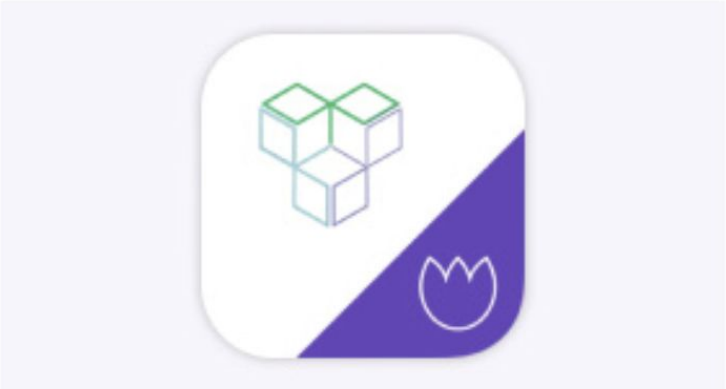
Early Detection in Parkinson’s using Voice Features

Miller Tracy

Dataset



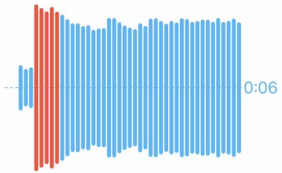
mPower Parkinson Study and Public Researcher Portal

The mPower study uses surveys and tasks that activate phone sensors to collect and track health and symptoms of Parkinson's Disease.

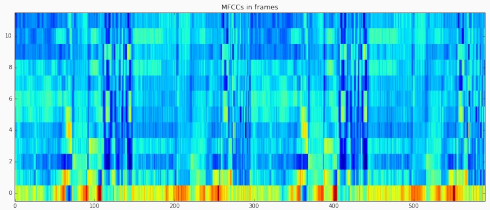
Task Name	Type of task and schedule	unique participants	unique tasks
Demographics	Survey - once	6,805	6,805
MDS-UPDRS	Survey - monthly	2,024	2,305
PDQ8	Survey - monthly	1,334	1,641
Memory	Activity - t.i.d.	968	8,569
Tapping	Activity - t.i.d.	8,003	78,887
Voice	Activity - t.i.d.	5,826	65,022
Walking	Activity - t.i.d.	3,101	35,410

Idea

Say "Aaaaah" into the microphone for as long as you can.



Voice feature extraction



Classification

Diagnosis
"Mild Stage"

Diagnosis

Clinical Application

Early Detection

Survey Screening

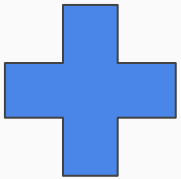
- Screen out:
  - Surgeries
  - Medications for Controls
  - ‘Are Caretaker’ Field for Parkinson’s group
- Identify Parkinson’s Mild Stage group
  - MDS-UPDRS Part II (13 questions)
  - Martinez-Martin et al. - https://www.ncbi.nlm.nih.gov/pubmed/25466406
  - Scores 12/13 cutoff between Mild/Moderate
  - MDS-UPDRS < 10 - Mild Stage (10 questions)

Voice Sample Cleaning

- Removed outliers (samples that were too long or too short)
  - 2 std from mean
- Screen for medication time point
  - Parkinson’s - [‘Immediately After’, ‘Don’t take meds’]
  - Controls - [‘Dont take meds’]

Voice Features

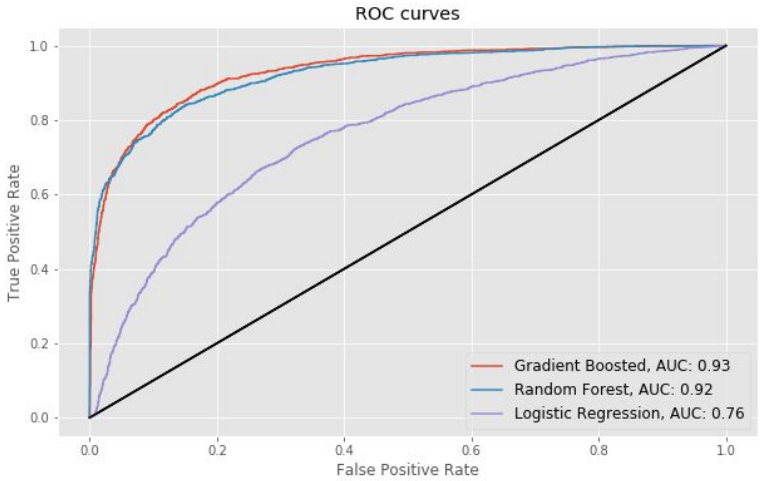
Py Audio Features	
Description	**Features**
Zero Crossing Rate	1
Energy	1
Entropy of Energy	1
Spectral Centroid	1
Spectral Spread	1
Spectral Entropy	1
Spectral Flux	1
Spectral Rolloff	1
MFCCs	13
Chroma Vector	12
Chroma Deviation	1
Total	**34**



