REPORT

# Multidisciplinary Screening of Cognitive Impairment Following Acquired Brain Impairment. Is there Repetition?

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People with acquired brain impairment, such as stroke or traumatic brain injury, commonly experience cognitive impairment. There is evidence that cognitive ability significantly relates to functional performance (Carter, Oliveira, & Lynch, 1988; Knight, 2000), therefore cognitive impairment is prognostically important within brain impairment rehabilitation. Thorough assessment is an essential prerequisite to develop an appropriate rehabilitation plan for cognitive impairment (Depoy, 1992) and within a rehabilitation unit, assessment of cognition is undertaken by a number of different health professionals (Toglia, 1999).

Psychologists and occupational therapists commonly administer cognitive assessments to patients following acquired brain impairment (Toglia, 1999). These assessments often place a large burden of assessment time on the patient (Sodring, Laake, Sveen, Wyller, & Bautz-Holter, 1998) and are subjectively thought to overlap one another with respect to outcomes. This, combined with the professional goal within occupational therapy towards using functional evaluation of cognition, all raises questions regarding the necessity of both professions to administer standardised, pen-and-paper screening assessments of cognition.

Whilst a large body of literature exists relating to the validity and reliability of individual cognitive assessments, rarely is it acknowledged that different cognitive screening tools are routinely used in conjunction with one another within the clinical setting. Specifically, as clinicians we were interested to know the extent to which each of these screening tests yielded the same results as other screening tests, given that they purport to measure the same phenomenon (concurrent validity) and also the extent to which the occupational therapy screening adds to what is already known through screening undertaken by the neuropsychologist (incremental validity). The cost of duplicity (on both the patient and the rehabilitation facility) and the need to ascertain the unique value (diagnostic gain) of occupational therapy standardised assessments prompted this multidisciplinary project within our facility.

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## Method

### Subjects

A referred sample of 23 adults with acquired brain impairment from Townsville Hospital Rehabilitation and Neurology departments were involved in the study. Patients were medically stable, however all displayed cognitive impairment within functional tasks which prompted referral for formal cognitive screening. Complete data sets from 14 subjects were used in the final analysis; 9 subjects withdrew from the study following administration of only one of the two test batteries. Subjects had a mean age of 56 years (SD=15) and the majority were men (64%). Subjects had a mean education of 12 years (SD=3.5); 4 (28%) had less than 10 years, 5 (36%) finished high school, 3 (21%) had 1-3 years of college, and 2 (14%) completed 4 or more years of college. Most subjects (86%) were Caucasian, and all were native English speakers.

Subjects experienced the following acquired brain impairment diagnoses: 6 (43%) stroke, 6 (43%) traumatic brain injury, and 2 (14%) hypoxic brain injury. All subjects were right-handed prior to onset of acquired brain impairment.

Patients with visual, language, auditory or motor disturbances were not included in order to avoid the possible confounding effects on test performance. Further, those patients with untreated psychiatric disorders and those taking medications that impair cognition were also excluded from participation. All subjects completed the World Health Organization Alcohol Use Disorders Identification Test (AUDIT) to identify harmful or addictive alcohol use; all subjects who were classified as demonstrating these behaviours were subsequently excluded from the study.

Written, informed consent was obtained from all patients.

### Procedure

Two centres were involved in this study: the occupational therapy department in The Townsville Hospital, and the university department of psychology in James Cook University, North Queensland, Australia. A neuropsychology screening test battery of three tests (30 tasks) and an occupational therapy screening test battery of two tests (37 tasks) was given to each patient; the assessment batteries were chosen based on usual clinical practice within the respective departments. Calculations and comparisons with the results of both sets of data were completed only after all forms and reports had been received. Subjects received the test batteries (neuropsychology and occupational therapy) in no specific order; all tests were administered within 7 days.

