, so that now the scale ranges from 0–100, a higher score indicating extreme bias to one side.<br>Total RCPM score <19 = USN<br>Max. score=36 | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>*Known groups:* Difference in scores between right CVA and left CVA is statistically significant ($z = 2.51$, $p < .01$) (Sunderland, Wade, & Langton Hewer, 1987[79])<br><br>*Convergent validity:* When using factor analysis, RCPM loaded significantly with tests of similar construct (Block Design and Letter Cancellation Test) (Sundet, Goffeng, & Hofft, 1995[80])<br><br>**Criterion validity:**<br>When using a cutoff of <19, it gave a high sensitivity (91%) and adequate specificity (72%) (Blake, McKinney, Treece, Lee, & Lincoln, 2002[81])<br><br>**Responsiveness:**<br>Responsive to clinical change over time (Sunderland et al., 1987[79]) | **Skills:**<br>Visual perceptual skills, analogical reasoning<br><br>**Testing position:**<br>Seated at a table<br><br>**Time:** ≈ 30 min |
| *Rivermead Perceptual Assessment Battery (RPAB)*<br><br>(Whiting, Lincoln, Bhavnani, & Cockburn, 1985[39]) | 16 subtests of visual perception that consist of picture, object and color matching, cancellation, figure ground, sequencing, body image, and copying shapes, words, and three-dimensional figures<br><br>**Scoring:** The RPAB criterion score is defined as the number of subtests passed, with the criterion score ranging from 0 to 16. Subjects with criterion scores anywhere between 0 and 12 are classified as having perceptual deficits. Normative data for each subtest are also available by the authors. The criterion for visual perceptual deficits is a score of less than 2 *SD* below the normative mean for each subtest. | **Test-retest:**<br>$r = 0.59$-$1.00$ for most subtests except for one (series subtest: $r = 0.27$) (Whiting et al., 1985[39])<br><br>**Inter-rater:**<br>$r = 0.72$-$1.00$ (Whiting et al., 1985[39])<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Scores on RPAB correlated significantly ($r = 0.40$–$0.70$) with selected functional tasks- upper limb dressing, making a sandwich, and setting the table (Donnelly, Hextell, & Matthey, 1993[85])<br><br>5 of the 16 subtests correlated significantly with ADL ($r = 0.43$–$0.59$) (Matthey, Donnelly, & Hextell, 1993[86])<br><br>**Criterion validity:**<br>No evidence<br><br>**Responsiveness:**<br>Responsive to clinical change after treatment for USN (spatiomotor cueing) (Kalra, Perez, Gupta, & Wittink, 1997[21])<br><br>Responsive to clinical change during the first 3 months post stroke (Friedman & Leong, 1992[87]) | **Skills:**<br>Hold a pencil, reading, visual perceptual skills<br><br>**Testing position:**<br>Seated at a table<br><br>**Time:** ≈ 30 min<br><br>**Concern:** Rule out apraxia |

**Table A-II.** Near extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Rivermead Perceptual Assessment Battery-shortened*<br><br>(Lincoln & Edmans, 1989[88]) | Version A: Picture and object matching, size recognition, animal halves, right left copy shapes and words, 3-D copy and cube copy<br>Version B: Copying words and shapes, cube copy, 3-D copy, cancellation, figure ground, sequencing pictures and body image<br>Version C: Picture and color matching, sequencing pictures, body image, right left copy shapes, cube copy, 3-D copy, cancellation<br><br>**Scoring:** Normative data for each subtest is also available by the authors with a cutoff of <2 *SD* below the mean. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>Inter-correlation between each subtest and the total score:<br><br>Version A = .988<br>Version B = .998<br>Version C = .995<br>(Lincoln & Edmans, 1989[88]) | **Construct validity:**<br>No evidence<br><br>**Criterion validity:**<br>Version A: Sensitivity = 81%<br>Specificity = 100%<br>Version B: Sensitivity = 59%<br>Specificity = 100%<br>Version C: Sensitivity = 46%<br>Specificity = 100%<br><br>Proportion of those tested who have a perceptual deficit when the criterion score on the short RPAB was compared with the full RPAB.<br><br>**Responsiveness:**<br>Not very responsive to clinical change (Lincoln & Edmans, 1989[88]) | **Skills:**<br>Hold a pencil, reading, visual perceptual skills<br><br>**Testing position:**<br>Seated at a table<br><br>**Time:** ≈ 30 min |
| *Motor-Free Visual Perception Test*<br><br>(Bouska & Kwatny, 1983[83]) | A 36-item, two-dimensional multiple-choice test designed to evaluate spatial relations, visual discrimination, figure-ground perception, visual closure, and visual memory. Patient is asked to indicate one out of the 4 alternatives that match the test example.<br><br>**Scoring:** Max. score = 36. Normative data available for presence of USN. Cutoff = 33 indicates visual perceptual impairment. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>*Convergent validity:* $r = 0.75$, $p < .001$ with visual skills screening battery (visual acuity, visual field, oculo-motor function, visual scanning and attention) (Cate & Richards, 2000[84])<br><br>**Criterion validity:**<br>No evidence<br><br>**Responsiveness:**<br>No evidence | **Skills:** Visual perceptual skills<br><br>**Testing position:**<br>Seated at a table<br><br>**Time:** ≈ 30 min |

