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A short bedside battery for visuoconstructive hemispatial neglect: Sunnybrook Neglect Assessment Procedure (SNAP)

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Although it is currently not known whether early assessment and treatment of hemispatial neglect improves rehabilitation outcome, identification in the acute phase of post stroke is important for nursing, counseling families, and planning intervention strategies. Previous tests of neglect either fail to detect mild forms of neglect or are too lengthy for use at the bedside. We tested and selected an efficient, small battery of tests to address this gap. Two hundred and twenty-four stroke patients completed the Sunnybrook Neglect Assessment Procedure (SNAP). Normal performance was determined from a population of 100 normal elderly volunteers. The SNAP was shown to be a highly reliable and valid instrument. Factor analysis showed good internal consistency, suggesting that performance on each subtest is positively correlated with the others. The SNAP is a useful and reliable tool to assess neglect at the bedside in acute stroke patients.

Keywords: Hemispatial neglect; Unilateral neglect; Assessment; Visuospatial attention.

Hemispatial neglect is a common sequela of acute hemispheric stroke that is usually more severe and persisting following right-hemisphere damage (RHD; Weintraub & Mesulam, 1987). Patients with hemispatial neglect fail to orient or respond to stimuli on the side of space contralateral to their brain damage (contralesional; Heilman, Watson, & Valenstein, 1993). The frequency of neglect has varied widely depending on definitions that are applied, patient selection, and the instruments used to assess it, with an approximate incidence rate of 23% and estimates ranging from 8% to 81% (Bowen, McKenna, & Tallis, 1999; Cassidy, Lewis, & Gray, 1998; Fullerton, McSherry, & Stout, 1986; Hier, Mondlock, & Caplan, 1983; Ogden, 1987; Schenkenberg, Bradford, & Ajax, 1980; Stone, Halligan, & Greenwood, 1993; Stone et al., 1991). A more recent report on neglect frequency confirmed that acute neglect is quite common, occurring in 48% of right-hemisphere stroke patients, but this percentage could be further subdivided depending on subtype classification (Buxbaum et al., 2004). A large-scale cohort analysis of 1,281 stroke patients revealed neglect in 43% of right-brain-lesioned (RBL) patients and 20% of left-brain-lesioned (LBL) patients (Ringman,

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Saver, Woolson, Clarke, & Adams, 2004). The same authors concluded that after three months, neglect persisted in 17% of RBL patients and 5% of LBL patients (Ringman et al., 2004). Although spontaneous improvement can occur in many cases, it is usually not a complete recovery, and neglect often remains a chronic disabling disorder for stroke survivors (Farné et al., 2004; Hier et al., 1983; Katz, Hartman-Maeir, Ring, & Soroker, 1999; Samuelsson, Jensen, Ekholm, Naver, & Blomstrand, 1997). Furthermore, neglect is recognized as a major impeding factor to improved functional outcome, leading to a more difficult recovery period for these patients (Boisson & Vighetto, 1989; Denes, Semenza, Stoppa, & Lis, 1982; Edmans, Towle, & Lincoln, 1991; Fullerton, Mackenzie, & Stout, 1988; Jehkonen et al., 2000; Kalra, Perez, Gupta, & Wittink, 1997; Katz et al., 1999; Stone, Patel, & Greenwood, 1993). The severity of behavioral symptoms can range from mild to severe, but when severely affected, patients completely ignore information or events in contralesional hemispace and have difficulties with simple activities of daily living, such as eating and dressing. Even mild neglect, however, can significantly impact an individual's life by restricting other day-to-day routines like driving. Being unable to complete routine daily activities can have a detrimental impact on a patient's independence and subsequent recovery (Stone, Patel, & Greenwood, 1993). Rehabilitation specially designed for neglect can help patients learn compensatory techniques to alleviate their deficits, enabling them to become more self-reliant (Antonucci et al., 1995). It is important that patients with neglect receive counseling and rehabilitation training as early as possible to expedite their recovery and reduce hospital stay. Thus, neglect should be assessed clinically and recognized as early as possible after stroke onset. Given the already overburdened demands on clinicians and patients, it is also important that any bedside standardized neglect battery be as efficient and comprehensive as possible. However, it is currently unknown whether the timing of rehabilitation programs affects eventual outcome. Early assessment and treatment of neglect has the potential to improve rehabilitation options and is worthy of further investigation.

