# Internal Consistency and Construct Validity of the Neuropsychological Assessment Battery Screening Module (NAB-SM) in a sample of individuals with Acquired Brain Injury (ABI)


Dennis J. Zgaljardic
Transitional Learning Center
University of Texas Medical Branch
Galveston, TX

Richard O. Temple
CORE Health Care
Dripping Springs, TX



## ABSTRACT

**Objective:** To provide preliminary data on the internal consistency and construct validity of the NAB-SM in a sample of individuals with ABI.

**Participants and Methods:** The sample consisted of 42 individuals (31 males, 11 females) admitted to a post-acute residential rehabilitation program with a history of moderate to severe ABI (24 traumatic brain injury, 18 cerebrovascular accident). Mean age of the sample was 41.8 (SD = 15.1) and mean educational attainment was 13.4 years (SD = 2.7). The NAB-SM and a comprehensive neuropsychological (NP) test battery were administered separately within the first 2 weeks following admission. Statistical analyses included Cronbach's alpha and Pearson product moment correlation coefficients to assess the internal consistency and construct validity of the NAB-SM respectively.

**Results:** The internal consistency for each NAB-SM cognitive domain (Attention, Language, Memory, Spatial, and Executive) was weak, whereas the internal consistency for the NAB-SM Total index score was adequate. The NAB-SM index and subtest scores maintained several significant relationships with other NP tests that shared test structure and content (i.e., corresponding) or not. These relationships were limited or absent when addressing the validity of the NAB-SM Executive subtests and the NAB-SM Shape Learning subtest.

**Conclusions:** Based on our preliminary findings the NAB-SM appears to be a valuable NP screening tool in a post-acute rehabilitation setting. However, when administering the NAB-SM in patients with ABI one may consider (a) the value in the interpretation of NAB-SM individual subtest scores rather than the NAB-SM cognitive index scores and (b) supplementing the NAB-SM with other tests that assess executive functions and nonverbal/visual memory.


## INTRODUCTION

- The NAB is "a comprehensive, modular battery of NP tests developed for the assessment of a wide variety of cognitive skills and functions in adults aged 18 to 97, with known or suspected disorders of the central nervous system" (Stern & White, 2003).
- The NAB consists of six modules, the first designated as the Screening Module, and five main modules (Attention, Language, Memory, Spatial, and Executive). Two alternate forms are available for all six modules.
- The Screening Module, which takes approximately 30 minutes to administer, contains items identical or similar to each of the five main modules, referred to as "screening domains."
- Validation of a screening battery with a given clinical population typically involves an examination of the relationships between variables in the proposed battery and some established "gold standard". In NP assessment, the latter typically entails traditional cognitive tests with good psychometric properties (e.g., reliability and validity).
- Much of the work to date on the validation of a screening battery in patients with ABI has been conducted with the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph, 1998). Previous work has reported moderate to strong correlations with it and other NP tests (e.g., McKay et al., 2007). However, one limitation of the RBANS as a comprehensive screening measure is its lack of tests assessing executive functions. Given the frequency with which executive functions are disrupted in ABI, it is important that any screening measure used in this population include such measures.

### NAB-SM Cognitive Domains and Subtests

| Screening Domain | Subtest | Construct Assessed |
|---|---|---|
| Screening Attention Domain (S-ATT) | Digits Forward | Auditory Attentional Capacity |
| | Digits Backward | Working Memory |
| | Letter Cancellation | Selective and Divided Attention |
| Screening Language Domain (S-LAN) | Auditory Comprehension | Comprehension of brief commands |
| | Naming | Confrontation naming |
| Screening Memory Domain (S-MEM) | Immediate and Delayed Story Recall | Verbal memory |
| | Immediate and Delayed Shape Recognition | Visual Memory |
| Screening Spatial Domain (S-SPT) | Visual Discrimination | Visual analysis |
| | Design Construction | Visual construction |
| Screening Executive Functions Domain (S-EXE) | Word Generation | Organization of verbal output |
| | Mazes | Visual Planning |