**Table A-II.** Near extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Baking Tray Task*<br><br>(Tham & Tegner, 1996[75]) | The "baking tray" consists of a 75 x 100-cm board with an edge of 3.5-cm height. Patient is asked to pick up 16 "buns" (3.5-cm cubes) and spread them as evenly as possible all over the board as if they were buns on tray to be baked. The authors found that using an 8.5 x 11 sized tray was only slightly less sensitive.<br><br>**Scoring:** The numbers of cubes in each half field are counted. Accuracy of measurement is 0.5 cm. If a cube is straddled in midline, a score of .5 is granted for each half field. Distributions skewed more than 7 in one half field and 9 in the other indicates USN. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>No evidence<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>Data from this tool did not significantly correlate with other visuospatial tests (Line cancellation, Letter cancellation, figure copying, or Line bisection test) (Tham & Tegner, 1996[75])<br>Correlated with Star Cancellation Test ($r$ = 0.79) and Line Bisection Test ($r$ = -0.66) (Bailey, Riddoch, & Crome, 2000[55])<br><br>From patients identified with USN using the cancellation tests, only 45% of those with right CVA and 25% of those with left CVA were correctly detected using this task.<br>(Tham & Tegner, 1996[75])<br><br>**Criterion validity:** Sensitivity: 66.7% (when compared with other cancellation tests) (Bailey et al., 2000[55])<br><br>**Responsiveness:**<br>No evidence | **Skills:**<br>Unilateral voluntary movement and control of shoulder, elbow, and fingers<br><br>**Testing position:** Supine in bed or seated<br><br>**Time:** <5 min<br><br>**Concern:** Rule out apraxia |

**Table A-III.** Near and far extrapersonal space

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Rivermead Behavioral Inattention Test (RBIT)*<br><br>(Wilson, Cockburn, & Halligan, 1987[23]) | **Conventional subtests (6):** Line crossing, letter and star cancellation, figure and shape copying, line bisection, and representational drawing<br><br>**Behavioral subtests (9):**<br>Picture scanning, telephone dialing, menu reading, article reading, telling and setting time, coin sorting, address and sentence copying, map navigation, card sorting<br><br>**Scoring:** Scores for each subtest are summed to provide a score for the total test, as well as overall scores for the conventional and behavioral subtests.<br>Max. and cutoff scores to indicate USN:<br>Conventional subtests: 129 out of 146;<br>Behavioral subtests: 67 out of 81; Total test: 196 out of 22 | **Test-retest:**<br>$r = 0.99$ (Wilson et al., 1987[23])<br><br>**Inter-rater:**<br>$r = 0.99$ (Wilson et al., 1987[23])<br><br>Internal consistency:<br>$r = 0.832$ (Wilson et al., 1987[23]) | **Construct validity:**<br>*Convergent validity:*<br>Conventional and behavioral subtests of RBIT ($r = 0.92$) (Hartman-Maier & Katz, 1995[89])<br>Overall correlation between total BIT behavioral subtests and items on an ADL checklist ($r = 0.77$) (Hartman-Maier & Katz, 1995[89])<br>Correlation between BIT score and Barthel score at 1 month ($r = 0.642$) (Cassidy, Bruce, Lewis, & Gray, 1999[24])<br><br>**Criterion validity:**<br>*Predictive validity:*<br>Behavioral subtests predicted poor functional outcome on the Frenchay Activities Index (FAI) at 3 months ($r = -0.57$), 6 months ($r = -0.73$), and 12 months ($r = -0.71$)<br>(Jehkonen et al., 2000[26]) | **Skills:**<br>Writing, reading, recognize letters, hold a pencil, visual memory, visual discrimination, visual perceptual skills, unilateral voluntary movement and control of shoulder, elbow, and fingers<br><br>**Testing position:**<br>Seated at a table<br><br>**Time:** ~30 min<br><br>**Concern:** Rule out apraxia and aphasia |
| *Semi-Structured Scale for the Functional Evaluation of Hemi-inattention in Extrapersonal Space*<br><br>(Zoccolotti, Antonucci, & Judica, 1992[18]) | The tool is comprised of four subtests: serving tea, card dealing, picture description, and description of an environment. The patient is asked to perform these activities with objects that are provided on a table.<br><br>**Scoring:** 4-point scale where 0 = normal; 1 = slight asymmetries, uncertainty, or slowness in space explored; 2 = clear omissions; 3 = significant reduction in space explored. Max. score = 18, with a cutoff of 3 to indicate USN. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>$r = 0.96$<br>(Zoccolotti et al., 1992[18])<br><br>**Internal consistency:**<br>$r = 0.44–0.71$<br>(Zoccolotti et al., 1992[18]) | **Construct validity:**<br>Convergent validity: Significant correlations with Line Cancellation Test: Tau = 0.60; Letter Cancellation Test: Tau = -0.52 (Zoccolotti et al., 1992[18])<br><br>**Criterion validity:** No evidence<br><br>**Responsiveness:**<br>Responsive to clinical change after rehabilitative treatment<br>(Zoccolotti et al., 1992[18]) | **Skills:**<br>Unilateral voluntary movement and control of shoulder, elbow, and fingers; language; cognition;<br>visual perceptual skills<br><br>**Testing position:**<br>Seated at a table<br><br>**Time:** 15 min<br><br>**Concern:** Rule out apraxia and aphasia |