There are many tests available to assess hemispatial neglect. Some have been developed for the specific purpose of dissociating different types of neglect, such as motor-intentional versus sensory-attentional (D'Esposito, McGlinchey-Berroth, Alexander, Verfaellie, & Milberg, 1993; Maeshima et al., 1997; Na et al., 1998) and personal versus extrapersonal neglect (Beschin & Robertson 1997; Guariglia & Antonucci, 1992). More generally, neglect assessment tools can be divided into two categories: those used for quick screening and those used for in-depth assessment. The more comprehensive batteries such as the Behavioural Inattention Test (BIT; Wilson, Cockburn, & Halligan, 1987) are generally too demanding for bedside testing in the acute/subacute stage of stroke. On the other hand, the options for screening tools have a variety of strengths and weaknesses. Some have shown higher sensitivity to detect neglect symptoms (Zoccolotti et al., 1989), while others have an increased ability to detect change over time (Fullerton et al., 1986). In reviewing screening test choices for neglect, it becomes apparent that the psychometric properties of many have not been evaluated (Menon & Korner-Bitensky, 2004). Furthermore, it is clear that even the most studied screening tests, such as the cancellation and line bisection tasks, assess different dimensions of the disorder and as a result are not comprehensive enough on their own. Lastly, many of the instruments have been designed to test neglect arising from nondominant (usually right) hemisphere damage and have not been properly tested in patients with damage to their dominant (usually left) hemisphere who are often unable to complete language-associated tasks (Towle & Lincoln, 1991; Wilson et al., 1987). Right hemispatial neglect following left-hemisphere damage (LHD) is detectable if appropriately tested (Nagafuchi, 1990; Ogden, 1987) in approximately one third of LHD patients (Leibovitch et al., 1997), although it is usually mild, and its impact on outcome has not been well studied. Thus it is desirable for a bedside battery of tests for neglect to be usable in patients with damage to either hemisphere.

Another issue with current batteries is that they take too long to administer, given the competing demands for clinical care in the acute hospital setting. A study of acute care hospitals in Canada found that only 13% of patients received a standardized neglect assessment, and a mere 4% were assessed within 48 hours post stroke or 48 hours after regaining consciousness (Menon-Nair, Korner-Bitenski, Wood-Dauphinee, & Roberson, 2006). Assessment within this window with standardized and valid assessment tools is recommended by the clinical best practice guidelines for stroke (Lindsay et al., 2010), but many facilities are unable to meet these best practice requirements. In addition to having an assessment tool that is easy to administer and minimizes the time required, it is also desirable to have a battery of tests that maximizes sensitivity. With these desiderata in mind, we compiled a standardized battery of pragmatic paper-and-pencil tests of neglect that could be administered quickly and reliably at the bedside, with sufficient sensitivity to detect even mild neglect so that a patient could be referred quickly for rehabilitation training.

METHOD

Participants and procedure

The study sample consisted of 224 stroke patients (125 with RHD and 99 with LHD) selected from a prospectively studied stroke population admitted to the Acute Stroke Care Unit at Sunnybrook Health Sciences Centre in the early 1990s. The patient sample consisted of 122 males (102 females) with a mean age of 72 years. The SNAP was administered to all patients within 7 (±4) days post stroke. Study inclusion criteria included right-handedness, adequate visual acuity (>20/40), and the ability to complete the battery of tests. One hundred and ten volunteers from the community were recruited as control participants, although not all subjects completed all subtests. Based on the performance of the control volunteers, normal limits of performance on the battery were calculated.

