

Introduction

Picture description tasks are widely used to assess speech and language ability. Here we present a digitized version of the picture description task, with an additional delayed recall version to assess visuospatial memory. This test is administered as a part of the California Cognitive Assessment Battery¹ (CCAB), a computerized test battery with automatic test administration and remote monitoring. Verbal responses are automatically transcribed and scored using consensus automatic speech recognition (CASR).

Methods

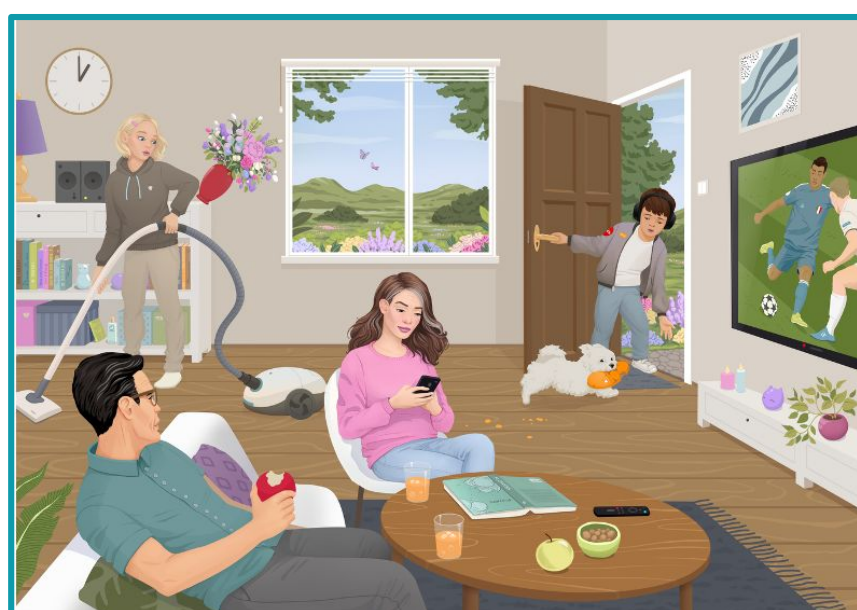
Participants: The CCAB Picture Description and Delayed Recall task was administered to 1753 healthy adults. 54% of participants were female, with a mean age of 54.1 years, \pm 17.3.

Technology: Participants were tested using a tablet computer with circumaural headphones and head-mounted microphone. Instructions and stimuli were delivered using text-to-speech (TTS) with intensities adjusted to the participant's auditory threshold. Responses were automatically scored using consensus automatic speech recognition (CASR) with performance scores displayed in real time. An examiner remotely monitored participant performance over audio and visual feeds.

Task: Participants were shown a scene of a family in a living room. Instructions were presented via text and audio over the headphones, and participants were asked to describe the scene verbally during the encoding trial. After an interval of ~20 minutes, participants were prompted to verbally recall the scene.

Scoring: Participant responses were transcribed with consensus automatic speech recognition (CASR), with transcription accuracy rates > 98%. Transcripts were automatically scored for keywords, relating to 35 semantic concepts.

Analysis: In addition to keyword scores, responses were analyzed for a diverse set of linguistic features, including acoustic, timing, lexical/semantic, and syntactic measures. Speech and language metrics were extracted using Praat and NLTK.