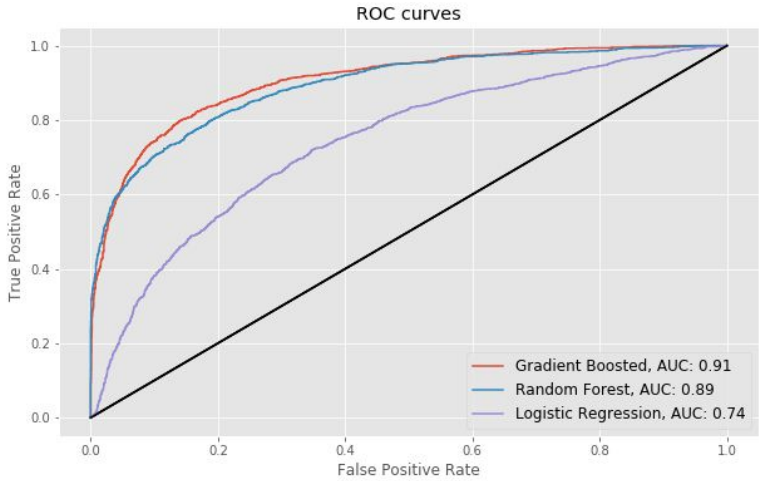
GeMaps	
Description	**Features**
Frequency	6
Energy / Amplitude	3
Spectral (balance)	9
Functionals	44
Total	**62**

