

# Development of a novel digital speech composite measure for Frontotemporal Dementia

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## Background

- Changes to speech and language patterns occur across FTD subtypes, including: slowed speech rate, reductions in content, naming difficulties, apraxia and agrammatism.<sup>1,2,3</sup>
- Current tools to assess speech and language abilities in FTD often involve specialized neuropsychological testing, which can be lengthy, costly and burdensome to patients and their caregivers.
- Digital tools can be used to objectively measure speech abilities remotely with lower patient burden and higher functional relevance to everyday life.<sup>4,5</sup>
- The objective for this study was to examine longitudinal change in speech patterns in Frontotemporal Dementia (FTD) and to develop a novel composite measure for assessing speech and language abilities.

## Methods

- 36 participants (16F, 20M; mean age = 61.3 years, sd = 8.7) with varying subtypes of FTD were enrolled in a remote, longitudinal study collecting digital speech assessments over 12 months.
  - 21 participants (58%) had behavioral variant FTD (bvFTD)
  - 9 participants (25%) had a variant of primary progressive aphasia (PPA)
  - 6 participants (17%) were reported to have both bvFTD and a PPA variant
- Speech assessments were collected via an iOS app, with the help of a caregiver, and included short, naturalistic tasks like picture description.
- Speech samples were analyzed using Winterlight's speech analysis platform, generating >500 variables describing the acoustic and linguistic features of the speech sample.
- Using an exploratory approach, we identified speech variables that:
  - Demonstrated significant change over time, while controlling for demographics and stimulus effects using linear mixed models.
  - Had significant test-retest reliability over the first three assessments.
  - Had low redundancy with other selected variables.
- Based on the selected variables, we developed a novel composite score to measure longitudinal speech changes in FTD.

### Schedule of remote speech assessments



Figure 1: Longitudinal trajectory of selected speech variables and novel speech composite score

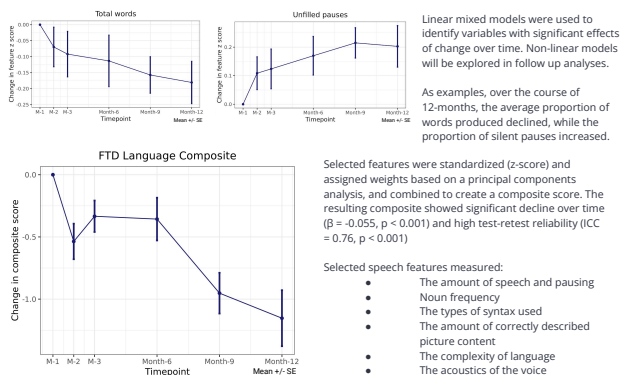
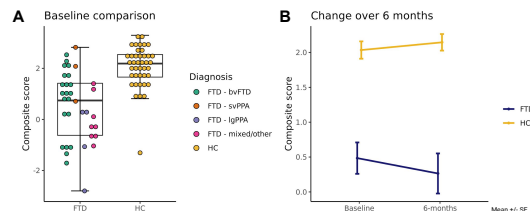


Figure 2: Validation of novel speech composite score by comparing scores to a matched sample of healthy controls at a) baseline and b) over 6-months



At baseline, scores on the speech composite were lower and had more variability in the FTD group compared to healthy controls (HC) (effect of group:  $\beta = 1.50$ ,  $p < 0.001$ ).

Over 6-months, there was a trend of decline in speech composite scores in the FTD group ( $\beta = 0.32$ ,  $p = 0.08$ ), but not in the HC group ( $\beta = 0.02$ ,  $p = 0.79$ ). 12-month data was not available in the HC group for comparison.

## Schematic of the Winterlight Speech Analysis Pipeline

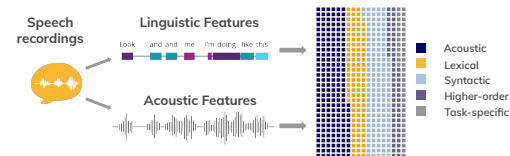
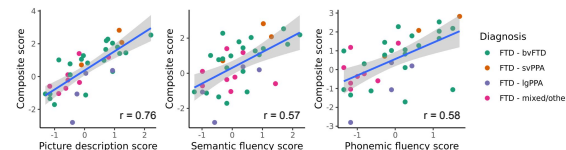


Figure 3: Validation of novel speech composite by correlating with standard speech assessment scores



Scores on the novel speech composite were significantly associated with automated standard scores on language assessment tasks, including the number of items named in the picture description task, and the number of correct words produced in a semantic (category) fluency task and a phonemic (letter) fluency task.

## Conclusions

- This study demonstrated that digital speech assessments can be used to characterize speech and language abilities in FTD.
- We developed a novel composite measure sensitive to disease-related differences and progression.
- Future work will further validate this score using clinical standards and biomarkers, and integrate these measures into clinical trials.
- This study highlights the usability of remote digital assessments in FTD populations, which have the potential to allow for lower burden and more sensitive monitoring of speech and language symptoms.

## References

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