The original battery had several other drawings, paragraph reading, writing, and additional visual search tasks, but based on pilot studies in an initial sample of 40 stroke patients (Black, Vu, Martin, & Szalai, 1990), it was determined that the current four tasks were nonredundant and complementary to each other.

The Sunnybrook Neglect Assessment Procedure (SNAP) consists of four paper-and-pencil visuoconstructive subtests: *drawing/copying* of a clock and daisy; *line bisection; line cancellation* (modified from Schenkenberg et al., 1980); and *shape cancellation* (p. 146, Fig 2.6 from Mesulam, 1985, with permission of Oxford University Press). These tasks have demonstrated strong psychometric properties individually in the past and have been recognized for their usefulness in neglect screening (Menon & Korner-Bitensky, 2004). A recent study evaluating several clinical measures used to detect neglect found that shape cancellation and line bisection tasks were among those tests with the highest level of sensitivity (Lindell et al., 2007). Furthermore, it is consistently found that multiple tests combined to assess neglect are more sensitive than any one test alone (Azouvi et al., 2002; Halligan, Cockburn, & Wilson, 1991). It was thus important to include all these tests as part of the SNAP. Based on a weighted sum of the four SNAP subtests, a total neglect score out of 100 was calculated for each subject. The scoring system was originally based on clinical intuition, and statistical validation is presented in the current study. Normal limits of performance were determined in 75 elderly volunteers for the line bisection subtest and 45–51 volunteers for the remaining subtests.

Tools required for SNAP administration

SNAP requires two blank sheets of paper for the spontaneous drawings of a clock and daisy, two other sheets of paper with a drawing of a clock and daisy for copying, the line bisection, line cancellation, and shape cancellation subtests, and a pen/pencil.

Order of administration of the subtests of SNAP

1. Spontaneous drawing of clock and daisy
2. Line cancellation
3. Line bisection
4. Copying of clock and daisy
5. Shape cancellation.

Administration instructions for SNAP

Spontaneous drawing tasks

Place a blank $8\frac{1}{2} \times 11$-inch white sheet of paper in front of the patient, ensuring the page is midline to the patient. Repeat to the patient: "*I want you to draw a clock face and make sure you put all of the numbers on the clock*." With a fresh piece of blank paper, say to the patient: "*Now, I want you to draw a daisy, a flower with many petals*."

Line cancellation task

The line cancellation task consists of an $8\frac{1}{2} \times 11$-inch white sheet of paper with 21 lines scattered across the page, with 10 lines to the left and right of midline and 1 at midline. Position the page in front and midline to the patient and repeat: "*For this task I want you to cross out all of the lines on this page*." Demonstrate the task by crossing out the one line in the center of the page. Say to the patient: "*Let me know when you are finished the task*." Mark a T at the top of the page to ensure the test is scored correctly.

Line bisection task

The line bisection task consists of two $8\frac{1}{2} \times 11$-inch white sheets, each with two lines positioned on the upper half and lower half of the page, respectively. One page contains two 15-cm lines and the other has two 20-cm

> lines. Position the page with the 15-cm lines at the patient's midline and repeat: "*For this task I want you to make a mark on this line that divides this line into two equal halves. I want you to draw a mark that cuts this line exactly in half.*" If the bottom line is distracting, then it may be covered with a blank piece of paper. Repeat the procedure using the bottom line. Mark the top of the page to ensure the task is scored correctly. Repeat the entire procedure using the page with the 20-cm lines.

Copying tasks

> Place the picture of the clock in front of the patient and align the test midline to the patient. Repeat to the patient: "*I want you to copy this picture the best you can*." Do not tell the patient it is a picture of a clock face. Using the picture of a daisy, repeat to the patient: "*I want you to copy this picture the best you can*." Once again, do not tell the patient it is a picture of a daisy.

Shape cancellation task

> The shape cancellation task consists of an 8½ × 11-inch white sheet of paper with different shapes scattered across the page, including both targets and distractors. Position the test at the patient's midline. Show the patient a magnified picture of the target and say "*Here is the target. Please find and circle all the targets on this page. Do not circle anything else other than the target. When you are satisfied that you have circled all the targets let me know that you are finished*." Mark the top of the page to ensure the task is scored correctly.

