

# Predictive value and test-retest reliability of the tablet-based Brief Assessment of Cognition (BAC App) for assessment of cognition in aging: preliminary findings from an ongoing normative study



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## BACKGROUND

- Continuing advances in the understanding of Alzheimer's disease (AD) progression have ignited widespread interest in the development of disease-modifying therapeutics intended for use in preclinical, largely asymptomatic populations.
- In order to support industry-sponsors clinical trials in this area, cognitive instruments with increased sensitivity to early cognitive decline and with appropriate normative data must be developed and validated for use in a regulated environment.
- The Brief Assessment of Cognition (BACS) is a pen-and-paper cognitive assessment used in hundreds of research studies and clinical trials. A tablet-based version of the BACS, the BAC App, has been developed to allow standardized presentation of task instructions and stimuli, audio-recording of responses, and automatized scoring and data management.
  - The BAC App is a brief tablet-based assessment of the paper-and-pencil based Brief Assessment of Cognition (BACS) assessing multiple cognitive domains, including verbal memory, working memory, motor function, verbal fluency, processing speed and executive function.
  - The BAC App minimizes site and rater burden by providing standardized presentation of task instructions and stimuli, audio-recording of subject responses, automated scoring and data storage.
  - Development of the BAC App was aimed at reducing rater burden and variability.
- We describe results of a recent study utilizing the novel tablet-based BAC App to examine criterion validity for the assessment of cognition in individuals with subjective cognitive decline by assessing the diagnostic sensitivity, specificity and test-retest reliability of the BAC App endpoints.**

## METHODS

### Participants

- Data currently includes 649 participants, including 254 healthy young adults (YA, <55 years), 323 healthy older adults (OA, ≥55 years), and 72 individuals with cognitive complaints.
  - Participants with subjective cognitive decline were categorized as such based on total scores of ≥ 4 on the Mail-In Function Cognitive Screening Instrument (MCSFI).
  - T scores were computed for the 6 cognitive domains of the BAC App (Verbal Memory, Digit Sequencing, Token Motor, Verbal Fluency, Symbol Coding, Tower of London) and the cognitive composite. Participant characteristics are presented in Table 1.
- Participants completed the BAC App tasks (see Figure 1) along additional assessments of cognition and function at two study visits approximately 1 week apart.

### Analysis

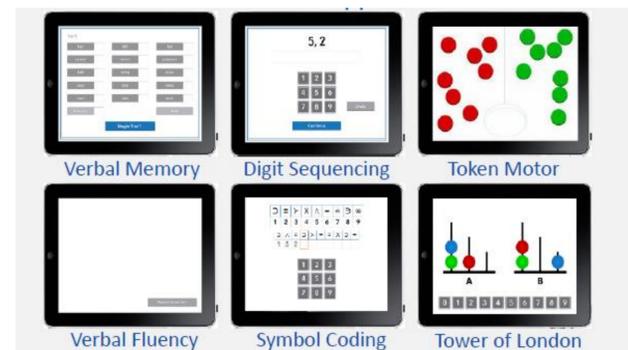
- ROC analysis (Area Under the Curve AUC) and intraclass correlation (ICC, two-way random effects model for absolute agreement) coefficient were computed.
- Consistent with previous findings using the BACS pen-and-paper version, 1.5 SD's was identified as a position of a high probability of either significantly below or above average cognitive performance and was used as the cutoff for predictive value for the ROC analysis.

