Logical Memory Performance and Speech Metrics in the California Cognitive Assessment Battery

Background: Logical memory (story recall) tasks are frequently used to assess episodic memory and language abilities in older participants to assist in detecting mild cognitive impairment (MCI) and Alzheimer's disease (AD), [1]. Here we describe a logical memory encoding and recall (LM) task from the California Cognitive Assessment Battery (CCAB) [2]. Administration and scoring of this task is automated, and allows for the automatic extraction of speech and language biomarkers (SLBs).

Methods:
PARTICIPANTS: 772 participants (55% female, 66.5 ± 8.5 years) completed the CCAB logical memory task in their homes during normative data collection. Participants underwent two days of identical testing.

TECHNOLOGY: CCAB LM administration is fully automated, with instructions delivered using text-to-speech and responses transcribed and timestamped using consensus automatic speech recognition (CASR). Participants are remotely monitored through the CCAB browser-based interface, which provides an A/V feed and videochat capabilities. Acoustic and phonetic measures are quantified from high quality (48 kHz, 24-bit) recordings obtained with a head-mounted microphone while linguistic SLBs were quantified from CASR generated transcripts.

TASK: Participants heard a novel story, and were then asked to immediately recall the story followed, with delayed recall occurring ~30 min later. Responses were automatically scored for total match count against a scoring set of 49 keyword elements.

Results: Analysis of immediate and delayed recall of the LM tasks revealed excellent test-retest values for total match count (r=.77 and r=.79, respectively) with significant effects of vocabulary***, age***, gender**,education**, and race* on both immediate and delayed recall. SLBs such as speech rate and pause ratio showed good reliability(r = .61, r =.58) . and significant correlations (r = .32***, r = .42***) with delayed recall performance.

Conclusion: The CCAB's logical memory tasks provide automated objective analysis of recall performance and SLBs to assess episodic verbal memory and communication abilities in older adults.

References
[1] Wechsler, D. (1945). Wechsler memory scale.
[2] Woods, D., Pebler, P., Johnson, D. K., Herron, T., Hall, K., Blank, M., ... & Baldo, J. (2024). The California Cognitive Assessment Battery (CCAB). Frontiers in Human Neuroscience, 17, 1305529.

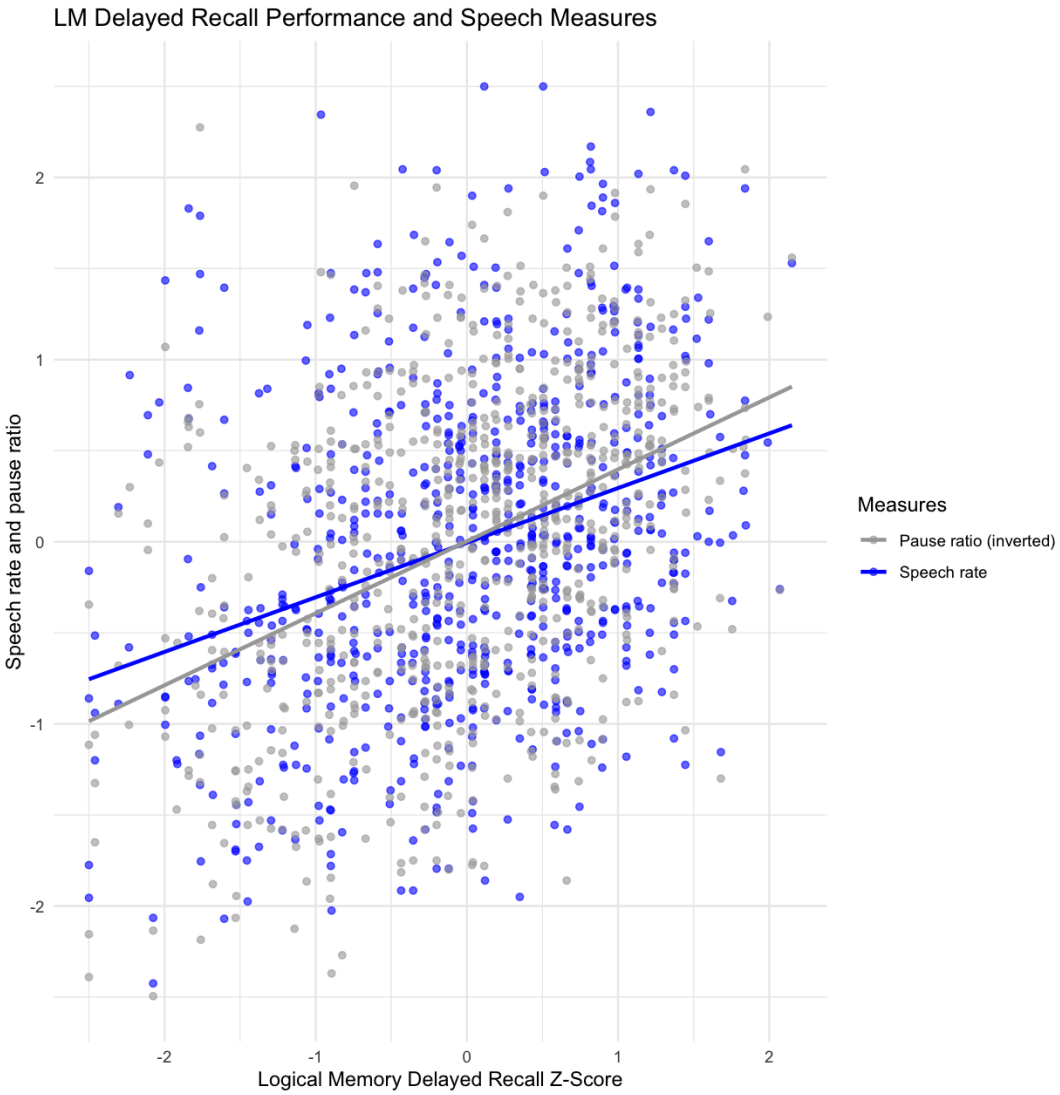


Figure 1: Mean delayed recall z-score for logical memory across both days of testing is displayed on the x-axis, speech rate and pause ratio z-scores (inverted) are shown on the y-axis. Blue indicates speech rate, and dark grey indicates pause ratio. Correlation lines demonstrate the relationship between these select speech measures and delayed recall performance.