SNAP scoring

Scoring of the various subtests was based on omissions made contralateral to the side of brain damage—that is, left-sided omissions are scored in patients with right-hemisphere damage and right-sided omissions in patients with left-hemisphere damage. Separate scoring sheets were used for patients with right and left-hemisphere strokes. For this study, ipsilateral omissions and commissions were not included in tabulating the final score. See Figure 1 for an example of SNAP scoring for a patient with right-hemisphere stroke.

Copying and drawing

The decision rules with respect to the drawings/copyings were based on a blinded reliability study of elderly controls and stroke patients (Black et al., 1990) and were guided by the need to balance reliability with sensitivity. To achieve a satisfactory interrater reliability, actual omissions, and not just distortions or poor executions, were required on the contralateral side of the drawing to count as abnormal. All copying and drawing tasks were scored according to the same guidelines. Drawings with significant omissions of detail on the contralateral half were scored as showing neglect. Omissions include details missing on the contralateral half but present on the ipsilateral half—for example, missing numbers on the clock face or missing petals on the daisy and/or leaves on the stem. Poorly placed numbers or petals that resulted in gaps were not scored as errors of omission. Drawings that were not recognizable due to severe constructional apraxia were considered unassessable. Patients with no omissions on drawing/copying were given a score of 0, those with one abnormal drawing/copying were given a score of 20, and patients with two or more abnormal drawing/copyings were given a score of 30.

Line cancellation

Omission of any line on the contralateral half of the page was scored as neglect. There was a maximum of 10 omitted lines per side. Each line was given a "weight" of 3, for a maximum score of 30 (i.e., 10 × 3) for the line cancellation task.

Line bisection

Line bisection score was based on the mean percentage deviation of the patient's mark from the true midpoint, modified from Schenkenberg et al. (1980). Instructions were as follows:

> Using the transparency provided in SNAP, place the transparency over the correct line (i.e., either the 15- or the 20-cm line) and determine the percent deviation for that line. Repeat with the other three lines. Average the percent deviations for the four lines and using the legend on the transparency determine the score associated with the average percent deviation.

Note there is a different legend to use depending on which hand is used to bisect the lines. This is because we found that the normal controls deviated slightly more to the left when using the left hand, a finding previously reported (Brodie & Pettigrew, 1996). Thus line bisection scores were adjusted to reflect hand use. Maximum line bisection score was 10.

A score was also obtainable without the transparency, albeit with some additional required calculations. Instructions were as follows:

> Using a ruler, find the midpoint of the line, mark it with a pencil, and then measure the amount of deviation of the patient's marking from that midpoint. Convert the deviation to a percentage (deviation in mm divided by either 75 for the 15-cm line or 100 for the 20-cm line, and then multiply by 100). Next average the percent

