Preliminary Analysis of the Influence of Age and Education on the Boston Cognitive Assessment (BoCA)

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INTRODUCTION

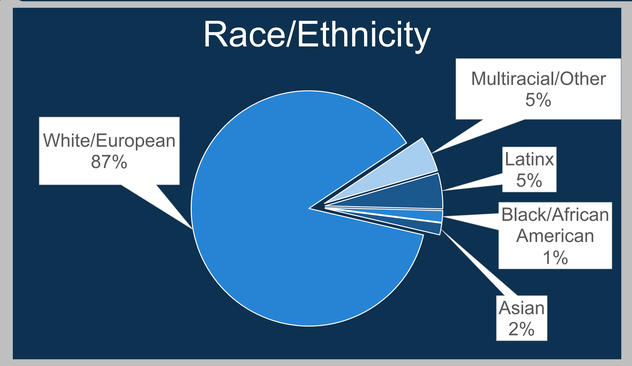
Digital, remote, cognitive assessment has become crucial for efficient screening of patients' cognitive status. The Boston Cognitive Assessment (BoCA) is a brief, digital, global screening instrument that can be administered in a variety of settings. Recent psychometric studies have supported the usefulness of the BoCA in assessing cognitive status in various contexts. Performance on the BoCA is not affected by location at time of completion (Ferguson et al., 2021) or the type of device on which it is administered (Vyshedsky et al., 2022).

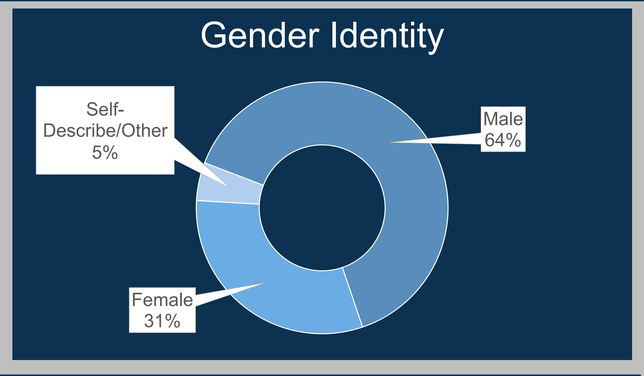
Other brief measures of cognitive status, such as the Montreal Cognitive Assessment (MoCA), have demonstrated affects of education on performance and adjusted their scoring protocol to accommodate. To establish the BoCA as a standard tool used in brief cognitive screening, potential differences in performance based on age and education should be explored.

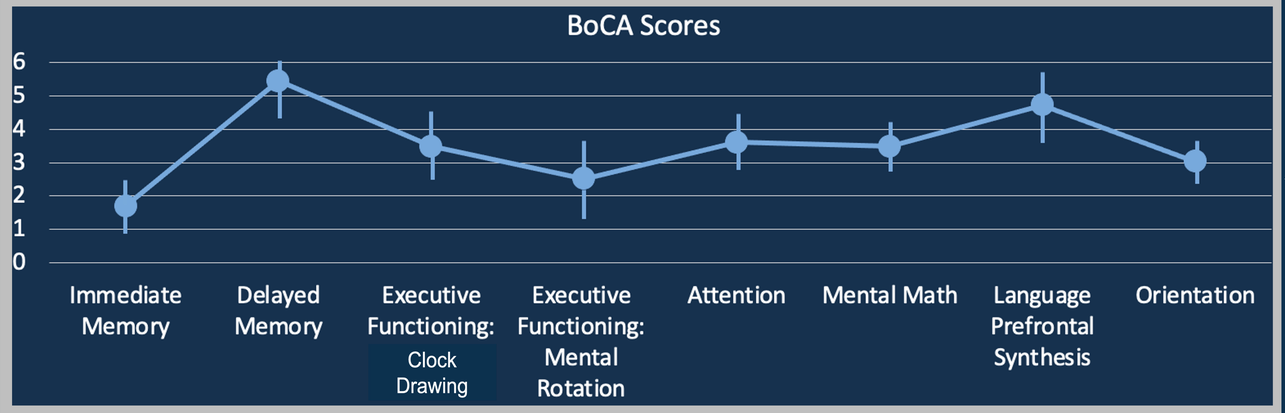
METHODS

A sample of 61 cognitively healthy adults were administered the BoCA, Montreal Cognitive Assessment (MoCA), and Telephonic Interview for Cognitive Status (TICS) during an in-person neuropsychological evaluation. Scores were accessed archivally. An ANOVA was conducted to assess the relationship between individual subscale and total BOCA scores based on participant membership in specific age groups (18-39, 40-50, and >60). To assess the additional impact of education level, an ANCOVA was conducted between the individual subscales of the BOCA and the education level of participants. A linear regression model was constrcuted to evaluate if age or education could predict total BOCA scores for this sample.

RESULTS







Age was a significant predictor of total BoCA Score:

The regression coefficient (B= -0.056) indicated that an increase in age corresponded, on average, to a decrease in their total score of 0.0464 points.

