

Exploratory Factor Analysis of Acoustic and Semantic Speech Measures in Brazilians with mild Alzheimer's Disease

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Take away: Multiple speech biomarkers appear to capture one common signal of verbal impairment in mild AD.

INTRODUCTION

- Linguistic and speech changes are promising biomarkers in Alzheimer's disease (AD).
- It remains unclear whether acoustic and semantic markers represent separate dimensions or a single construct.
- This study examined the dimensionality of digital speech biomarkers and the feasibility of a composite index.

METHODS

- Participants: individuals >60 years with mild AD (NINCDS-ADRDA; CDR=1);
- Spontaneous speech was collected using the Cookie Theft task via TELL;
- Acoustic, temporal, and semantic biomarkers were analyzed;
- Dimensionality was assessed using exploratory factor analysis (EFA), Bartlett's test, and KMO.

RESULTS

Table 1: Exploratory factor analysis results for speech-derived variables.

	Factor	Uniqueness	MSA (KMO)
	1		
Global factor score			0.870
HNR	1.000	0.000039	0.862
HNR standard deviation	1.000	0.000039	0.850
Jitter	1.000	0.000039	0.905
Shimmer	1.000	0.000039	0.881
Jitter standard deviation	1.000	0.000039	0.896
Shimmer standard deviation	1.000	0.000039	0.845
Mean speech rate	1.000	0.000039	0.856
Mean speech tone	1.000	0.000090	0.885
Mean pause duration	1.000	0.000040	0.891
Pause duration variability	1.000	0.000039	0.881
Mean syllable duration	1.000	0.000039	0.889
Syllable duration variability	1.000	0.000039	0.840
Granularity	0.409	0.833	0.735
Ongoing semantic variability	1.000	0.000039	0.862

MSA = Measure of Sampling Adequacy; KMO = Kaiser-Meyer-Olkin test; HNR = Harmonics-to-Noise Ratio; Extraction was performed using the minimum residue method with oblimin rotation; Factor loadings ≥ 0.30 are considered meaningful.

Table 2: Exploratory factor analysis summary and model fit.

Domain	Parameter	Value
Factor		1
	Eigenvalue	13.2
	% Total variance explained	94.0
Model fit indices	Cumulative variance (%)	94.0
	RMSEA	1.03
	RMSEA 90% CI (lower-upper)	1.02 – NA
	TLI	0.372
Model test	BIC	1884
	χ^2 (df)	2132 (77)
	p-value	< 0.001
Assumption testing	Bartlett's test χ^2 (df)	4106 (91)
	Bartlett's test p-value	< 0.001

RMSEA = Root-Square Error of Approximation; TLI = Tucker-Lewis Index; BIC = Bayesian Information Criterion; Bartlett's Test of Sphericity.

CONCLUSIONS

- Speech biomarkers reflect a single latent dimension of verbal production in mild AD.
- A composite speech biomarker index may support future prediction and clinical screening.