Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)™

Supplement 1

This supplement provides

* subtest means and SDs for the normal standardization sample,
* comments on general issues in interpreting performance on the RBANS,
* additional information on test-retest interpretation,
* further information on "cortical–subcortical deviation" scores, and
* updated clinical validity information.

Contacting the Author

Users may contact the author with any and all questions, concerns, and research findings by email or regular mail:

crandol@lumc.edu
Christopher Randolph, PhD
Chicago Neurological Institute
233 East Erie, 7th Floor
Chicago, IL 60611

Subtest Means and Standard Deviations (SDs)

The following table contains subtest information from the standardization sample (N = 540), described in the manual. The data are from Form A, as only a portion of the standardization sample (N = 100) also received Form B. The Form B sample was collected primarily to ensure form equivalency at the index level (see manual), and this sample was not sufficiently large to provide age-based subtest means and SDs. From the existing data, however, it would appear that performance is comparable at the subtest level for both forms. There is one necessary subtest adjustment on Form B: Four points were added to the Semantic Fluency subtest in the Record Form to ensure equivalency with Form A.

Table 1: RBANS Subtest Means (SD) by age group

	Age Group					
Subtest	**20–39**	**40–49**	**50–59**	**60–69**	**70–79**	**80–89**
List Learning	30.7 (4.3)	27.6 (4.4)	27.5 (4.7)	28.0 (4.5)	26.6 (5.0)	23.2 (4.5)
Story Memory	19.1 (3.3)	16.9 (3.2)	17.5 (3.7)	18.4 (3.5)	17.4 (3.6)	15.3 (3.9)
Figure Copy	19.1 (1.3)	18.3 (1.4)	18.2 (1.4)	18.1 (1.7)	17.8 (1.8)	17.3 (2.0)
Line Orientation	16.8 (3.0)	15.4 (3.0)	16.4 (2.9)	16.6 (2.9)	16.4 (2.8)	15.7 (2.6)
Picture Naming	9.6 (0.7)	9.4 (1.1)	9.4 (0.9)	9.7 (0.5)	9.6 (0.7)	9.1 (1.0)
Semantic Fluency	21.6 (3.7)	20.8 (5.0)	21.0 (5.0)	21.0 (4.6)	19.8 (5.2)	17.4 (3.7)
Digit Span	11.7 (2.5)	10.6 (2.2)	10.5 (2.4)	10.2 (2.1)	10.4 (2.5)	9.2 (2.2)
Coding	56.5 (8.8)	49.8 (8.1)	46.3 (8.9)	46.1 (7.9)	41.3 (9.0)	34.0 (6.8)
List Recall	7.5 (1.8)	6.3 (1.9)	6.0 (2.1)	6.0 (2.2)	4.9 (2.5)	3.9 (2.3)
List Recognition	19.8 (0.7)	19.7 (0.6)	19.5 (1.0)	19.4 (1.2)	19.2 (1.2)	18.8 (1.4)
Story Recall	10.1 (2.1)	8.9 (1.8)	9.1 (2.2)	9.3 (2.1)	9.0 (2.2)	7.4 (2.8)
Figure Recall	16.1 (2.9)	13.5 (3.3)	13.5 (3.3)	13.6 (4.0)	12.5 (4.2)	11.4 (4.1)

General Issues in Interpreting Performance on the RBANS

Certain index scores can be significantly affected by relatively minor changes on certain subtests. This is particularly true for scores in the normal average range for young patients. Because the range is narrow, particularly in young normals on measures such as Picture Naming, Word List Recognition, and Figure Copy, a few points on any of these can result in a rapid drop of the associated index score. It is certainly worthwhile to routinely examine the subtest scores underlying index score performance for additional interpretive information, particularly if the index score appears to be unusually low in the context of a patient's presentation or other test scores.

Certain subtests have range restrictions and a skewed distribution of scores in normals, caution should be exercised in attempting to interpret individual patient performance on the basis of the normal mean and standard deviation for these subtests. The subtest data be used primarily to interpret index score performance, and not as stand-alone measures.