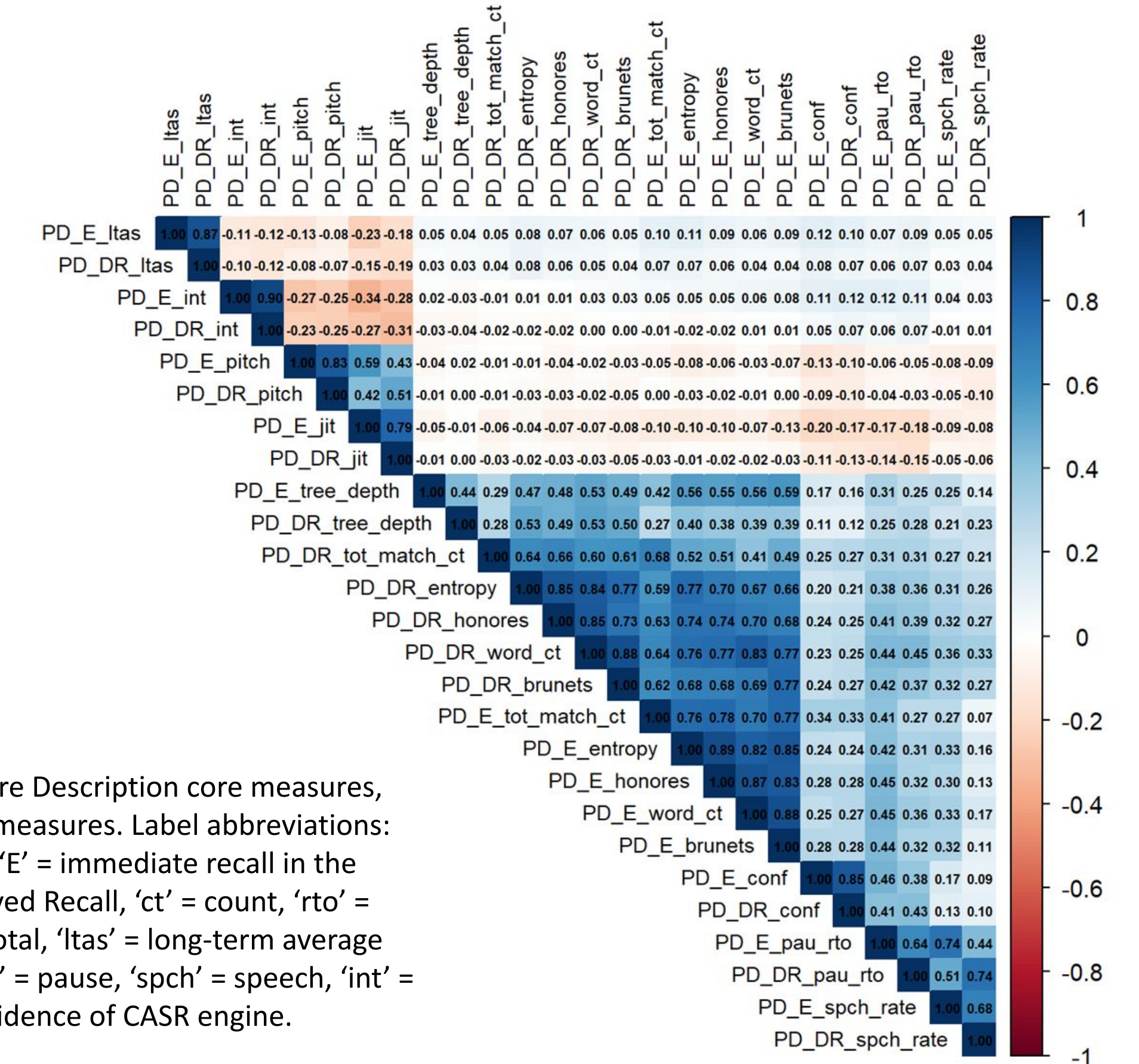
Intratest Reliability

Measure	Pearson's r	ICC
Total Match Count	.64	.39
LTAS	.9	.9
Jitter	.79	.79
Harmonicity	.87	.87
Speech Rate	.68	.65
Honore's Statistic	.72	.56
Brunet's Index	.77	.75
Word Entropy	.8	.66

Correlations with performance

Measure	Correlation with match count
LTAS	.02
Jitter	-.1
Harmonicity	.02
Speech Rate	.2
Honore's Statistic	.61
Brunet's Index	.52
Word Entropy	.56

Results



Summary

- Core measures of Picture Description encoding and recall demonstrated good reliability
- Acoustic measures such as long-term average spectrum and jitter show high reliability, but do not correlate with core performance.
- Timing measures such as speech rate demonstrate have a modest positive relationship with core measures, and have good reliability.
- Measures of lexical diversity and semantic predictability, such as Honore's statistic and word entropy, are closely related to recall metrics and display high reliability
- Picture Description recall was significantly predicted by age, gender, education, and vocabulary level (not shown). These predictors are mirrored in other recall tasks, such as Logical Memory.

Discussion

Analysis of results from the Picture Description encoding and recall task indicate that an automated, digitized implementation successfully captures performance in an objective manner. High reliability of core measures signal excellent psychometric properties.

Speech and language measures predict Picture Description performance to differing degrees, although all demonstrate high reliability. Lexical and Semantic measures most closely track with performance, and are promising variables to investigate in other task types. Acoustic variables did not covary with core measures, in contrast with previous research² suggesting a relationship between phonetic metrics and cognitive decline.

The novel Picture Description delayed recall task in the CCAB displays high internal validity and is a valuable tool for assessing visuospatial and episodic memory.

References

- [1] Woods, David, et al. "The California cognitive assessment battery (CCAB)." *Frontiers in Human Neuroscience* 17 (2024): 1305529.
- [2] Ivanova, O., Martínez-Nicolás, I., & Meilán, J. J. G. (2024). Speech changes in old age: methodological considerations for speech-based discrimination of healthy ageing and Alzheimer's disease. *International Journal of Language & Communication Disorders*, 59(1), 13-37.

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