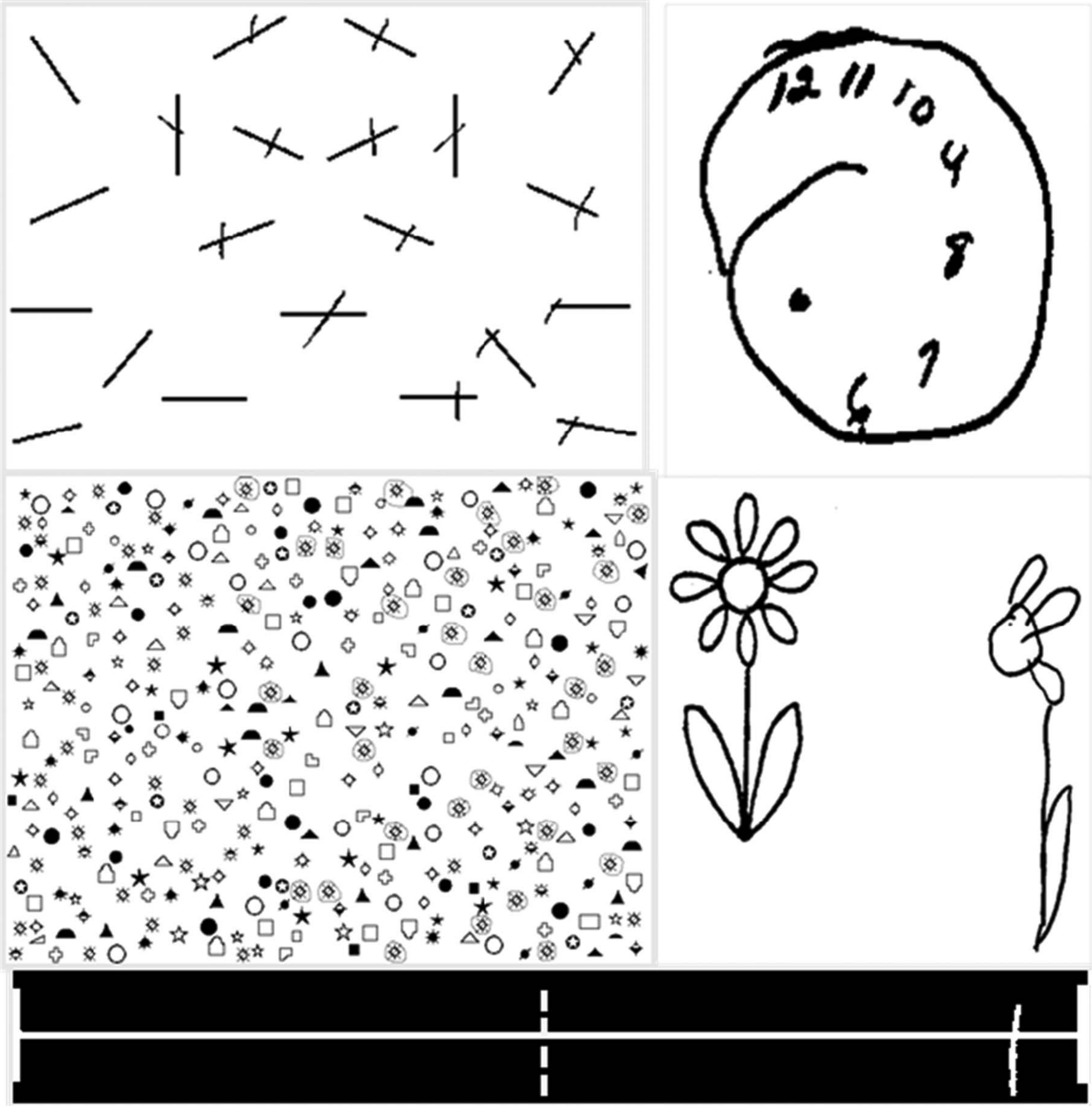

Figure 1. Sample scoring on the Sunnybrook Neglect Assessment Procedure (SNAP). SNAP scoring of a right-hemisphere stroke neglect patient. Drawing and copying task (clock and daisy)—number of drawings scored as neglect (e.g., 2 = 30 points). Line cancellation—number of lines missed multiplied by 3 (e.g., 6 × 3 = 18 points). Shape cancellation—number of target shapes not circled (e.g., 24 = 24 points) (adapted from Mesulam, 1985, with permission of Oxford University Press). Line bisection—number of standard deviations from normal mean percentage deviation multiplied by 2 (e.g., 89% > 5 *SD* × 2 = 10 points). Total score = 82/100.

deviations for the four lines and using a look-up chart based on normal control performance, determine the score for the averaged percent deviation (2 points were assigned to each standard deviation away from the mean of the normal controls).

Shape cancellation

All targets omitted on the contralateral half of the page were counted. There were 30 targets on each half of the page. Each target missed was given a score of 1, for a maximum score of 30.

