

Early identification of Mild Cognitive Impairment using multi-modal digital assessments

CAMBRIDGE COGNITION

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Introduction

- Early identification of Mild Cognitive Impairment (MCI) is critical for timely intervention to delay potential progression to Alzheimer’s disease and related dementias.
- Digital cognitive assessments are scalable, objective tools for cognitive screening, but the relative sensitivity of different assessment modalities (e.g., touch vs speech-based assessments) remains unclear.
- This analysis of data from the Bio-Hermes-002 study aimed to evaluate the potential of digital touch-based cognitive tasks and speech assessments to improve MCI classification beyond demographic variables alone, and to identify which assessment domains provided unique predictive value.

Methods

- Bio-Hermes-002 is an ongoing, multicentre, observational study of a diverse population aged 60–90 years, with or without memory concerns.
- Digital cognitive (PAL, DST, SWM) and speech (picture description task) assessments were administered to study participants via the CANTAB app (**Figure 1**).
- Cognitive outcomes were selected based on previous evidence of their sensitivity to dementia^{1,2} and speech features were selected using LASSO logistic regression with 10-fold cross-validation (λ_{1se}).
- Participants with non-missing cognitive and speech assessment data from the initial assessment (N = 353 participants: 173 cognitively normal [CN] and 180 with MCI) were included in the analysis.
- Discrimination of patients with MCI versus CN was predicted using logistic regression models, progressing from demographics only (age, sex, education) to models including cognitive outcomes and speech features.
- As MMSE scores contributed to MCI classification, the MMSE-based model is included as a clinical reference.

See the **supplementary material** for further details on the study design and statistical methods.

 E-poster

 Supplementary material

 References

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Presented at the Alzheimer’s Association International Conference (AAIC), 12–15 July 2026, London, UK

