Background

- Verbal neuropsychological tests are widely used to identify early signs of neurodegeneration in older adults. To date, employing these tasks remotely at scale, for example in large-scale screening and home-based monitoring programmes, has been limited by the dependence on skilled raters.
- We report data from a large sample of participants tested in their own homes showing that these tasks can be reliably administered and scored via device-agnostic web-based technology (Cambridge Cognition’s Neurovocalix platform).
- Analysis focused on a brief verbal test battery showing: 1) performance across different devices and platforms; 2) performance with respect to participant demographics, particularly age and native language.

Methods

- Participants were tested at home on their own devices, using the Cambridge Cognition Neurovocalix platform.
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- Automated quality checks resulted in 10.8% of testing sessions being flagged as poor and requiring manual review. On review, these had excessive background noise (talking or television in the background) or other poor audio quality. Data from these sessions was not included in subsequent analysis.
- Results are presented from two verbal tasks:
  - Verbal Paired Associates Learning
  - Digit Span Forward and Back

Results

- The goal of this analysis was to replicate established task characteristics for verbal cognitive tasks, supporting internal validity.
- For Verbal Paired Associates, in line with other versions of the task, probability of success increased across the three learning trials, particularly for hard trials (Figure 3A). We observed fewer errors for the semantically related than semantically unrelated words (Figure 3B).
- In Verbal Digit Span, accuracy decreased as number of items to be recalled increased. Overall, there was a significant difference in performance between forward and backward span trials, with better performance on forward span.

Task Characteristics

- The majority of participants were located in English speaking countries, particularly UK and US. 128 participants reported a language other than English as their first language.

Table 1: Participant Characteristics

<table>
<thead>
<tr>
<th>Age (Mean [SD])</th>
<th>Male</th>
<th>Female</th>
<th>Education</th>
<th>Middle / Junior High</th>
<th>High school</th>
<th>Higher Education</th>
<th>Postgraduate</th>
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<tbody>
<tr>
<td>67.4 (12.3)</td>
<td>1378</td>
<td>538</td>
<td>2588</td>
<td>35</td>
<td>542</td>
<td>143</td>
<td>578</td>
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</tbody>
</table>

Conclusions

- These data demonstrate the feasibility of large scale, automated verbal testing.
- We replicate well-established findings from conventionally administered verbal tasks, supporting the validity of remote verbal testing using ASR technology.
- We expected observed associations between verbal episodic memory measures and age, gender and education. Education level and Gender were the strongest predictors of verbal working memory. Language was associated only with worse performance on Forward Digit Span, but with small effect size, supporting the scalability and robustness of the system.
- In future work, we aim to extend these findings in patients with neurodegenerative disease.