SNAP total scoring

A complete score was calculated by summing the scores for the individual subtests. Total SNAP scores can range from 0 (normal performance) to 100 (maximum neglect performance). Performance on the battery was classified according to neglect severity, based on clinical intuition. Based on the performance of the normal controls, total SNAP score was considered within normal limits if it was <5. Mild–moderate neglect was classified as SNAP scores 5–40, and severe neglect was classified as SNAP scores >40. For the individual subtests, no normal control omitted any details on the drawing/copying subtests, or missed circling any lines on the line cancellation subtest. Thus, any contralateral omissions (and hence any scores above 0) were considered to be showing neglect behavior. For the line bisection subtest, we asked our normal controls to bisect the lines using both their hands, in random order across subjects. Deviation from the midline was calculated for the right and left hands separately. Paired *t* tests showed there was no difference in the performance based on hand use, $t(74) = -1.8$, $p = .08$, although there was a trend towards leftward deviation with left hand usage. Based on these data, normal limits were calculated as the mean deviation from the sample and within 2 standard deviations (*SD*s). Outside 2 *SD*s, a score of 2 was given for every additional *SD*. This procedure was simplified with the use of the transparency provided in SNAP. Finally, 70% of the normal controls did not omit any targets on the shape cancellation task, and 4 of 50 controls missed two targets. Thus, a score of 3 or greater on the shape cancellation task was considered abnormal.

RESULTS

Hemispatial neglect was reported in this sample to occur in 54% of RHD patients, in 34% of LHD patients, and in 45% of overall stroke patients. Shape cancellation was the most frequently abnormal subtest in both the RHD and the LHD groups. Statistical tests were also applied to the patient data to test the validity and reliability of the data sets and of the weighted scoring system.

Reliability

Internal consistency

The scores from the four subtests were correlated with each other to investigate whether there was any redundancy. A very high correlation (i.e., $r > .9$) between subtests would imply that only one of them needs to be administered and that no additional information can be obtained from the redundant subtest. Although the subtests significantly correlated with each other ($p < .0005$), the Pearson correlation coefficients were all less than .7 for each of the correlations. The fact that the correlation coefficients were positive and relatively high implies that performance on each subtest provides similar information and is therefore measuring the same construct (i.e., visuospatial abilities). However, that all of the coefficients remained under .7 also implies that the subtests are not redundant and that each one is providing somewhat different information. Cronbach's coefficient α was calculated to determine the internal consistency reliability of the SNAP subtests. Overall, the Cronbach's coefficient α was .84, and removal of any subtest reduced α further, thus establishing a high level of internal consistency reliability.

Factor analysis of the subtest scores for all patients ($n = 224$) revealed that all four subtests equally loaded onto a single factor that accounted for 69% of the total variance (eigenvalue = 2.8). To see whether the same pattern emerged in RHD and LHD patients, factor analysis was carried out separately in both populations. For RHD patients ($n = 126$), a very similar pattern emerged, with all four subtests equally loading onto a single factor, which also accounted for 69% of the total variance (eigenvalue = 2.9). Correlation of the four subtests also revealed a relatively high correlation among the subtests, although no correlation was greater than .8. For LHD patients ($n = 98$), a somewhat different picture unfolded. Factor analysis revealed two factors, which together accounted for 62% of the total variance. The first factor, which accounted for 37% of the total variance, had three subtests—drawing/copying, line cancellation, and shape cancellation subtests—positively and equally correlated with that factor. Line bisection, on the other hand, correlated slightly negatively with that factor ($r = -.1$) and correlated positively and almost independently ($r = .97$) with the second factor, which accounted for 25% of the total variance.

