

Validating an automatic phone-based speech biomarker measuring cognition SB-C against PACC5 and MoCA in the Swedish H70 epidemiological cohort

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Introduction

A speech biomarker measuring cognition in an automated, remote and low-burden fashion can be a powerful tool to screen for Alzheimer's (AD) and other neurodegenerative diseases. This has applications both in clinical trial research as well as for case finding in healthcare once newly approved AD drugs enter the market. As new tools and methods have to be validated against the current standard, the aim of this research is to investigate validity by comparing an automatic remote speech biomarker measuring cognition against established AD cognitive assessments such as the PACC-5 or MoCA.

Methods

The ki:e Speech Biomarker for cognition (ki:e SB-C; Tröger et al., 2022) was collected from 206 (107 F) participants of the H70 epidemiological cohort (Rydberg Sterner et al., 2019) with 29 (20 F) of them presenting with mild cognitive impairment (compare Table 1). Spearman rank correlations were computed between the ki:e SB-C Cognition Score, an adaptation of PACC5 (Öhman et al., 2022) and the MoCA score. Furthermore, to benchmark the performance of ki:e SB-C to screen for MCI, we trained 3 Machine Learning classifiers (SVM with class weights and GridSearch), once with SB-C and once MoCA score. Models were evaluated using Leave One Out cross-validation. Balanced accuracy, ROC AUC score as well as sensitivity and specificity were reported as classification performance.

Results

The ki:e SB-C Cognition Score was significantly correlated with both PACC5 score ($r = 0.80$, $p < 0.001$, Cohen's $d = 2.67$) and MoCA score ($r = 0.51$, $p < 0.001$, Cohen's $d = 1.17$). The classification experiment results show that the ki:e SB-C Cognition Score is comparable to the MoCA score in diagnostic performance while showing a higher sensitivity to detect MCI (see Table 2 and Figure 1).

References

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Discussion

The aim of this research was to investigate the validity of an automatic remote speech biomarker measuring cognition against established AD cognitive assessments—the PACC-5 and MoCA.

The significant strong correlation of the ki:e SB-C Cognition Score with both the PACC5 and MoCA score show that the SB-C lives up to modern cognitive composite scores and screening tools that are frequently used in AD clinical trials.

Simulating a downstream automatic screening for MCI scenario, the classification experiment shows that the ki:e SB-C Cognition Score is comparable to the diagnostic performance of MoCA. However the SB-C is an automatically collected and calculated score which can be remotely applied over a standard landline telephone and thereby has multiple benefits over even a digital screening application that is taken on a tablet like MoCA.

Conclusion

Overall we present evidence that the automated remote speech biomarker for cognition SB-C relates well to established AD cognitive assessments in MCI patients from the H70 epidemiological birth cohort. Results are encouraging and point towards potential application in both pharmaceutical research and future healthcare scenarios in AD.

Disclosure

JT, EM, AK, and NL are employed by the digital biomarker company ki:elements. NL, AK and JT own shares of the company. SK has served at SK scientific advisory boards and / or as consultant for Geras Solutions and Biogen. AZ, IS, JS, MS, SS, FÖ have no conflict of interest to report.