Adjusted Score:

29.696 - 0.056 * (age)

http://bocatest.org/

Age was a significant predictor of BoCA Subscales:

Immediate Memory and Delayed Memory

*Controlled for education

Regression Analysis: Age and Total BoCA

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	29.696	0.701		42.353	0
	Age	-0.056	0.014	-0.464	-4.026	0

Uncorrected ANOVA for Age

	Mean	SD
BOCA Immediate Memory [b, c]	1.7	0.558
BOCA Delayed Memory [b, c]	4.54	0.765
BOCA Executive Functioning: Visual [b]	3.49	0.887
BOCA Executive Functioning Mental Rotation	2.52	0.808
BOCA Attention	3.61	0.665
BOCA Mental Math	3.49	0.698
BOCA Language Prefrontal Synthesis	4.72	0.521
BOCA Orientation	3.03	0.256
BOCA Total [b, c]	27.11	2.484
MOCA Total [a, b]	26.34	2.562
TICS Total	34.03	2.828
Education [b]	15.61	2.492
Age	46.25	20.664

Corrected ANCOVA for Age and Education

	Mean	SD
BOCA Immediate Memory	1.7	0.558
BOCA Delayed Memory [b, c]	4.54	0.765
BOCA Executive Functioning Visual	3.49	0.887
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Education	15.61	2.492
Age	46.25	20.664

[a] = significant difference between 18-39 vs. 40-59
[b] = significant difference between 18-39 vs. >60
[c] = significant difference between 40-59 vs. >60

UNCORRECTED ANOVA

An ANOVA was conducted to assess the relationship between individual subscale and total BOCA scores based on participant membership in specific age groups (18-39, 40-50, and >60). There was a significant effect of age on specific BOCA subscales including Immediate Memory ($F(2,58) = 3.41$, $p = 0.04$, $n^2_p = 0.105$); Delayed Memory ($F(2,58) = 12.917$, $p = <.001$, $n^2_p = 0.308$); and total BOCA score ($F(2,58) = 7.506$, $p = .001$, $n^2_p = 0.206$). Post hoc comparisons using the least significant difference (LSD) test revealed the following intergroup mean differences: MOCA total 18-39 vs 40-59 (mean difference 1.788, $p = .045$) and 18-39 vs. >60 (mean difference = 1.768, $p = .013$); and education 18-39 vs. >60 (mean difference = -1.446, $p = .04$); BOCA total sore >60 vs. 18-39 (mean difference = -2.415, $p = <.001$); Immediate Memory >60 years old vs. 18-39 (mean difference = -.337, $p = .031$) and >60 vs. 40-59 (mean difference = -.431, $p = .033$); Delayed Memory >60 vs. 18-39 (mean difference = -.852, $p = <.001$) and >60 vs. 40-59 (mean difference = -.909, $p = <.001$); Executive Functioning: Mental Rotation >60 vs. 18-39 (mean difference = -.517, $p = .024$).

CORRECTED ANOVA

When adjusting performance based upon education level, significant differences were identified on Delayed Memory $F(3,57) = 8.532$, $p < .001$; Language $F(3,57) = 3.139$, $p = .032$; and Total BOCA score $F(3,57) = 4.937$, $p = .004$. Pairwise comparisons using the least significant difference (LSD) test revealed that the mean difference was significant for the following groups on the following tasks: Delayed Memory >60 vs. 18-39 (mean difference = -.833, $p = <.001$) and >60 vs. 40-59 (mean difference = -.908, $p = <.001$); Language 18-39 vs. 40-59 (mean difference = .414, $p = .026$) and >60 vs. 18-39 (mean difference = -.355, $p = .018$); BOCA total sore >60 vs. 18-39 (mean difference = -2.454, $p = <.001$) and >60 vs. 40-59 (mean difference = -1.943, $p = .023$); TICS Total Score >60 vs. 18-39 (mean difference = -1.649, $p = .05$); MOCA Total Score >60 vs. 18-39 (mean difference = -1.676, $p = .024$).

REGRESSION ANALYSIS

A linear regression including age and education yielded a significant model, ($F(2,58) = 8,.143$, $p < .001$) $R^2 = 0.219$, $R^2_{adjusted} = .192$. Age was a significant predictor of total BOCA, ß = -0.483, $t(58) = -3.974$, $p < .001$; however, education level did not significantly contribute to the model, and was subsequently removed, ß = 0.064, $t(58) = 0.525$, $p = .601$. Using age as the sole predictor of BOCA score, the regression yielded a significant model, ($F(1,59) = 16.21$, $p < .001$) $R^2 = 0.216$, $R^2_{adjusted} = .202$.

The regression coefficient (B= -0.056) indicated that an increase in age corresponded, on average, to a decrease in their total score of 0.0464 points. Participants predicted score is equal to 29.696 - 0.056 * (age).

DISCUSSION

Results from the present study suggest that performance on the BoCA is influenced by age. Using the equation 29.696 – 0.056 *(AGE) can correct for the age effect. The current results also demonstrate that BoCA performance is not influenced by level of education. This further adds to the utility of the BoCA as a remote, self-administered, global screening instrument, and may support its adoption in settings where serial screening is indicated. This has implications for clinical providers and professions in which quick and efficient cognitive screening is practiced.

Funding and Conflicts of Interest:

The authors report no conflicts of interest.