## RESULTS

- The internal consistency (Cronbach's alpha) for each cognitive domain of the NAB-SM was found to be weak (**range = -.14 to .42**). The Cronbach's alpha obtained for the Total NAB-SM (**α = .60**) did, however, reach an adequate level.
- Several associations between NP tests and their respective NAB-SM cognitive domain index score were significant (**see Table 1**). None of the scores from selected NP tests that assess "executive functions" (e.g., WCST, TMT - Part B, or COWAT) were significantly associated with the NAB-SM Executive domain index score ($p \geq .06$).
- When assessing the associations between NAB-SM subtests and corresponding NP tests the strongest relationships were discovered between tests that assess digit span, confrontation naming, story learning (immediate and delayed recall), and verbal fluency **(see Table 2).** As for nonverbal/visual tests of memory, both nonsignificant and weak correlation coefficients were found between variables from *WMS-III Visual Reproduction and NAB-SM Shape Learning*.
- Select variables from the *RAVLT* correlated significantly with several NAB-SM subtests, especially those from the NAB-SM Language and Memory domains (**see Table 3**). Furthermore, NP tests of attention and visuomotor processing speed (e.g., TMT [Parts A & B] and WAIS-III Digit-Symbol Coding) maintained statistically significant relationships with the *NAB-SM Numbers and Letters Efficiency [parts A & B] and the NAB-SM Mazes* subtests. None of the variables from the *Wisconsin Card Sorting Test (WCST)* correlated significantly with NAB-SM Executive subtests.

**Table 1 – Pearson Product Correlation Coefficients between NABM-SM Cognitive Domain Index Scores and NP Test Raw Scores**

| NAB-SM Index Scores | NP Test | r | p |
|---|---|---|---|
| Attention | Trail Making Test - Part A | -.33 | .03 |
| | WAIS-III Digit Span | .52 | .0001 |
| | WAIS-III Digit-Symbol Coding | .56 | .0001 |
| Language | Boston Naming Test | .70 | .0001 |
| | Token Test | .35 | .03 |
| Memory | Rey Auditory Verbal Learning Test - Total | .33 | .04 |
| | Rey Auditory Verbal Learning Test - Delay | .35 | .02 |
| | Rey Auditory Verbal Learning Test - Hits | .37 | .10 |
| | WMS-III Logical Memory I | .53 | .0001 |
| | WMS-III Logical Memory II | .46 | .002 |
| | WMS-III Visual Reproduction I | .21 | .20 |
| | WMS-III Visual Reproduction II | .44 | .004 |
| Spatial | Visual Form Discrimination Test | .58 | .0001 |
| | WAIS-III Block Design | .52 | .0001 |
| Executive | Wisconsin Card Sorting Test - Perseverative Errors | -.13 | .42 |
| | Wisconsin Card Sorting Test - Categories | .12 | .45 |
| | Wisconsin Card Sorting Test - Fail to Maintain Set | .25 | .11 |
| | Controlled Oral Word Association Test | .28 | .07 |
| | Trail Making Test - Part B | -.30 | .06 |

**Table 2 – Pearson Product Correlation Coefficients between NABM-SM Subtest Raw Scores and Corresponding NP Test Raw Scores**

| NAB-SM Subtest | Corresponding NP Test | r | p |
|---|---|---|---|
| Attention | | | |
| Digits Forward | WAIS-III Digit Span | .63 | .0001 |
| Digits Backward | WAIS-III Digit Span | .70 | .0001 |
| Numbers and Letter Efficiency Part A | ---------- | ----- | ----- |
| Numbers and Letters Efficiency Part B | ---------- | ----- | ----- |
| Language | | | |
| Auditory Comprehension | Token Test | .44 | .003 |
| Naming | Boston Naming Test | .80 | .0001 |
| Memory | | | |
| Shape Learning (Immediate) | WMS-III Visual Reproduction I | .32 | .04 |
| Shape Learning (Delay) | WMS-III Visual Reproduction II | .12 | .44 |
| Story Learning (Immediate) | WMS-III Logical Memory I | .56 | .0001 |
| Story Learning (Delay) | WMS-III Logical Memory II | .63 | .0001 |
| Spatial | | | |
| Visual Discrimination | Visual Form Discrimination Test | .45 | .003 |
| Design Construction | WAIS-III Block Design | .33 | .03 |
| Executive | | | |
| Word Generation | Controlled Oral Word Association Test | .56 | .0001 |
| Mazes | ---------- | ----- | ----- |