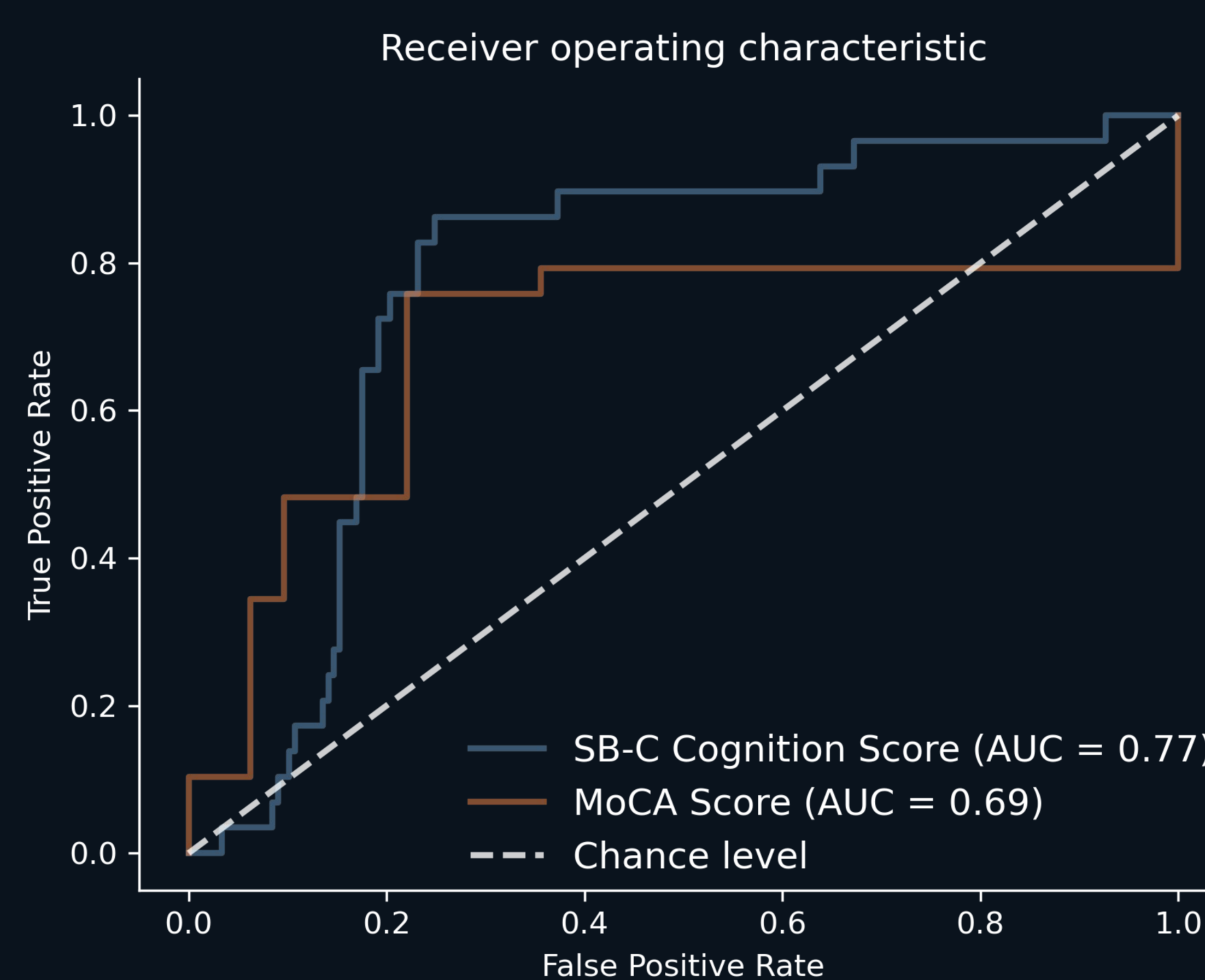


Figure 1: ROC AUC curve of the three classification models, using the ki:e SB-C Cognition Score and the MoCA score.

Table 1: Sample description and clinical measures; mean (stdv). HC = Healthy Control, MCI = Mild Cognitive Impairment, MoCA = Montreal Cognitive Assessment, PACC5 = Preclinical Alzheimer's Cognitive Composite, ki:e SB-C = Speech Biomarker for Cognition.

	HC	MCI
N	177 (87 F)	29 (20 F)
Age	75.00 (0.00)	75.00 (0.00)
Education	14.22 (4.55)	13.90 (3.71)
MoCA score	26.49 (2.28)	22.97 (3.59)
PACC5 score	0.20 (0.55)	-0.93 (0.53)
ki:e SB-C cognition score	0.33 (0.08)	0.21 (0.07)

Table 2: Performance of classification experiment (N=206).

	ki:e SB-C Cognition Score	MoCA Score
Balanced Accuracy	0.80	0.75
ROC AUC score	0.77	0.69
Sensitivity	0.86	0.72
Specificity	0.73	0.78