Results

Figure 1. Digital cognitive and speech assessments

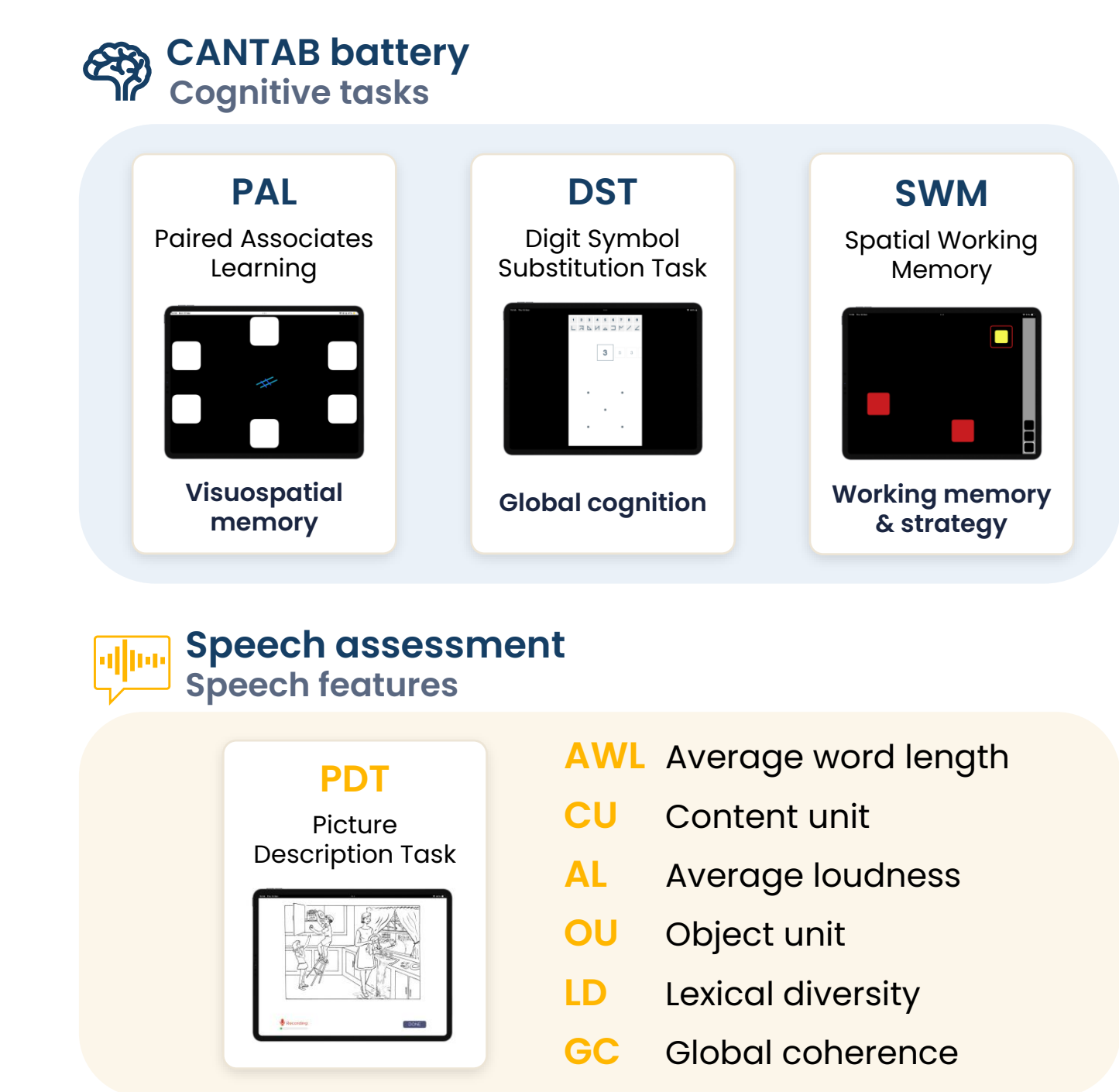


Table 1. Baseline demographics and clinical characteristics

Demographic/ characteristic	CN (N = 173)	MCI (N = 180)
Age	69.6 (7.2)	73.1 (7.7)
Female, n (%)	109 (63)	95 (53)
MMSE	28.3 (1.42)	26.7 (2.17)
GDS	1.74 (1.88)	2.64 (2.19)
FAQ	0.81 (1.64)	3.96 (5.13)

All data are mean (SD) unless otherwise specified.

Figure 2. Touch-based cognitive tests showed stronger associations with MCI than speech features