## SAMPLE CHARACTERISTICS

Table 1. Participant Group Characteristics

	Young Adults (YA)	Older Adults (OA)	Subjective Cognitive Decline (SCD)
Gender	n(%)	n(%)	n(%)
Male	120 (40.7)	153 (51.9)	22 (7.5)
Female	134 (37.9)	170 (48.0)	50 (14.1)
Race	n(%)	n(%)	n(%)
African American	81 (48.5)	64 (38.3)	22 (13.2)
American Indian/Alaska Native	2 (100.0)	0 (0.0)	0 (0.0)
Asian	10 (90.9)	1 (9.1)	0 (0.0)
Caucasian	153 (33.3)	256 (55.8)	50 (10.9)
Other	8 (80.0)	2 (20.0)	0 (0.0)
Ethnicity			
Hispanic/Latino	33 (61.1)	15 (27.8)	6 (11.1)
	Mean(SD)	Mean(SD)	Mean(SD)
Education (years)	14.0 (2.2)	14.9 (2.7)	14.7 (2.4)
Age (years)	39.1 (10.2)	68.7 (8.4)	72.0 (9.3)

Figure 1. BAC App Cognitive Domains and Task Summary



Cognitive Domain	Test	Summary
Verbal Memory & Learning	Verbal Memory	Subjects are presented with 15 words and asked to recall as many as possible. This procedure is repeated 5 times.
Working Memory	Digit Sequencing	Subjects are presented with auditory clusters of numbers (e.g. 936) of increasing length and asked to tell the rater the numbers in order from lowest to highest.
Motor Function	Token Motor	Subjects are presented with tokens and asked to drag them to a center container as quickly as possible for 60 seconds.
Verbal Fluency	Semantic Fluency	Subjects are given 60 seconds to generate as many words as possible in a given category.
	Letter Fluency	In two separate trials, subjects are given 60 seconds to generate as many words as possible beginning with a given letter of the alphabet.
Speed of Processing	Symbol Coding	Subjects are provided a key and asked to fill in the corresponding numbers beneath a series of symbols as quickly as possible within 90 seconds.
Executive Function	Tower of London	Subjects are asked to give the minimum number of times the balls in one picture would need to be moved in order to make the arrangement of balls identical to that in the opposing picture.

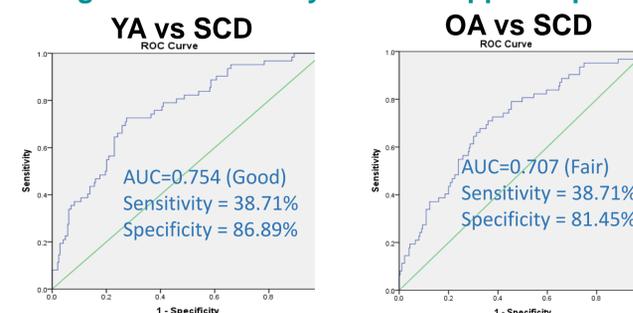
## RESULTS

- The intra-class correlations (ICC) between performance from test session 1 and test session 2 for each BAC App domain and the overall BAC Composite are included in Table 2.
- ICCs for the BAC composite were strong, ICC>.8 for each group.
- Each test had one measure that produced an ICC of 0.74 or greater for the subject cognitive decline group.
- The lowest ICC was observed for the Tower of London for the Young Adult and Older Adult groups and the Token Motor for the Subjective Cognitive Decline group.

Table 2. Test-Retest Reliability of the BAC App domains and composite

BAC App	Intra Class Correlation (ICC)			
	YA	OA	YA + OA	SCD
Verbal Memory	.682	.671	.685	.755
Digit Sequencing	.708	.732	.714	.776
Token Motor	.800	.754	.811	.748
Verbal Fluency	.822	.836	.822	.840
Symbol Coding	.772	.731	.758	.773
Tower of London	.600	.531	.561	.772
BAC APP Composite	.850	.824	.844	.846

Figure 2. ROC Analysis: BAC App Composite for YA vs SCD and OA vs SCD



The AUC of the BAC App when comparing YA to the individuals with SCD was good, 0.754 (95% CI: 0.70, 0.82). When a cut-off point of 1.5 SD was used, individuals without SCD were accurately identified 86.89% of the time (specificity), with a 90% chance that this identification is accurate (NPV).

## CONCLUSIONS

- The BAC App has good test-retest reliability; individual subtests demonstrate higher test-retest for individuals classified with subjective cognitive decline.
- The BAC App has good discriminative validity in terms of specificity and predictive value for categorizing subjective cognitive decline.

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