Additional Information on Test-Retest Interpretation

One of the most unique features of the RBANS is that it has equivalent alternate forms, which allows for retesting patients without the confounding of significant content-related practice effects. There are a variety of ways of interpreting neurocognitive change scores, and a complete discussion of this topic is beyond the bounds of this handout. On a practical basis, it seems unlikely that most clinicians will be interested in plugging test scores into regression

equations in order to compute the statistical probability of various score changes. It is often more useful to have a good understanding of the distribution of change scores for a particular test, and to use that information in clinical decision-making regarding the etiology of the observed change. It is always best, of course, to avoid relying upon a single source of information to conclude that there has been a significant change in a patient's neurocognitive status, and the prudent clinician will consider multiple sources of information in reaching such a conclusion.

Data are provided for the interpretation of change when comparing a patient's performance on Form A to Form B (regardless of order). Data are derived from N = 280 (99 normal controls and 181 patients with schizophrenia). See Wilk et al. (Am J Psychiatry, 2002) for more details. Change distributions for the two separate samples were comparable, and therefore the samples were combined for this purpose. Test-retest intervals ranged from 1 to 134 days, and there was no apparent effect of time on retest performance over this interval range.

The Average Total Scale Change Score was Less Than 1 Point

Table 2 indicates the percentage of the combined sample that obtained a change score within each interval. For example, 4.6% of the sample had a increase in their Total scaled score on the second testing between 16 and 20 points (inclusive). **Less than 7% of the sample declined by more than 10 points on the second testing, and less than 21% of the sample declined by more than 5 points- two bits of data that are clinically relevant.**

Table 2: Change Score Magnitude Intervals by Percent of Combined Sample

Change Score Magnitude Intervals	Percent of Combined Sample
+21 to +25	1.4
+16 to +20	4.6
+11 to +15	10.4
+6 to +10	14.6
+1 to +5	23.6
0 to –5	25
–6 to -10	13.6
–11 to –15	4.3
–16 to –20	1.4
–21 to –25	0.7
–26 to –30	0.4

A Discussion of Cortical–Subcortical Deviation Scores

The distinction between "cortical" and "subcortical" dementias is commonly understood to reflect different patterns of neurocognitive impairment, associated with different patterns of neuropathology. Although this topic cannot be reviewed in detail here, Alzheimer's disease is usually considered the prototypical "cortical" dementia, with impairments of memory and language as dominant features. In contrast, attentional and certain visuospatial functions may be more prominently impaired in disorders like Huntington's disease, Parkinson's disease, ischemic cerebrovascular disease, and progressive supranuclear palsy, all of which are characterized by greater early pathologic involvement of subcortical white matter and/or subcortical nuclei (e.g., the basal ganglia). Randolph et al. (1998) originally presented data comparing RBANS profiles of patients with Alzheimer's disease (AD) and patients with Huntington's disease (HD). The patient profiles from that paper are presented below (note: the data below have been simplified by combining the normative samples, and the scaling is from the full standardization sample). A single Cortical–Subcortical deviation score was calculated by subtracting the mean of the Delayed Memory index and the Language index from the mean of the Attention index and the Visuospatial Constructional index. This was done for each subject, and the group performances are shown in Figures 1 and 2.