The occupational therapy screening test battery included administration of the Cognitive Assessment of Minnesota (CAM) (Rustad, et al., 1993) and the Barry Rehabilitation Inpatient Screening of Cognition (BRISC) (Barry, Clark, Yaguda, Higgins, & Mangel, 1989), commonly used standardised assessments administered by occupational therapists within inpatient populations. The CAM is a standardised test which measures the cognitive abilities of adults with neurologic impairment; subtests measure attention span, memory orientation, visual neglect, temporal awareness, safety and judgement, recall/recognition, auditory memory and sequencing, and simple math skills (Rustad, et al., 1993). The BRISC is also a standardised screening assessment, divided into eight functional categories: reading, design copy, verbal concepts, orientation, mental imagery, cognitive functioning (mental control), verbal fluency, and memory (Barry et al., 1989). Both assessments have reported validity and reliability (Rustad, et al., 1993; Barry, et al., 1989) and were chosen because they were currently used in the clinical setting under study.

The neuropsychological test battery included administration of the Mini Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975), the Brief Neuropsychology Cognitive Evaluation (BNCE) (Tonkonogy, 1997), and The Neurobehavioural Cognitive Status Examination (Cognistat) (1985). The MMSE (Folstein, et al., 1975) is commonly used within clinical settings as a brief indicator of cognitive functioning and screens orientation to time and place, immediate recall, short-term memory, calculation, language, and constructive ability. The MMSE has established reliability and validity (Mitrushina & Satz, 1991; Anthony, LeResche, Niaz, VonKoroff, & Folstein, 1982; Folstein, et al., 1975). The BNCE assessment provides a general cognitive profile in a time-efficient manner and is composed of 10 subtests which evaluate working memory, gnosis, praxis, language, orientation, attention, and executive functions (Tonkonogy, 1997) and has been shown to be reliable and valid assessment within this client population. And finally, Cognistat (Kiernan, Mueller, Langston, & Van Dyke, 1987) is designed to rapidly assess cognitive functioning of adults in five ability areas: language, constructional ability, memory, calculation skills, and reasoning/judgment and more general factors (level of consciousness, attention, and orientation) are assessed independently (Schwamm, Van Dyke, Kieman, Merrin, & Mueller, 1987). Previous studies have shown Cognistat to be valid and reliable assessment within the population under study (Katz, Hartman-Maeir, Weiss, & Armon, 1997; Kiernan, et al., 1987; Schwamm, et al., 1987).

**Data Analysis**

For each instrument, scale scores were computed according to established scoring criteria. Cognistat results were not correlated within analysis of overall scores as the assessment does not calculate an overall score. Level of significance was predetermined at the .05 level.

Internal consistency reliability was estimated using Cronbach's alpha coefficient for each scale. In addition being a measure of reliability, coefficient alpha is another potential indicator of the construct validity of a measure, since it involves the cohesion of a set of items. The items of a measure possessing good internal consistency will be highly correlated, indicating that together they measure aspects of the same construct, in a reliable manner, from application to application (Nunnally & Bernstein, 1994). For the purposes of this study alpha> 0.6 was considered as evidence of an acceptable internal consistency of the instrument (Bland, 1997). The concurrent validity of the different instruments was assessed by examining the association between different scales that measure similar cognitive domains. Because of the small clinical sample size, Spearman correlation coefficient was computed, which has a possible range of -1.0 to 1.0 : the closer to 1 (in either direction), the stronger the association between scales. The discriminant validity of the different scales was evaluated by comparing their ability to detect cognitive impairment. Overall analysis of sensitivity was examined, including detection rates and discordant pair analysis using McNemar's test for correlated binomial proportions.

## Results

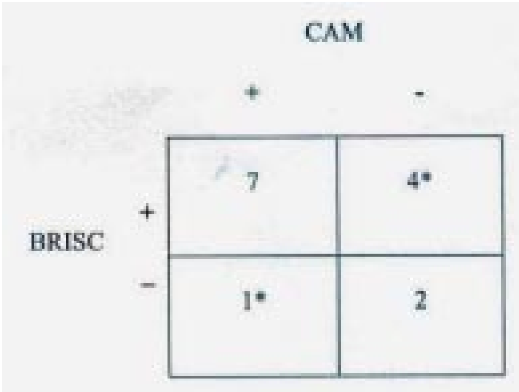
**Comparison of cognitive scales**

Unique test items were identified within CAM, including assessment for impairment in money management, social awareness, and planning ability, and within the Cognistat, assessment for consciousness only. The remaining assessments (BRISC, MMSE, and BNCE) did not contain test items unique to only themselves.

