

AI-Enabled Speech and Language Analytics as a Digital Biomarker for Cognitive and Communication Decline

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AI-derived speech and language features detected gradual declines in fluency and conversational engagement over time — even when standard cognitive test scores remained stable — positioning speech analytics as a scalable, early digital biomarker of cognitive and communication decline.

INTRODUCTION	METHODS	RESULTS	CONCLUSIONS	REFERENCES
Communication decline is a core, yet underutilized, marker of cognitive aging and neurodegenerative disease. Subtle changes in speech production, lexical retrieval, fluency, and conversational interaction often precede measurable decline on conventional neuropsychological tests. These early signals are rarely captured systematically in routine clinical practice, leaving a critical detection gap. Advances in artificial intelligence (AI) and speech-language processing now offer a chance to transform everyday communication into a scalable digital biomarker for cognitive and functional change.	We developed an AI-enabled speech-language analytics framework to examine how cognitive aging affects communication. Speech samples collected from older adults during: • Structured verbal fluency tasks (e.g., COWAT, semantic fluency) • Semi-structured conversational speech • Naturalistic communication during therapy-guided activities Processing pipeline: audio recordings processed using automated speech recognition (ASR) and acoustic feature extraction. Features quantified: articulation rate, pause duration, speech rate, lexical diversity, and error patterns.	AI-derived speech and language features showed systematic associations with conventional cognitive and language measures. Cross-sectional associations: reductions in articulation rate, increased pausing, and decreased lexical diversity were significantly associated with lower verbal fluency and global cognitive scores. Longitudinal findings: AI-based metrics detected gradual communication changes over time, including subtle declines in fluency and conversational engagement. Critically, these AI-detected declines emerged even when standard neuropsychological test scores remained relatively stable — suggesting greater sensitivity to early change.	AI-enabled speech-language analytics provide a scalable and clinically meaningful approach to monitoring cognitive and communication changes in aging populations. By capturing fine-grained speech, language, and interactional features across real-world contexts, this framework complements traditional neuropsychological testing. This approach enhances early detection of decline, offering a practical pathway toward continuous, low-burden monitoring outside the clinic.	1. Boschi V, et al. Connected speech in neurodegenerative language disorders: a review. <i>Front Psychol.</i> 2017. 2. de la Fuente Garcia S, et al. Artificial intelligence, speech, and language processing approaches to monitoring Alzheimer's disease: a systematic review. <i>J Alzheimers Dis.</i> 2020. 3. Konig A, et al. Automatic speech analysis for the assessment of patients with predementia and Alzheimer's disease. <i>Alzheimers Dement (Amst).</i> 2015. CONTACT Navilashini Rajasekar navilashini@gmail.com  ALZHEIMER'S ASSOCIATION AAIC 26