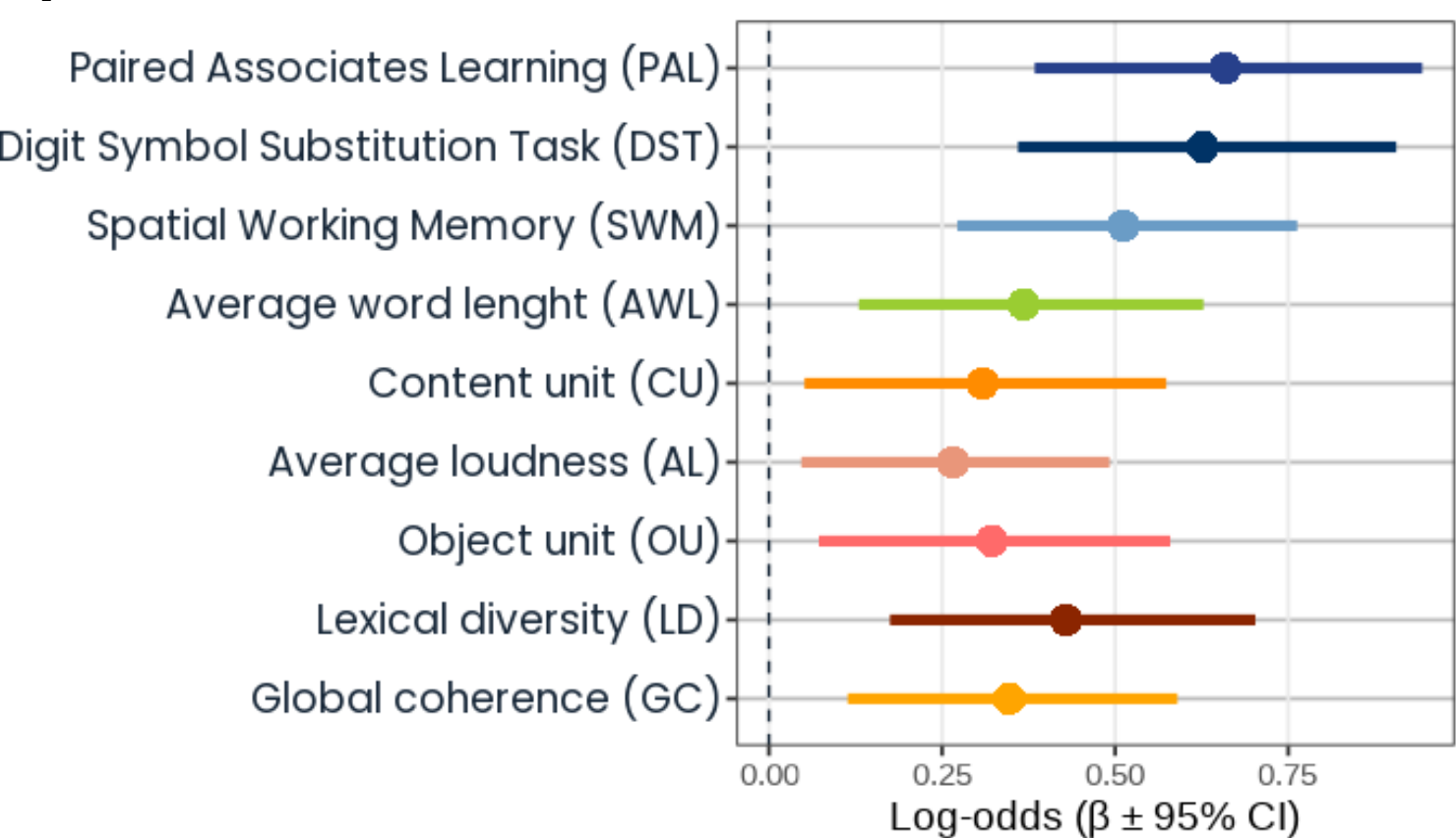


Figure 3. ROC analysis of cognitive only (A) and speech only (B) modalities predicted significantly increased performance with the addition of each measure, except GC (B)

