Speaker Verification For Remote Self-Assessments in Clinical Trials

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SUBMISSION DETAILS

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Methodological Issue Being Addressed The current study aims to evaluate a novel analytical approach: using a person’s voice and speech data for identity verification in longitudinal clinical research.

Introduction Remote self-administration of clinical and cognitive assessments have become increasingly common, but present a unique challenge: verifying a participant's identity (Van Patten, 2021). Ensuring data is uniquely attributed to the correct individual is important for maintaining the integrity, accuracy, and reliability of trial results. Patient identification methods to avoid 'professional patients' in traditional in-person clinical trials have been described (Resnik & McCann, 2015). However, identity verification methods in remote digital trials in general, and Alzheimer's in particular, remain to be established. The current study evaluates the performance of an automated speaker verification system to detect responses from the same individual across different assessments, devices, environments and over time.

Methods 197 adults confirmed as cognitively unimpaired (CU) (N=93), or with mild cognitive impairment (MCI) or mild Alzheimer’s disease (AD) (N=104) took part in the AMYPRED-UK (NCT04828122) and AMYPRED-US (NCT04928976) studies. Supervised assessments were completed at baseline, including the Automated Story Recall Task (ASRT, stories L1 and L2) and Category Fluency tasks (CAT). A subsample completed the ASRT L1 story (N=110) or CAT (N=129) remotely on their smart devices in the following week, and 102 participants (N=42 MCI/Mild AD, N=60 CU) returned for a 1-year follow-up appointment in which supervised ASRTs were repeated. All tests were audio-recorded.

Representations from a pre-trained deep learning model were used for speaker verification, extracting a 192-dimensional vector from each audio recording. Vectors were compared with cosine similarity distance, producing an output from -1 to 1 with a higher score indicating greater similarity.

Six assessment pairings were compared, including related and different tasks at baseline (supervised ASRT L1 →supervised ASRT L2, supervised ASRT L1→supervised CAT), the same task in supervised and remote settings (supervised and remote ASRT L1), different tasks in supervised and remote settings (supervised ASRT L1 → remote CAT), the same task completed a year apart (supervised ASRT L1 baseline → supervised ASRT L1 follow-up) and related tasks completed a year apart (supervised ASRT L1 baseline → supervised ASRT L2 follow-up). Performance was assessed using Receiver Operating Curve analyses and Area Under the Curve (AUC).

Results Consistently high performance of the speaker verification system was seen across all assessment contexts. This included comparisons of: related supervised tasks at baseline: AUC=0.997 (N=196); different supervised tasks at baseline: AUC=0.992, (N=197); the same task across supervised and remote settings: AUC=0.999 (N=139); different tasks in supervised and remote settings: AUC=0.998 (N=129); the same and similar tasks at baseline and 1-year follow-up: AUCs=0.973 and 0.996, respectively (N=102-103). When restricting the analyses within male and female groups, performance of the speaker verification system remained high, with all AUCs≥0.950.

Conclusion The speaker verification system is effective for confirming participant identity across tasks, environments, and devices, and shows high performance longitudinally, even in participants with a progressive neurodegenerative condition. This system could be implemented in remote assessment platforms to enhance reliability of collected data, prompting further investigation of data points where speaker verification mismatches occur.

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Guidelines I have read and understand the Poster Guidelines

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