Reproducibility

To assess the stability of SNAP, inter- and intrarater reliability statistics were calculated for the individual subtests and the total battery. The test set for administration reliability consisted of an equal mix of patients and normal controls. Twenty-four subjects were given repeated administration of the battery and were scored by one rater. Of the 24 subjects with repeated administration, 12 were elderly normal controls, and 12 were stroke patients, 6 of whom had neglect (5 with right-hemisphere damage and 1 with left-hemisphere damage). For stroke patients, the battery was given, in most cases, within 24 hours at approximately the same time of day. For the normal controls, the battery was administered in most cases on the same day, approximately 2–3 hours apart. For scoring reliability, a different set of 20 batteries, including an equal mix of normal controls and stroke patients, were selected and were rated by two different raters. Kappa statistics were performed on the drawing/copying scores, and intraclass correlation coefficients were calculated for all other comparisons. Overall, the correlations were high for individual subtests and the total battery (mean $r = .92 \pm .08$, range .73 to .99, $p < .001$, for all tests), thus showing that SNAP is a highly reliable instrument.

Validity

Face validity

Face validity refers to the question of whether the test "on the face" looks like it tests what it should. The subtests of SNAP mainly consist of modified visuoconstructive tasks that, in isolation, have been used as tests of neglect. Thus, on the whole, the selected subtests would appear to be appropriate for obtaining a measure of neglect.

Concurrent criterion validity

Concurrent criterion validity refers to the ability of the test of interest to perform as accurately as the "gold standard." There is no comparable gold standard for assessing neglect in terms of short length and ease of administration. One option could have been to use the shortened BIT (Stone, Wilson, & Rose, 1987), composed of conventional subtests that are very similar to those of the SNAP (e.g., line crossing, star cancellation, and figure copying) and behavioral subtests, which are more related to functional performance. However, we could not use the BIT because data collection for this study predated the availability of the BIT. Furthermore, the behavioral subtest component contains some language-based tasks that would not be appropriate for testing left-hemisphere aphasic stroke patients, a group we wanted to capture in the development of the SNAP, in order to revisit hemispheric specialization. Instead, we used a visual search task using the visual search board (VSB; Kimura, 1986), which had been validated for use at the bedside, as a comparator. In this visuospatial task, patients have a large board placed in front and midline to them. The board has a number of schematic drawings scattered on the page, some of which are present on both sides. A matching picture is placed in front of the patient, who has to point to the matching drawing on the board. The time needed to find the item on the board is recorded using a stopwatch, and then subtotals can be calculated for items located in each hemisphere. A time difference (time to find contralesional items minus time to find ipsilesional items) is calculated, and those with a time difference of 4 or greater are considered to be displaying neglect, as described by Kimura (1986). Using the VSB as the comparator, SNAP was significant on logistic regression ($p < .001$) in predicting neglect category (present/absent) on the VSB and had an area under the curve of 0.78, showing that the SNAP had good concurrent criterion validity.

Individual subtest comparison revealed that the shape cancellation subtest was the most sensitive subtest in identifying neglect category (sensitivity = 70%), while the drawing/copying subtest was the most specific (specificity = 99%). Overall, sensitivity of the SNAP was 68%, and specificity was 76% compared with the VSB task.

DISCUSSION

Visual neglect has been shown to be a poor prognosticator of outcome, impeding functional recovery among stroke patients (Boisson & Vighetto, 1989; Denes et al., 1982; Edmans et al., 1991; Fullerton et al., 1988; Jehkonen et al., 2000; Kalra et al., 1997; Katz et al., 1999; Stone, Patel, & Greenwood, 1993). There has been much research on rehabilitation techniques for neglect, and several intervention strategies have demonstrated the ability to decrease neglect symptoms (Antonucci et al., 1995; Katz et al., 1999; Stone, Patel, & Greenwood, 1993; also see Luauté, Halligan, Rode, Rossetti, & Boisson, 2006, for review). However, the first step before enrollment in cognitive intervention is to detect the presence of neglect. Thus, it is important that patients are assessed quickly and are entered into neglect rehabilitation training as soon as possible so that they can make the quickest and most complete recovery possible.