**Reliability**

The internal consistency reliability coefficients of all scales were satisfactory, ranging from good to excellent. The reliability of the CAM item scores produced an alpha coefficient of .89, BRISC produced an alpha coefficient of .85, MMSE produced an

**Figure 1a.**
*Discordant pair analyses of occupational therapy assessments' sensitivity. Scores in the impaired range (+) and unimpaired range (-) are given. * = discordant pair*



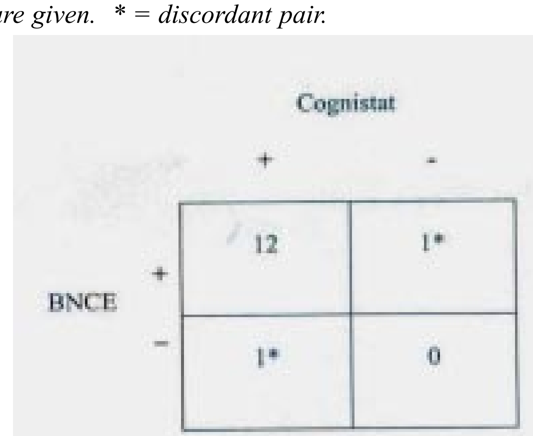

alpha of .69, BNCE produced an alpha of .841, and Cognistat produced an alpha of .75.

**Sensitivity:**

The battery of assessments administered by occupational therapists correctly identified cognitive impairments in 12 of the referred subjects (sensitivity 86%), and the battery of assessments administered by psychologists correctly identified cognitive impairments in all 14 (sensitivity 100%). Specifically, the BRISC identified deficits in 11 subjects, CAM in 7, BNCE in 12, and Cognistat in 13. The MMSE did not detect cognitive impairment in any of the 14 subjects.

In addition to comparing the overall detection rates, we compared the examinations looking for significant differences in sensitivity with a discordant pair analysis. Discordant pair analysis within the battery of assessments administered by occupational therapists demonstrated a total of 5 discordant pairs: one subject identified by CAM as being impaired was not identified by BRISC, and 4 subjects identified by BRISC as being impaired were not identified by CAM (Figure 1a). This difference in sensitivity was found to be non-significant by McNemar's test (p>.5).

**Figure 1b.**
*Discordant pair analyses of neuropsychology assessments' sensitivity. Scores in the impaired range (+) and unimpaired range (-) are given. * = discordant pair.*




For the purposes of discordant pair analysis within the battery of assessments administered by psychologists, results from MMSE were excluded. Analysis between the BNCE and Cognistat demonstrated a total of 2 discordant pairs: one subject identified by Cognistat as being impaired were not identified by BNCE, and one subject identified by BNCE as being impaired was not identified by Cognistat (Figure 1b). There was no difference in sensitivity between these two screening assessments. Discordant pair analysis between the overall results obtained by the occupational therapy and neuropsychology batteries of screening assessments demonstrated 2 discordant pairs (Figure 1c). This difference in sensitivity was found to be non-significant by McNemar's test (p>.5).

**Comparability:**

Scores on most of the screening measures were positively (and statistically significantly) correlated at the .05 level or higher (range r = 0.55 to r = 0.68). Highest correlations were found between CAM and BNCE results (r = 0.68).

**Convergent validity**

To determine if the administered screening tests assess cognitive abilities similar to each other, we examined the relationship between the CAM, BRISC, BNCE, Cognistat and MMSE. These correlations are shown in Table 1. Significant correlations were found between the CAM, BNCE and Cognistat for the test items which assess memory, following directions, orientation, calculation, and object identification. For sub-test items of attention and constructive praxis, correlations were found within the psychology battery only (i.e. between Cognistat and BNCE only). For sub-test items of visual neglect and mental flexibility, correlations were found within the occupational therapy battery only (i.e. between CAM and BRISC only).