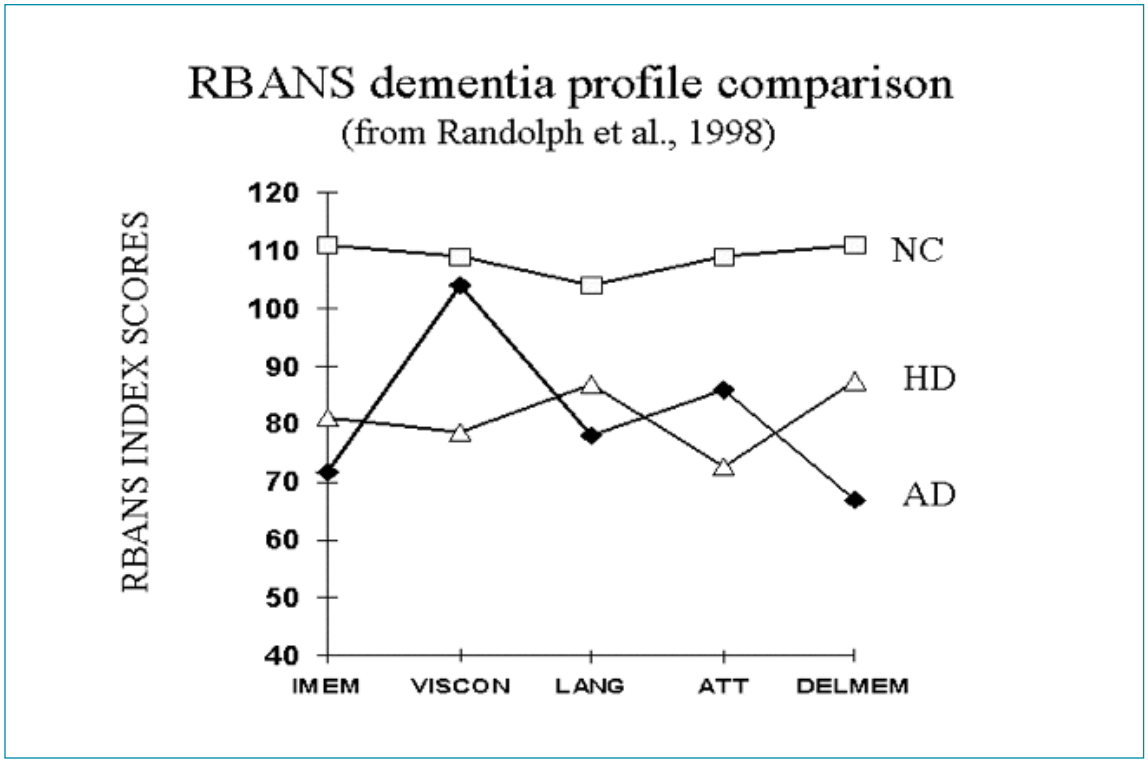

Figure 1 RBANS Dementia Profile Comparison

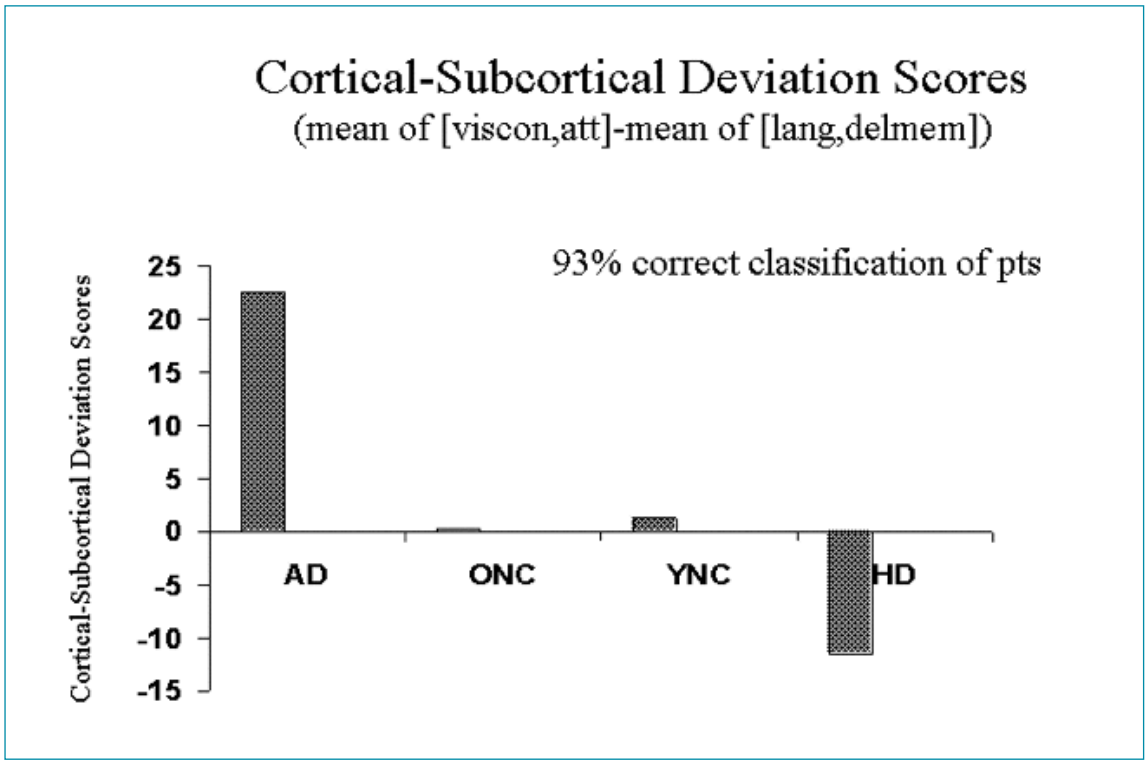

Figure 2 Cortical–Subcortical Deviation Scores

Using a cut point of 0, and classifying all patients with a score above 0 as "cortical" and all patients below 0 as subcortical, 37 of 40 patients were correctly classified (AD=Alzheimer's disease, NC= all normal controls, ONC=old normal controls, YNC=young normal controls, HD=Huntington's disease).

This analysis has also been applied in attempting to differentiate AD patients from patients with ischemic cerebrovascular disease, diagnosed according to State of California criteria (Fink et al., 1998). The demographic characteristics of the samples from this study and their data are below:

	AD	VaD
N	60	32
Gender	53%F	59%F
Age (SD)	75.1 (7)	76.3 (7)
Education (SD)	14.5 (3)	13.4 (3)

