MCI performance classification improves with a brief vocabulary test

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Introduction

Scores on verbal learning tests correlate with AD blood biomarkers and help identify older cognitively normal individuals who convert to AD/MCI (Stricker et al., 2020). Patients with MCI can be identified by low scores (1.5 z-scores below the mean) and MCI diagnostic accuracy is improved by correcting for significant demographic factors such as Age, Gender, and Education (AGE) on performance. Here, we evaluated whether estimates of premorbid verbal intelligence, derived from a brief vocabulary test, would further improve classification accuracy.

Methods

Participants: The California Cognitive Assessment Battery (CCAB) was administered to 446 healthy adults (mean age = 64.5 ±14.5, 41% female) in their homes.

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. The adaptive vocabulary subtest required touch screen responses. Verbal responses in the Bay Area Verbal Learning Test (BAVLT) were **automatically scored** using consensus ASR (CASR). An examiner telemedically monitored participant performance over audio and visual feeds.

Tasks: The <4 min CCAB Adaptive Vocabulary subtest included 24 multiple-choice trials. Participants selected synonyms out of 4 options, with target words ordered in difficulty over 60 levels. Difficulty was adapted using a 2:1 staircase with adjustable step sizes (Figure 1).

During the BAVLT (Woods et al, 2017), two 12-word lists were learned and recalled. Each encoding trial included immediate recall. First there were 3 List A encoding trials, then a List B encoding trial, followed by the uncued recall of List A. After 30 minutes the delayed recall of List A was assessed. The BAVLT was administered on two successive days using identical word lists. Total recall scores were averaged across test sessions prior to z-score calculations.

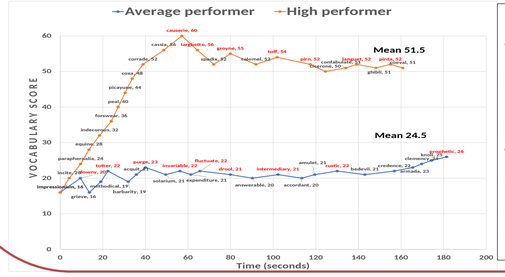

Figure 1. The adaptive CCAB vocabulary test. Participants were presented with 24 multiple choice trials. Difficulty was adapted over 60 levels beginning with large step sizes which were reduced following reversals. The data from two participants are shown along with the words presented, level, and accuracy (black = correct, red = error).

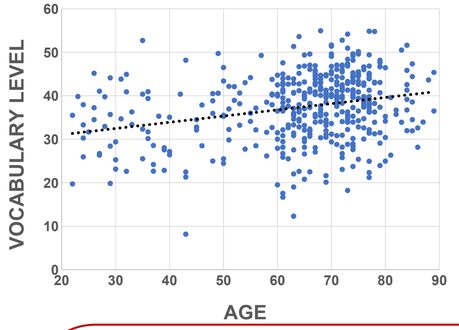

Figure 2. Vocabulary scores improved with participant age (r = 0.27, t(445) = 5.91, p< 0.0001) as in previous studies (Salthouse, 2019). Female gender and higher education also increased scores.

Results

BAVLT. BAVLT total-recall scores (summed over all trials) showed **high test-retest reliability (r = 0.87)** and correlated significantly with Age, Gender, and Education (AGE), as well as Vocabulary (V).

z-score calculations. The AGE model accounted for 24.6% of BAVLT total-recall score variance. The AGV model accounted for 37.4% of total-recall variance (education was insignificant), a significantly better fit (z = 2.1, p< 0.02) than the AGE model. Subjective memory impairments measured with the Cognitive Failures Questionnaire (Broadbent et al., 1982) correlated with both AGV (r = -0.15, p < 0.0015) and AGE (r = -0.13, p < 0.005) z-scores

Discussion

- Previous longitudinal studies have shown that vocabulary scores are stable in older individuals over a decade (Salthouse, 2019), suggesting that they provide a reliable estimate of premorbid verbal intelligence when corrected for small age effects.
- Vocabulary scores from a <4 min test correlated strongly with BAVLT total-recall scores and improved the precision of z-score calculations. They increased the classification of MCI in individuals with higher estimated premorbid verbal intelligence and reduced the MCI classification of individuals with lower estimated premorbid verbal intelligence.

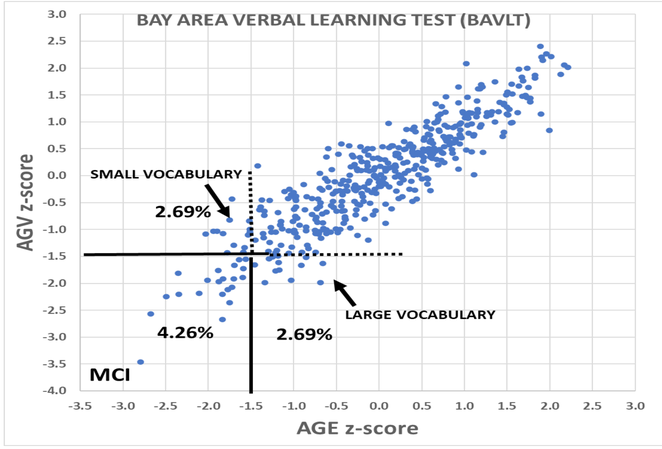

Figure 3. MCI Classification with and without vocabulary scores. AGE and AGV models each classified 6.95% of participants in the MCI range but the classification of many patients depended on the z-score model: 39% of the participants classified as MCI in the AGE model (those with small vocabulary scores) fell within the normal range with the AGV model, and 39% (2.69% of the population) of the participants classified as MCI in the AGV model (those with large vocabulary scores) fell within the normal range with the AGE model.

References

[1] Stricker et al, 2020: https://doi.org/10.3233/JAD-200087
[2] Woods et al. (2017) https://doi.org/10.3389/fnhum.2016.00654
[3] Broadbent et al (1982) http://www.ncbi.nlm.nih.gov/pubmed/7126941
[4] Salthouse (2019) https://doi.org/10.1037/pag0000288

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