Speed of administration is a key strength to the SNAP that sets it apart from other neglect assessment procedures. However, the SNAP does have much in common with other batteries of neglect, such as conventional subtests of the Behavioral Inattention Test (Halligan, Marshall, & Wade, 1989; Wilson et al., 1987), which is a similar compilation of visuoconstructive tests as well as other functional measures. Although the BIT has been shown to be related to activities of daily living and is more comprehensive than the SNAP, it would be more appropriate for rehabilitation setting than at the bedside in the acute hospital, due to its longer administration time. Furthermore, while the BIT exists in modified form as a shortened version, with only a subset of tests being administered, the test has not been assessed in terms of internal consistency and reliability when patients with left- and right-hemisphere damage are considered separately. This is especially important given that patients with right-hemisphere damage have been found to have more frequent, severe, and persisting neglect (Agrell, Dehlin, & Dahlgren, 1997; Cassidy et al., 1998; Stone, Halligan, & Greenwood, 1993). Moreover, patients with left-hemisphere damage may also be suffering from aphasia, which could confound interpretation of the results of some BIT subtests.

We have developed the Sunnybrook Neglect Assessment Procedure (SNAP), a simple-to-use bedside battery to assess visuospatial neglect in the acute phase of stroke. The purpose of this battery was to provide clinicians a reliable, standardized tool to assess hemispatial neglect with good sensitivity and specificity. The SNAP was shown to have high inter- and intrarater reliability, both in its administration and in its scoring routines. The SNAP was shown to have good criterion validity when compared with another visuospatial test for neglect (the VSB task), one that is less amenable to bedside testing since it requires a large wooden board to be carried around. We used this visual search type task because it was a good choice given the available options at the start of the study. Presently, the VSB task is not an established gold standard by which to measure the criterion for acute visual neglect. Although this choice of comparison task could be considered a limitation of the current study, there still is no widely accepted gold standard to date. It nevertheless suggests that the SNAP has good criterion validity, and it is likely that comparison with a current standardized battery (e.g., shortened BIT) would also show good validity.

Content validity refers to the broadness of the test and the relationship to the hypothesis upon which the test is based. In other words, it is assumed (or hypothesized) that patients with higher scores on the SNAP would have more severe neglect. One problem with assessing content validity for hemispatial neglect is that there is no definitive method of assessing neglect status without the use of another battery of tests. The SNAP does have good face and concurrent criterion validity, and it is reasonable to assume that it also has good content validity. The SNAP assesses visuospatial performance in four different ways, providing a tool that is more sensitive and specific than any individual subtest and one that is easily applied at the bedside.

A high Cronbach's α coefficient demonstrated that the SNAP had good reliability. Factor analysis of the battery also showed that it had good internal consistency, and the subtests of the SNAP all loaded positively onto a single factor for the overall analysis, suggesting that performance on each of the subtests is positively correlated with the others. In other words, each subtest is assessing similar visuospatial abilities, and thus performance on one subtest is related to performance on another. However, the fact that the subtests did not have a correlation coefficient above .8 suggests that inclusion of all subtests allows for a better range of performance and severity. This is especially important since neglect is not an all-or-none phenomenon (Halligan et al., 1989; Halligan & Marshall, 1992; Maeshima et al., 1997), but rather one that shows an erosion of visuospatial processing, often degrading along (but not limited to) the left–right horizon (Ahern, Herring, Labiner, & Weinand, 1998; Behrmann, Barton, Watt, & Black, 1999). Although all subtests loaded onto one factor in the analysis when all patients were included, a different model emerged when factor analysis was performed on patients with right- and left-hemisphere damage separately. For right-hemisphere-damaged patients, a very similar model to the one with all patients included emerged. However, factor analysis on the left-hemisphere-damaged patients alone found that two factors emerged. The first had three of the four subtests—drawing/copying, line cancellation, and shape cancellation—but not the line bisection load onto it. The second had line bisection load onto it almost exclusively. This finding is in keeping with the idea that neglect is not a single entity. Since patients with mild neglect predominated in the left-hemisphere-damaged group, it may be that the differences seen are directly related to severity. On the other hand, it may be that neglect resulting from damage to each hemisphere results in a different type of neglect. In either case, it is often important to be able to assess neglect severity at the bedside, and we have shown that the SNAP is a simple, easy-to-use, sensitive, and reliable test suited for this function.

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