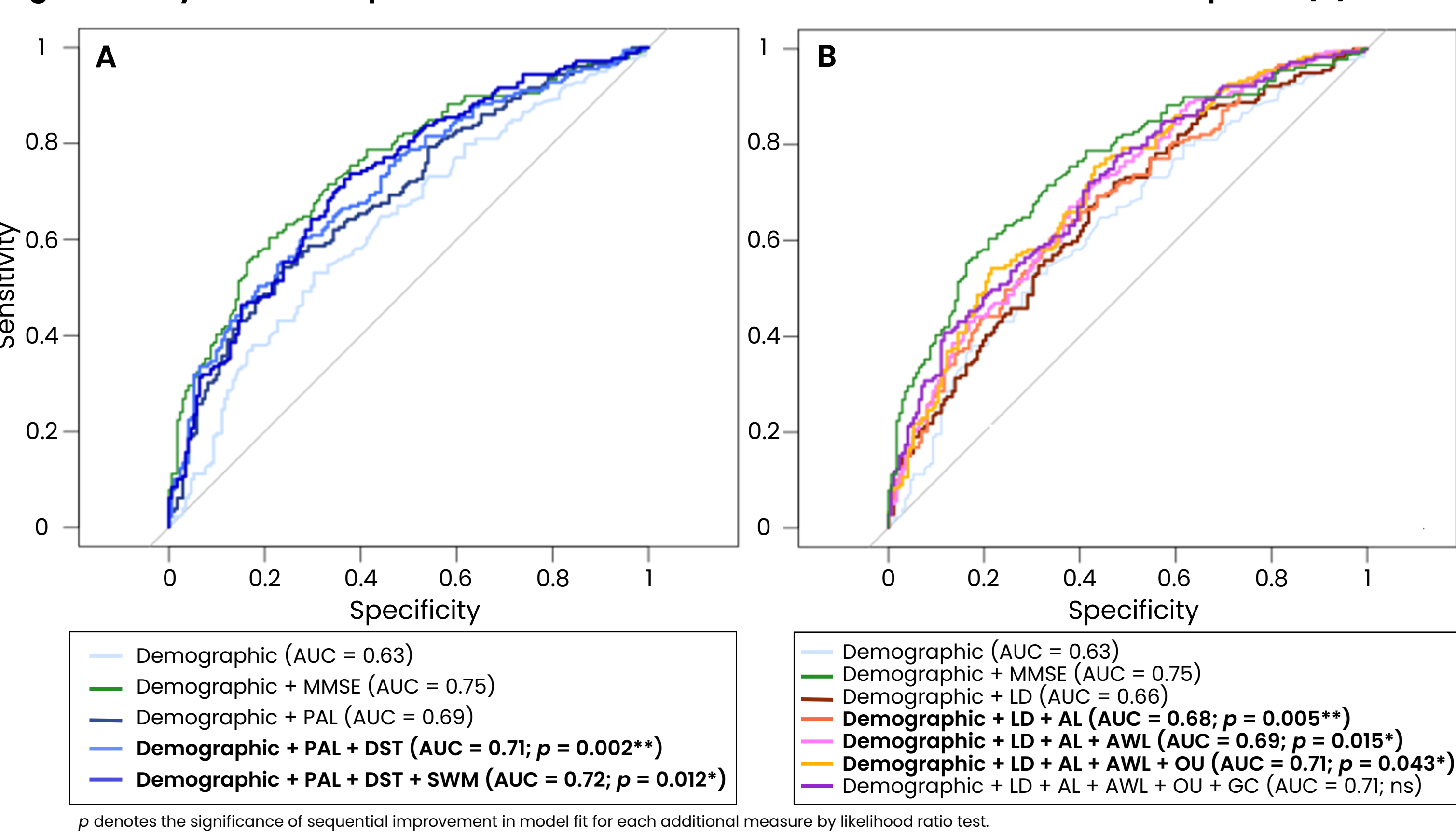
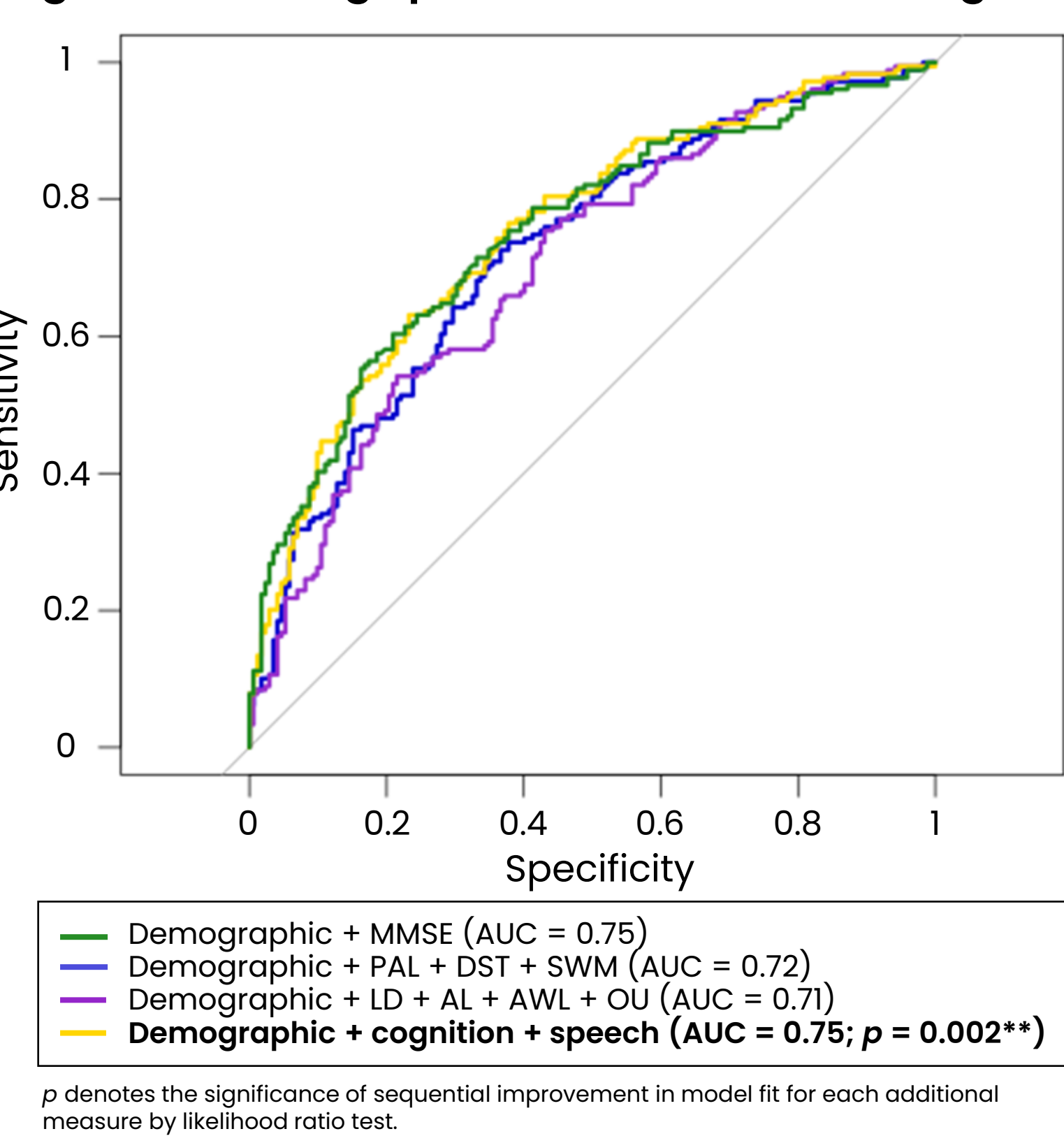


