

Introduction

Background: COVID-19 has underscored the need to be able to conduct remote assessments of patients whenever possible, both to decrease burden on clinic resources and reduce unnecessary patient exposure. Validated cognitive assessments are typically conducted by a clinician and rated by a clinician, with few remote options and none that are also self-administered. **This study focuses on understanding the feasibility and practicality of a remotely-administered and self driven cognitive assessment using a multimodal dialog agent.**

Aim: To develop and test the feasibility of a self-administered cognitive assessment protocol delivered via the Modality conversational platform, which is powered by HIPAA-compliant, cloud-based multimodal dialog technology. The protocol should comprise several well accepted cognitive testing aspects which assess **executive function, memory, processing, and planning.**

Method & Materials

- Participants were recruited via Prolific (<https://www.prolific.co/>), a crowdsourced research-focused website which allows participants to answer questionnaires to self-report health conditions.
- **Two groups of participants** were recruited. Healthy participants who recorded no cognitive impairments were classified as controls. Participants who reported a diagnosis of **mild cognitive impairment (MCI)** were classified as Patients.
- The virtual agent prompts participants with stimuli consisting of **structured conversational exercises designed to elicit speech, facial, and limb motor behaviors.**
- Each conversation includes standard tasks designed to capture assessments of cognitive functional areas traditionally assessed using gold standard cognitive assessments.
- **Automatic turn segmentation** allows **feature extraction modules** to compute, for each task:
 - ❖ speech acoustic, kinematic and vocal quality features
 - ❖ natural language features (e.g, lexico-semantic features)
 - ❖ oro-motor facial features (based on facial mesh tracking for each frame)

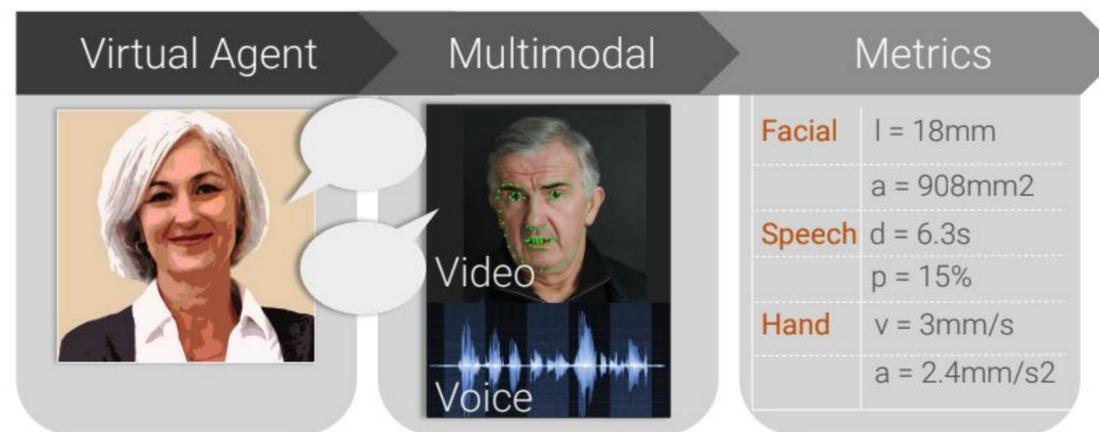


Figure 1. Example flow of Modality Platform

Task Descriptions

Task	Cognitive Area Assessed	Results (n=5)
Category Fluency	Executive function, working memory, searching strategy and inhibition of irrelevant words ¹	9.2 items listed (range=8-10)
Digit Forwards	Working memory ²	80% correct (range=20-100%)
Digit Backwards	Working memory ²	80% correct (range=0-100%)
Immediate Recall	Transient working memory ³	75% correct (range=50-100%)
Delayed Recall	Encoding memory and retrieval memory ³	15% correct (range=0-50%)

Table 1. Tasks included in Modality Cognitive Assessment

Observations

- 342 patients total, 5 identifying as diagnosed with MCI
- 41.5% of participants identify as male
- **86% of all participants completed the assessment** (i.e., starting the protocol and making it to the end, with metrics being generated)
- The worst performing patient subjectively gave good effort but failed multiple of the tasks, indicating use of the platform is likely lower effort than the current tasks
- **Frequent measurements that aid progress monitoring** are possible with the described system
- Remote setup enables **scalable and inexpensive collection** of large dataset

Limitations

- Small sample size
- Potential for poor effort levels
- Noisy data:
 - Potentially incomplete data (participant fatigue, boredom, forgetfulness, etc.)
 - Heterogeneous w.r.t. time since onset
 - Self-reported diagnosis
- No clinical gold standard for comparison

Conclusions and Future Work

- Data collected thus far suggests that **participants with and without varying levels of cognitive impairment are able to complete a self-driven remote-administered cognitive battery, providing promising evidence for the feasibility of such multimodal dialog-based cognitive assessments.** We further report on differences in performance between participants with and without cognitive impairments.
- Future work will be conducted to increase the sample size of patient with cognitive impairment. Future work will also be conducted to assess the data for differences between the two cohorts.