**Table A-III.** Near and far extrapersonal space *(continued)*

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Rivermead Behavioral Inattention Test (RBIT)—shortened version*<br><br>(Stone, Wilson, & Rose, 1987[76]) | **Conventional subtests (3):** Line crossing, star cancellation, and figure copying<br><br>**Behavioral subtests (5):**<br>Picture scanning, menu reading, article reading, coin sorting, and map navigation<br><br>**Scoring:** The percentage of omissions for each subtest is calculated and graded: Grade 0 = no neglect; Grade 1 = up to 20% of items omitted on the test; Grade 2 = 21%–40% of items omitted; Grade 3 = 41%–60%; Grade 4 = 61%–80%; Grade 5 = 81%–100% | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>Two examiners agreed on presence or absence of neglect on 7 out of 8 tests<br>(Stone et al., 1991[77])<br><br>**Internal consistency:**<br>No evidence | **Construct validity:**<br>*Convergent validity:*<br>16 out of 17 patients with neglect on the RBIT-short had neglect on the occupational therapist assessment of neglect in activities of daily living checklist (Stone et al., 1991[77])<br><br>**Criterion validity:**<br>No evidence<br><br>**Responsiveness:**<br>Responsive to clinical change over 3 months ($p$ = 0.02–0.05)<br>(Stone et al., 1991[77]) | **Skills:**<br>Writing, reading, hold a pencil, visual memory, visual perceptual skills, unilateral voluntary movement and control of shoulder, elbow, and fingers<br><br>**Testing position:**<br>Supine in bed or seated at a table<br><br>**Time:** 11 min<br><br>**Concern:** Rule out apraxia and aphasia |