Figure 4. Adding speech features to the cognitive model significantly improved model fit



Model	Threshold	
	Sensitivity	Specificity
Demographic + MMSE	0.60	0.79
Demographic + Cognition	0.73	0.63
Demographic + Speech (GC excluded)	0.54	0.78
Demographic + Cognition + Speech	0.63	0.77

The cognitive model showed the highest respective threshold sensitivity, the demographic + MMSE model showed the highest specificity, and the combined cognitive + speech model offered balanced classification performance

Conclusions

Among cognitive tasks, **PAL and DST were the strongest predictors of MCI status**, supporting their utility as early cognitive screeners

Among speech features, **LD was the strongest individual predictor of MCI status**, with additional speech features adding sensitivity

Digital cognitive assessments **significantly improve MCI classification** beyond demographics alone, with speech features further increasing accuracy

These results support the use of **digital, multimodal batteries** for accurately identifying patients with MCI, at scale

Abbreviations

AL, average loudness; **AUC**, area under the ROC curve; **AWL**, average word length; **CANTAB**, Cambridge Neuropsychological Test Automated Battery; **CI**, confidence interval; **CN**, cognitively normal; **CU**, content unit; **DST**, Digit Symbol Substitution Task; **FAQ**, Functional Activities Questionnaire; **GC**, global coherence; **LD**, lexical diversity; **MCI**, Mild Cognitive Impairment; **MMSE**, Mini-Mental State Examination; **OU**, object unit;

PAL, Paired Associates Learning; **ROC**, receiver operating characteristic; **SD**, standard deviation; **SWM**, Spatial Working Memory.

Disclosures

MDL, JR, MX, ET, NT and **FC** are employees of Cambridge Cognition and may own stock or stock options in Cambridge Cognition.

Funding

The Bio-Hermes-002 study was funded by Innovate UK through the Small Business Research Initiative Dementia Mission programme (Award #10124420). Bio-Hermes-002 is led by the Global Alzheimer’s Platform Foundation, with support from LifeArc and the UK Dementia Research Institute.

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