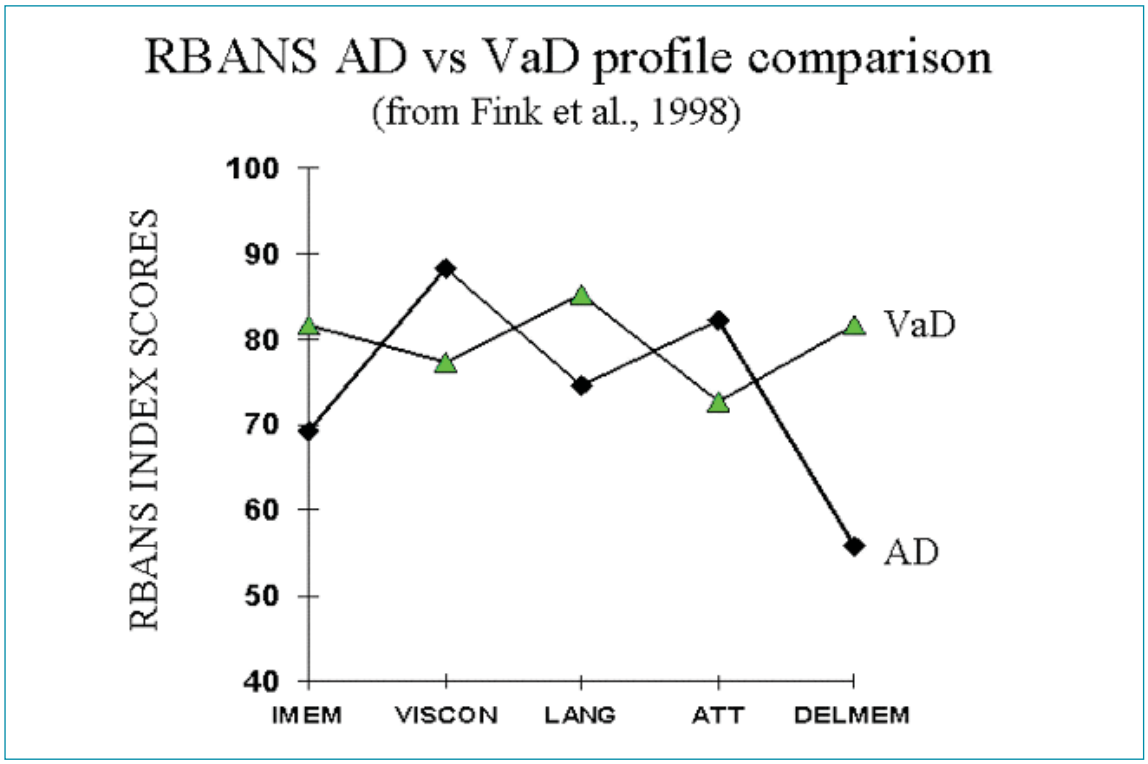

Figure 3 RBANS AD vs. VaD Profile Comparison

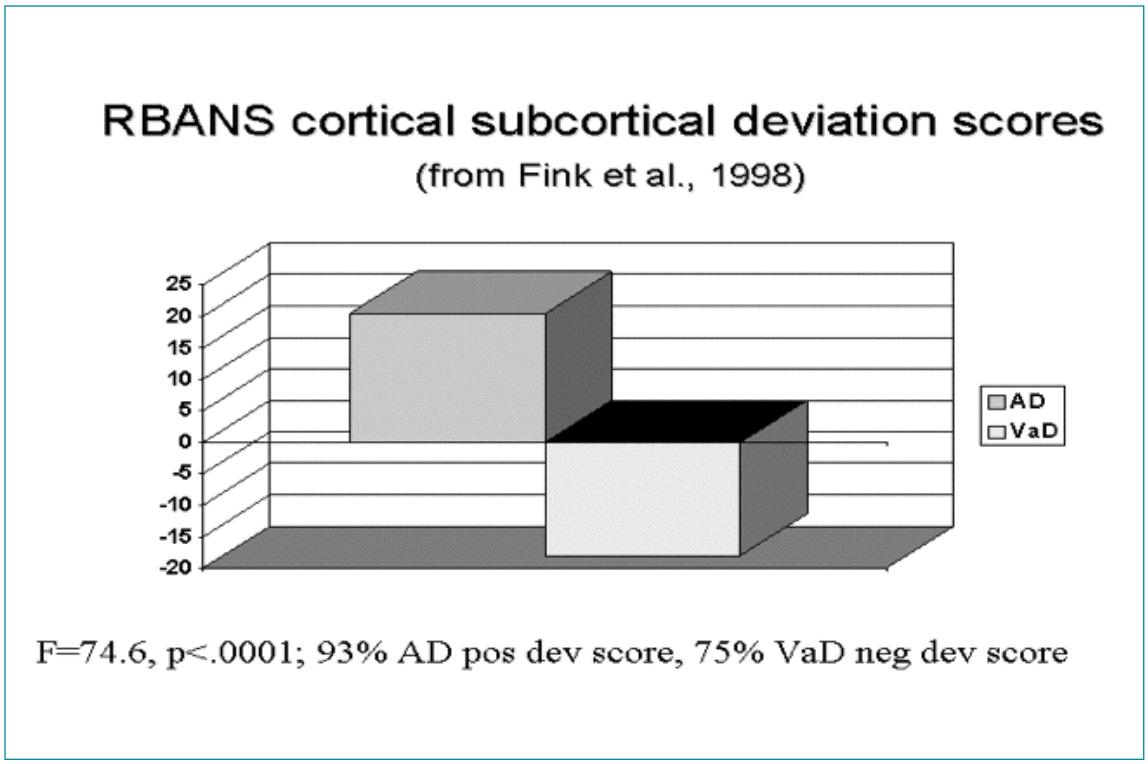

Figure 4 RBANS Cortical–Subcortical Deviation Scores

As shown in Figure 4, the use of this Cortical-Subcortical deviation score may have some diagnostic and/or heuristic value, although additional investigation is clearly needed.

Updated Clinical Validity Information

The manual enclosed with the published version of the test contains a fair amount of clinical data (N = 404), including the following patient groups: Alzheimer's disease, vascular dementia, HIV dementia, Huntington's disease, Parkinson's disease, depression, schizophrenia, and traumatic brain injury. Since the publication of the test, some additional clinical validity studies have been published. A few of the key post-publication findings are summarized below. The bibliography that follows contains the full references.

Concussion- Moser and Schatz (2002) reported that the RBANS was effective in detecting the effects of a recent (< one week) concussion in youth athletes.