**Table 3 – Pearson Product Correlation Coefficients between NABM-SM Subtest Raw Scores and Non-corresponding NP Test Raw Scores**

| NAB-SM Subtest | Non-corresponding NP Test | r | p |
|---|---|---|---|
| Attention | | | |
| Digits Forward | ---------- | ----- | ----- |
| Digits Backward | Rey Auditory Verbal Learning Test - Total | .43 | .004 |
| Numbers and Letter Efficiency Part A | Trail Making Test – Part A | -.50 | .001 |
| | Trail Making Test - Part B | -.37 | .02 |
| | WAIS-III Digit Symbol Coding | .70 | .0001 |
| Numbers and Letters Efficiency Part B | WAIS-III Digit Symbol Coding | .44 | .003 |
| | Trail Making Test - Part A | -.35 | .03 |
| Language | | | |
| Auditory Comprehension | Rey Auditory Verbal Learning Test - Total | .38 | .01 |
| Naming | Rey Auditory Verbal Learning Test - Total | .46 | .002 |
| | Rey Auditory Verbal Learning Test - Delay | .55 | .0001 |
| | Rey Auditory Verbal Learning Test - Hits | .32 | .04 |
| Memory | | | |
| Shape Learning (Immediate) | Trail Making Test - Part B | -.45 | .003 |
| Shape Learning (Delay) | Rey Auditory Verbal Learning Test – Total | -.32 | .04 |
| Story Learning (Immediate) | Rey Auditory Verbal Learning Test - Total | .53 | .0001 |
| | Rey Auditory Verbal Learning Test - Delay | .41 | .007 |
| Story Learning (Delay) | Rey Auditory Verbal Learning Test - Total | .58 | .0001 |
| | Rey Auditory Verbal Learning Test - Delay | .63 | .0001 |
| | Rey Auditory Verbal Learning Test - Hits | .49 | .001 |
| Spatial | | | |
| Visual Discrimination | ---------- | ----- | ----- |
| Design Construction | Wisconsin Card Sorting Test – Perseverative Errors | -.30 | .05 |
| | Trail Making Test - Part B | -.41 | .007 |
| Executive | | | |
| Word Generation | Rey Auditory Verbal Learning Test - Total | .33 | .03 |
| Mazes | WAIS-III Digit Symbol Coding | .46 | .02 |
| | Trail Making Test - Part A | -.57 | .0001 |
| | Trail Making Test - Part B | -.35 | .02 |

## CONCLUSIONS

- The internal consistency of the subtest scores that comprise each NAB-SM cognitive domain was found to be weak suggesting that the NAB-SM cognitive index scores may not be reliable indicators of a patient's performance on individual subtests. The Cronbach's alpha calculated for the *Total NAB-SM* index score, however, suggests that it alone may be a good indicator of overall NAB-SM subtest performances in our sample of patients with ABI.
- All NAB-SM Cognitive domain index scores (with the exception of the NAB-SM Executive domain index score) maintained significant relationships with various NP test variables within their respective cognitive domains suggesting convergent validity.
- NAB-SM subtests correlated most strongly with NP tests that assess digit span, confrontation naming, verbal fluency, story learning, cognitive flexibility, and visuomotor processing speed.
- Unlike other published screening measures, the NAB-SM has an executive domain; however, our preliminary findings suggest that it does not correlate very strongly with traditional tests of executive functions in this sample (i.e., lack of convergent validity). Thus, much like the RBANS, supplementation with other tests of executive functions is warranted.
- The NAB-SM may be a more valuable tool in screening verbal memory, as opposed to nonverbal/visual memory ability. Supplementation of other nonverbal/visual tests of memory when administering the NAB-SM is recommended.

## REFERENCES


McKay, C., Casey, J. E., Wertheimer, J., & Fichtenberg, N. L. (2007). Reliability and validity of the RBANS in a traumatic brain injured sample. *Archives of Clinical Neuropsychology, 22,* 91-98.

Randolph, C. (1998). *Repeatable battery for the assessment of neuropsychological status manual.* Toronto, ON: The Psychological Corporation.

Stern, R. A. & White T. (2003). Neuropsychological Assessment Battery: Administration, Scoring, and Interpretation Manual, Psychological Assessment Resources, Inc., Lutz, FL.