**Figure 1c.**
*Discordant pair analyses of neuropsychology assessment vs. occupational therapy assessment sensitivity. Scores in the impaired range (+) and unimpaired range (-) are given. * = discordant pair*

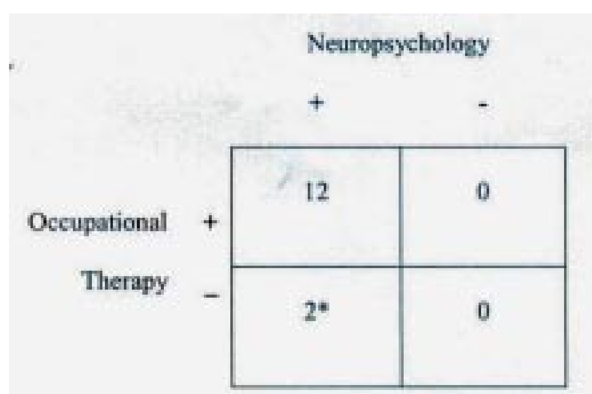


**Table 1.**
*Comparison of cognitive scales indicating incremental validity of unique test items.*

| | CAM | BRISC | MMSE | BNCE | COGNISTAT |
|---|---|---|---|---|---|
| Abstraction | ✓ | | | | |
| Attention span | ✓ | | ✓ | ✓ | ✓ |
| Calculations | ✓ | | | ✓ | ✓ |
| Comprehension | ✓ | | ✓ | ✓ | ✓ |
| Consciousness | | | | | ✓ |
| Construction Ability | | ✓ | ✓ | ✓ | ✓ |
| Following Directions | ✓ | | | | ✓ |
| Judgement | ✓ | | | | ✓ |
| Language | ✓ | ✓ | ✓ | ✓ | ✓ |
| Memory | ✓ | ✓ | | ✓ | ✓ |
| Mental Flexibility | ✓ | ✓ | | ✓ | |
| Money Management | ✓ | | | | |
| Orientation | ✓ | ✓ | ✓ | ✓ | ✓ |
| Planning | ✓ | | | | |
| Reasoning | ✓ | ✓ | | ✓ | ✓ |
| Shift Cognitive Set | | ✓ | | ✓ | ✓ |
| Social Awareness | ✓ | | | | |
| Visual Neglect | ✓ | ✓ | | | |

Unique test items

## Discussion

The purpose of this study was to take an initial look at whether the administration of standardised, brief screening assessments of cognition represents needless duplication for patients following brain impairment. This study showed that there is a significant, positive relationship between CAM and the battery of assessments administered by psychologists. This relationship included correlations between not only gross detection of cognitive impairment but also for the detection of individual cognitive strengths and weaknesses. In contrast, results obtained from BRISC showed a lesser positive relationship to the neuropsychology assessment battery and did not correlate well with individual cognitive skills. This may indicate that the CAM has greater content validity than the BRISC, however clinicians who choose to use these assessments should be aware that administration of the CAM is likely to duplicate the results achieved by administration of the assessments by the psychologists.

The use of a referred sample for this study provided insight into the sensitivity of the assessments in the absence of a control group. All subjects had displayed cognitive impairments within functional performance which prompted referral for cognitive screening, therefore it is reasonable that some impairment would be present on formal cognitive screening. On evaluation, the base detection rate of the Cognistat was highest, followed by BNCE, BRISC, CAM, and finally MMSE. The low detection rate of MMSE (0%) in our study replicates previous studies which indicate a high false negative rate (Schwamm, et al., 1987), and suggests that MMSE may not have adequate sensitivity to accurately screen for cognitive impairments with adults following acquired brain impairment, despite commonly being used within clinical practice for this purpose.