Schizophrenia- In a pair of articles published in the American Journal of Psychiatry, Gold and colleagues (Gold et al., 1999; Hobart et al., 1999) examined RBANS and WAIS–3/WMS–3 data from approximately 150 patients with schizophrenia. They concluded that the RBANS was highly sensitive to the neurocognitive impairments associated with schizophrenia, demonstrated convergent validity via strong correlations with specific WAIS–3/WMS–3 indices, and was minimally correlated with positive psychiatric symptoms (i.e., BPRS scores), but was strongly correlated with employment outcome. The authors concluded that the RBANS appeared to meet criteria for use as a neurocognitive screening instrument and outcome measurement tool in schizophrenia.

Test-retest reliability Wilk et al. (2002) examined 181 patients with schizophrenia on the alternate forms (A and B) of the RBANS, with test-retest intervals ranging from 1-134 days. The intraclass correlation coefficient for the total scale score was .84. The authors concluded that retest measurement error for the RBANS was comparable to that of WAIS-3/WMS-3, suggesting that the brevity of the RBANS in comparison to these much longer tests does not result in a marked decrease in test-retest stability.

Traumatic brain injury Smigielski et al. (2001) compared RBANS scores in patients with traumatic brain injury to other established neuropsychological measures. They concluded that the RBANS demonstrated satisfactory concurrent validity with these measures, and appeared to be sensitive to the impairments demonstrated by patients with moderate-severe TBI. They suggest that the RBANS may be a useful tool in the early psychometric evaluation of TBI.

Stroke Hoye et al. (2000) used the RBANS in the evaluation of stroke patients during inpatient rehabilitation. They found that the RBANS index scores were related to functional outcome at the end of rehabilitation. This finding was similar to an earlier study by Larson et al. (1999).

Ecological validity The studies by Gold and colleagues (see above) demonstrated that the RBANS was strongly related to employment outcome in schizophrenia, and the Hoye et al. (2000) and Larson et al. (1999) studies both found that RBANS scores in patients undergoing inpatient stroke rehabilitation were predictive of functional outcome. In addition, Efendov et al. (2002) found that all of the RBANS index scores were predictive of medication compliance in HIV patients undergoing highly active antiretroviral therapy (HAART).

Bibliography

Gold, J. M., Queern, C., Iannone, V. N., & Buchanan, R. W. (1999). Repeatable Battery for the Assessment of Neuropsychological Status as a screening test in schizophrenia, I: Sensitivity, reliability, and validity. *American Journal of Psychiatry*, 156, 1944–1950.

Hobart, M. P., Goldberg, R, Bartko, J. J., and Gold, J. M. (1999). Repeatable Battery for the Assessment of Neuropsychological Status as a screening test in schizophrenia, II: Convergent/discriminant validity and diagnostic group comparisons. *American Journal of Psychiatry*, 156, 1951–1957.

Mohr, E., Walker, D., Randolph C., Sampson, M., & Mendia, T. (1996). The utility of clinical trial batteries in the measurement of dementia of different etiologies. *International Psychogeriatrics*, 8, 397–424.

Moser, MS, & Schatz, P. (2002). Enduring effects of concussion in youth athletes. *Archives of Clinical Neuropsychology*, 17, 91–100.

Randolph, C. (1997). Differential diagnosis of vascular dementia and Alzheimer's disease: The role of neuropsychological testing. *Clinical Geriatrics*, 5, 77–84.

Randolph, C., Tierney, M. C., Mohr, E., & Chase, T. N. (1998). The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS): Preliminary clinical validity. *The Journal of Clinical and Experimental Neuropsychology*, 20, 310–319.

Wilk, C. M., Gold, J. M., Bartko, J. J., Dickerson, F., Fenton, W. S., Knable, M., Randolph, C., Buchanan, R. W.. (2002). Test-retest stability of the Repeatable Battery for the Assessment of Neuropsychological Status in schizophrenia. *American Journal of Psychiatry*, 159, 838–844.

Abstracts

Efendov, A., Joshi, R., Lancee, W., Saunders, D., & Rourke, S. B. (2002). Neurocognitive correlates of medication management in HIV/AIDS. *Journal of the International Neuropsychological Society*, 8, 159.