**Table A-IV.** Personal and near extrapersonal space

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *National Institute of Health (NIH) Stroke Scale*<br><br>(Adams, Davis, Torner, Grimsman, & Berg, 1998[71]) | This quantitative neurological assessment measures motor, sensory, perceptual, and speech impairments<br><br>**Scoring:** A higher score on this 14-item (3- or 4-point scale) test indicates greater deficit | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>Moderate to substantial inter-rater and intra-rater agreement (mean kappa = 0.69)<br><br>**Internal consistency:**<br>No evidence<br><br>(Brott et al., 1989[73]) | **Construct validity:**<br>No evidence<br><br>**Criterion validity:**<br>*Convergent validity:*<br>With CT scan at 7 days, $r = 0.74$<br>(Brott et al., 1989[73])<br><br>**Responsiveness:**<br>Responsive to the relative differences in the treatment and control group in intervention studies (Orgogozo, 1998[74]) | **Skills:**<br>No specific skills required<br><br>**Testing position:**<br>Supine in bed or seated on a chair<br><br>**Testing endurance:**<br>10 min |
| *Hemispheric Stroke Scale*<br><br>(Adams, Meador, Sethi, Grotta, & Thomson, 1987[72]) | It is a quantitative neurological assessment for stroke that measures motor, sensory, perceptual, and speech impairments. It includes the Glasgow Coma Scale.<br><br>**Scoring:** Each subtest has a graded scoring system with a maximum score of 100. A higher score indicates greater deficit. | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>$r = 0.95$<br><br>**Internal consistency:**<br>alpha = 0.88<br><br>(Adams, Meador, Sethi, Grotta, & Thomson, 1987[72]) | **Construct validity:**<br>*Convergent validity:*<br>Global assessment, $r = 0.89$<br>Barthel Scale, $r = 0.95$<br>(Adams, Meador, Sethi, Grotta, & Thomson, 1987[72])<br><br>**Criterion validity:**<br>No evidence<br><br>**Responsiveness:**<br>No evidence | **Skills:**<br>No specific skills required<br><br>**Testing position:**<br>Supine in bed or seated on a chair<br><br>**Testing endurance:**<br>10 min |

**Table A-V.** Personal, near, and far extrapersonal space

| Assessment tool | Description | Reliability | Validity | Skills required |
|---|---|---|---|---|
| *Catherine Bergego Scale*<br><br>(Azouvi et al., 1996[48]) | A direct observation of the patient in 10 everyday activities such as knowledge of left limbs, dressing, safe mobility, grooming, eating, personal belongings, gaze orientation, auditory attention, spatial orientation, mouth cleaning<br><br>This scale can also be administered as a questionnaire to assess how the patient self-evaluates his/her neglect during ADL using same scoring system (anosognosia).<br><br>**Scoring:** Each item is on a 4-point scale where 0 is no presence of neglect; 1 is mild neglect, 2 is moderate neglect, and 4 is severe neglect. Specific criteria for each score are given.<br>For the self-evaluation, the patient is asked to rate his/her difficulty for each item using a 4-point scale (0 = no difficulty, 1 = mild, 2 = moderate, 3 = severe).<br><br>Anosognosia score = rater's CBS score minus patient's self-evaluation score | **Test-retest:**<br>No evidence<br><br>**Inter-rater:**<br>Kappa coefficient for each of the items ranged from 0.59–0.99<br>Spearman's rho = 0.96 (Azouvi et al., 1996[48])<br><br>**Internal consistency:**<br>Spearman's rho = 0.58–0.88 between each item score and the total score<br>Personal hygiene = 0.58<br>All other items were >0.69<br>Mobility = 0.88<br>Dressing = 0.86<br>(Azouvi et al., 1996[48])<br><br>Principal component analysis of CBS: 1 factor explained 65.85 of total variance<br>All items loaded on this factor with a range of 0.77–0.84 (Azouvi et al., 2003[90])<br>Rasch-computed reliability is satisfactory (Azouvi et al., 2003[90]) | **Construct validity:**<br>*Convergent validity*<br>Spearman's rho: With Albert's Test = 0.73 (Azouvi et al., 1996[48])<br>Pearson: With Bell's Test: $r = 0.76$<br>Figure Copying: $r = 0.70$<br>(Azouvi et al., 2003[90])<br>*Known Groups:* Difference in scores between those identified with and without neglect is statistically significant (Azouvi et al., 1996[48])<br>Correlates with anosognosia score $r = 0.79$ (Azouvi et al., 2003[90]) and Barthel Index (ADL)<br>Spearman rho = -0.63 (Azouvi et al., 1996[48])<br><br>**Criterion validity:**<br>While incidence of USN identified on the Bell's Test was 53.8% and Figure copying was 44.4%, the 10 items on the CBS had a range of 49.5% to 79.5%. (Azouvi et al., 2003[90])<br>Sensitivity: 96% (using Bell's Test, Figure Copying, and Text reading as "gold standard")<br><br>**Responsiveness:**<br>Documents clinical change in severe neglect patients following visuo-spatio-motor cueing (Samuel, Louis-Dreyfus, & Kaschel, 2000[91]) | **Skills:**<br>Unilateral voluntary movement and control of upper and lower limbs<br><br>**Testing position:** Seated in front of a table, standing, and ambulating<br><br>**Time:** >30 min<br><br>**Concern:** Rule out apraxia |