**Table 2.**
*Correlations between discrete items of cognitive scales p= 0.05 (2-tailed).*

| Correlation within Occupational Therapy Battery Only | Correlation within Psychology Battery Only (BNCE, SMMSE, Cognistat) (CAM and BRISC) | Correlation Between Occupational Therapy and Psychology Tests | No Correlation between any test items |
|---|---|---|---|
| **Visual Neglect**<br>CAM & BRISC r= 0.52 (p=0.03) | **Attention**<br>BNCE & Cognistat r= 0.77 (p=0.04) | **Memory**<br>BNCE & CAM r= 0.55 (p=0.035)<br>Cognistat & CAM r= 0.53 (p=0.041)<br>CAM & BRISC r= 0.53 (p=0.027) | **Comprehension**<br>BNCE & MMSE r= -0.10<br>Cognistat & MMSE r =-0.10<br>Cognistat & BNCE r=0.46 |
| **Mental Flexibility**<br>CAM & BRISC r= 0.56 (p=0.019) | **Constructive Praxis**<br>Cognistat & BNCE r= .73 (p=0.01) | **Following Directions**<br>Cognistat & CAM r= 0.73 (p=0.002)<br>BNCE & CAM r= 0.68 (p=0.005) | **Judgement**<br>Cognistat & CAM r= 0.12 (p=0.66) |
| | | **Orientation**<br>BNCE & BRISC r= 0.65 (p=0.008)<br>BNCE & SMMSE r= 0.61 (p=0.014)<br>Cognistat & MMSE r= 0.65 (p=0.009) | **Initiation**<br>BRISC & MMSE r=0.25 (p=0.38) |
| | | **Calculation**<br>Cognistat & CAM r= 0.81 (p<0.01) | |
| | | **Object Identification**<br>Cognistat & CAM r= 1.0 (p<0.01)<br>BNCE & Cognistat r= 0.65 (p=0.006)<br>BNCE & CAM r=0.57 (p=0.025) | |
| | | **Reasoning**<br>Cognistat & BRISC r= 0.66 (p=0.007) | |
| | | **Language**<br>Cognistat & BRISC r= 0.57 (p<0.05)<br>BNCE & BRISC r=0.69 (p<0.05)<br>Cognistat & BNCE r= 0.65 (p<0.05) | |
| | | **Shifting Set**<br>Cognistat & BRISC r= 0.66 (p<0.05) | |

The observed higher detection rate of the neuropsychology screening assessment battery overall compared to the occupational therapy screening assessment battery may have been resultant from the format of the individual neuropsychology assessment tools, namely Cognistat. Following acquired brain impairment an individual may preserve some areas of cognitive performance while displaying impaired performance in others (Toglia, 1999), allowing impaired performance on one test sub-scale to be masked by normal performance in other sub-scales. Cognistat does not combine results of performance in different cognitive areas into one total score such that successful performances in several areas does not obscure deficits in others, this ensuring high sensitivity to detection of impairment (Schwamm, et al., 1987). This conclusion is further supported by our finding of Cognistat having the highest detection rate of all the administered screening tests (93%).

It is acknowledged that the small sample size limit the findings from this study, particularly with respect to discordant pair analysis given the non-significant findings. Additionally, the use of a referred sample to investigate the sensitivity of the instruments did not allow investigation of specificity. However, the purpose of this preliminary study was to explore if the current clinical practice within a busy rehabilitation hospital resulted in duplication, and the results do suggest this may be the case. Further testing using a larger sample size is required in order to generalise these findings beyond the clinical site where the data was collected.

Sensitive tests are useful for the identification of impairment (Derrer, et al., 2001). Although it is ideal that screening tests be both sensitive and specific, prognostic screening requires high sensitivity, whereas specificity is ultimately required for accuracy (Derrer, et al., 2001) and therefore of greater use during intervention planning. Our study suggests that high sensitivity can be obtained through the administration of one screening test, Cognistat. Our study additionally concludes that the combination of the Cognistat and the CAM may increase the specificity of such screening assessments which is likely to be useful for rehabilitation, however acknowledges that extensive neuropsychological testing would be likely to increase specificity in comparison to the use of screening assessments. These results may prove applicable to clinical settings where there is duplicity in the screening assessment of individuals with acquired brain impairments.

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