Fink, J., McCrea, M., & Randolph, C. (1998). Neuropsychological differentiation of vascular dementia and Alzheimer's disease: A neurocognitive profile approach using a short battery. *Journal of the International Neuropsychological Society*, 4, 30.

Hoye, W., Thompson, R., Sherer, M., Nick, T., Gaines, C, Collipp, D., & Vohra, R. (2000). Brief cognitive assessment after stroke: RBANS factor structure and performance patterns. *Journal of the International Neuropsychological Society*, 6, 138.

Kortenkamp, S, Barr, B, Randolph, C, & Ettinger, A. (2001). RBANS performance in patients with temporal lobe epilepsy. *Journal of the International Neuropsychological Society*, 7, 212.

Kozora, E, & Randolph, C. (2001). Cognitive deficits in patients with mild COPD using the Repeatable Battery of Neuropsychological Status (RBANS). *Journal of the International Neuropsychological Society*, 7, 170.

Larson, E., Clorfene, J., & Kirschner, K. (1999). Brief cognitive assessment in evaluating deficit and predicting outcome following stroke. *Journal of the International Neuropsychological Society*, 5, 146.

Smigielski, J. S., Bergquist, T. F., & Malec, J. F. (2001). Brief cognitive assessment in TBI: Use of RBANS and relationship to standard tests. *Journal of the International Neuropsychological Society*, 7, 136.

Recent RBANS Publications

Beatty, W. W. (2004). RBANS analysis of verbal memory in multiple sclerosis. *Archives of Clinical Neuropsychology*, 19, 825–34.

Beatty, W. W., Ryder, K. A., Gontkovsky, S.T., Scott, J. G., McSwan, K. L., & Bharucha, K. J. (2003). Analyzing the subcortical dementia syndrome of Parkinson's disease using the RBANS. *Archives of Clinical Neuropsychology*, 18, 509–520.

Dickerson, F., Boronow, J. J., Stallings, C., Origoni, A. E., Cole, S. K., & Yolken, R. H. (2004). Cognitive functioning in schizophrenia and bipolar disorder: comparison of performance on the Repeatable Battery for the Assessment of Neuropsychological Status. *Psychiatry Research*, 30, 45–53.

Duff K., Beglinger L. J., Schoenberg, M. R., Patton, D.E., Mold, J., Scott, J. G., & Adams, R. L. (2005). Test-retest stability and practice effects of the RBANS in a community dwelling elderly sample. *Journal of Clinical and Experimental Neuropsychology*, 27, 565–575.

Duff, K., Schoenberg, M. R., Patton, D., Paulsen, J.S., Bayless, J. D., Mold, J., Scott, J. G., & Adams, R.L. (2005). Regression-based formulas for predicting change in RBANS subtests with older adults. Archives of Clinical Neuropsychology, 20, 599–611.

Killam, C., Cautin, R. L., & Santucci, A. C. (2005). Assessing the enduring residual neuropsychological effects of head

trauma in college athletes who participate in contact sports. *Archives of Clinical Neuropsychology*, 20, 599–611.

Larson, E., Kirschner, K., Bode, R., Heinemann, A., & Goodman, R. (2005). Construct and predictive validity of the repeatable battery for the assessment of neuropsychological status in the evaluation of stroke patients. *Journal of Clinical and Experimental Neuropsychology*, 27, 16–32.

Patton, D. E., Duff, K., Schoenberg, M. R., Mold, J., Scott, J. G., & Adams, R. L. (2005). Base rates of longitudinal RBANS discrepancies at one- and two-year intervals in community-dwelling older adults. *The Clinical Neuropsychologist*,19, 27–44.

Wilk, C. M., Gold, J.M., Humber, K., Dickerson, F., Fenton, W.S., & Buchanan, R. W. (2004). Brief cognitive assessment in schizophrenia: normative data for the Repeatable Battery for the Assessment of Neuropsychological Status. *Schizophrenia Research*, 70, 175–186.

PsychCorp™
A brand of Harcourt Assessment