# Data Visualization: Association of acoustic biomarkers and neuropsychological measures in the Framingham Heart Study (FHS)

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## Problem & Motivation

- Over **16 million Americans will live with Alzheimer's disease** (AD) by 2040-2050
- Primary care **physicians fail to detect AD** in 24%-91% of cases[2]
- AD Screening methods are invasive, costly, inaccessible, and/or slow
- **Detecting AD earlier could save $7.9 trillion** in the US[1]
- **Language is affected in the early stages of dementia**

- We aimed to demonstrate the **association between acoustic features of voice and cognitive function** as measured by neuropsychological assessment measures

## Approach

### Subjects & Clinical Characteristics

- Neuropsych assessments + audio + clinical characteristics of FHS[3] participants
- Audio (n=1128) from 141 participants [age=73±16, female n=73(52%) at first exam] with an average of 1.3 longitudinal assessments per participant (181 unique assessments)

### Acoustic & Neuropsychological Features

- **GeMAPS[4] acoustic features** were extracted[5]
- **Spearman's correlation** of acoustic features with neuropsych variable was calculated

## Results: Exploring Acoustic Features & Cognitive Performance

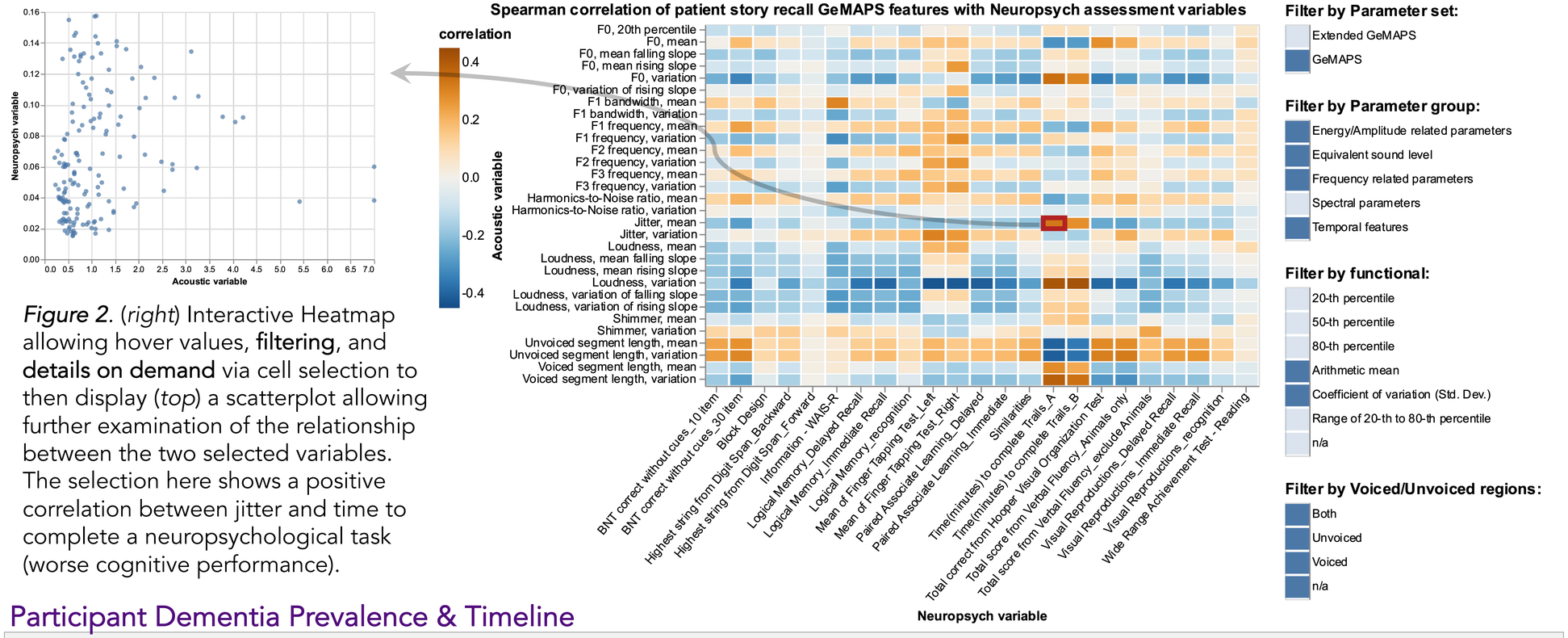


*Figure 2.* (*right*) Interactive Heatmap allowing hover values, **filtering**, and **details on demand** via cell selection to then display (*top*) a scatterplot allowing further examination of the relationship between the two selected variables. The selection here shows a positive correlation between jitter and time to complete a neuropsychological task (worse cognitive performance).

## Participant Dementia Prevalence & Timeline

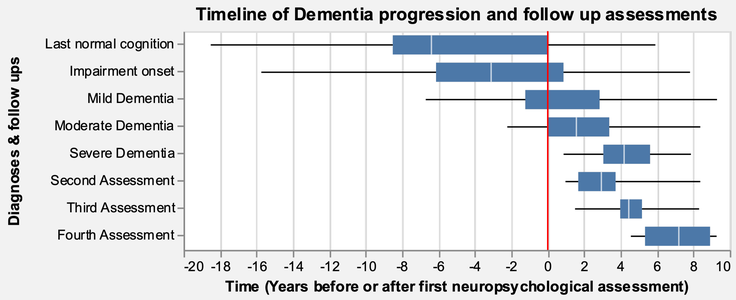


*Figure 1.* Patient cognitive status relative to first NP assessment/voice sample. **The time of first audio recording was mostly during the beginning stages of their dementia progression.** Median time of diagnosis for mild dementia is time of first assessment.

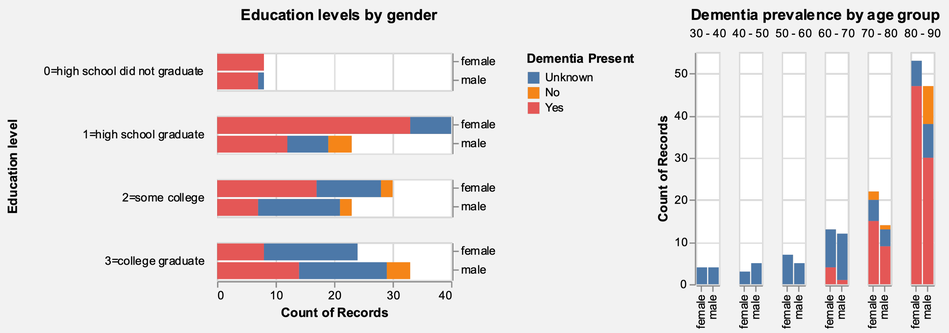


*Figure 3. Dementia prevalence by gender and education. Dementia is less common in males and the educated.*

## Discussion & Future work

- Our visualization aids in exploration of associations between **voice features and cognitive assessment variables** in FHS participants
- Our interactive heatmap could be repurposed to display other acoustic/linguistic features, different measures of association, or different data.
- Per the normalized timeline of our participants' dementia progression, **our audio are early enough in dementia progression to test their utility in the early identification of potential cognitive decline**.
- Future work: create predictive models for early cognitive impairment detection using acoustic and linguistic features
- Assess relation of predictive power to time until diagnosis in full FHS cohort

To see our interactive visualizations, please visit
https://cse512-19s.github.io/FP-FHS_neuropsychVoice/
or scan QR code

Scan me

Acknowledgements & Disclosures & References

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Disclosures: Dr. Hosseini Ghomi is a stockholder of NeuroLex Laboratories.

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