Temporal Summarization

Mean

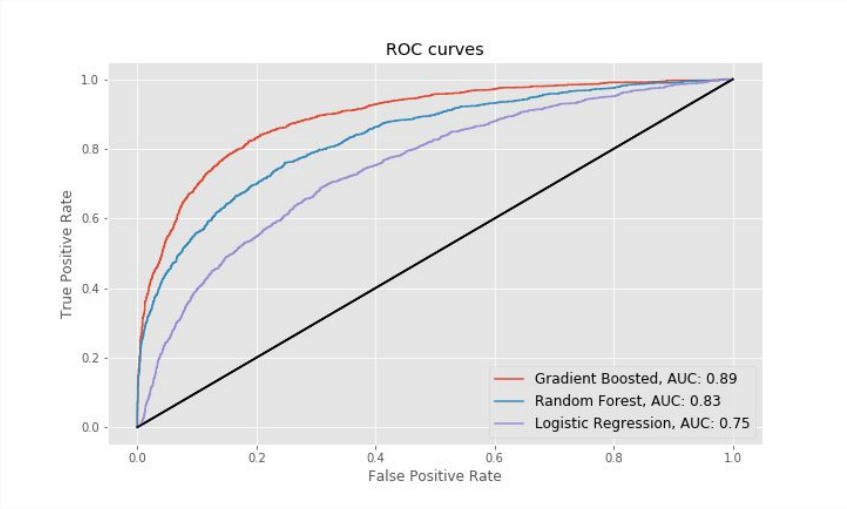


Variance

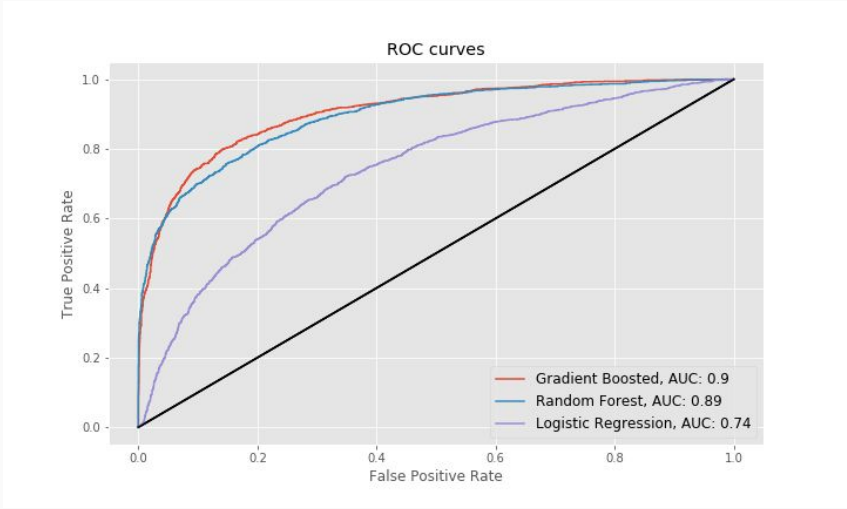


Frequency Summarization

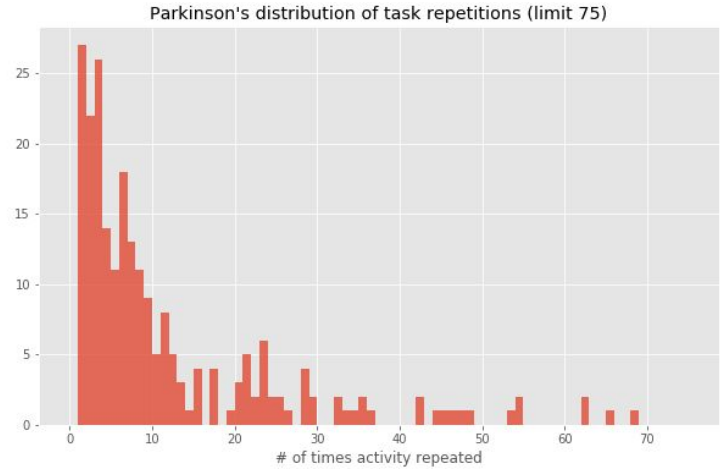
Mean

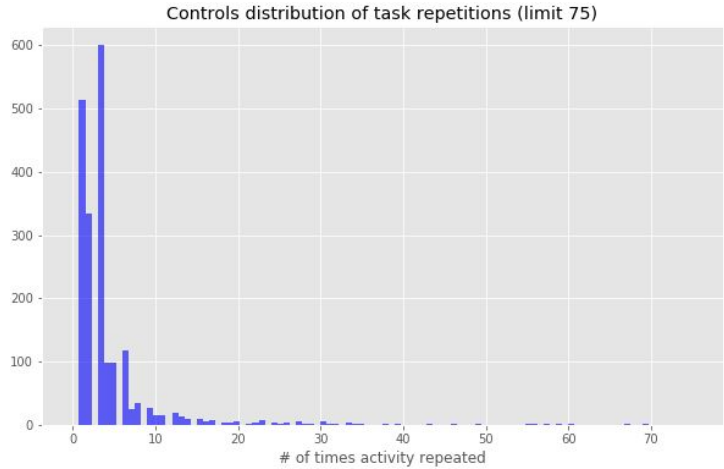


Variance

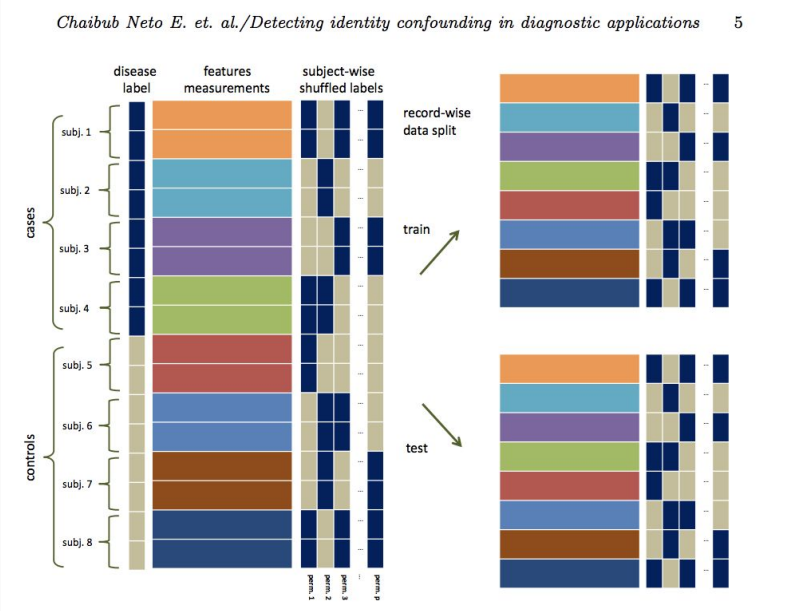


Identity Confounding

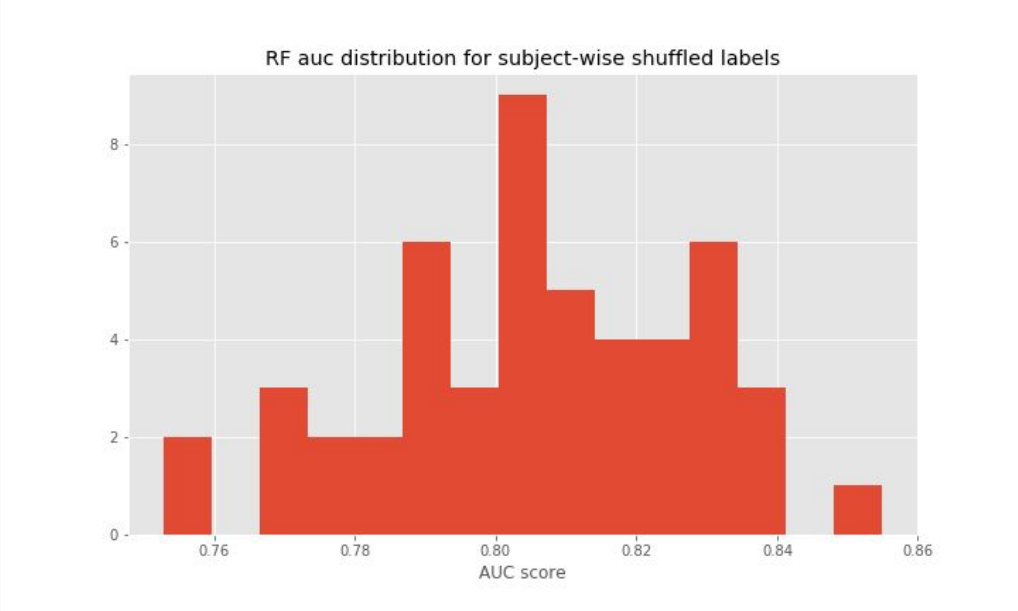




Method for Identifying Confounding



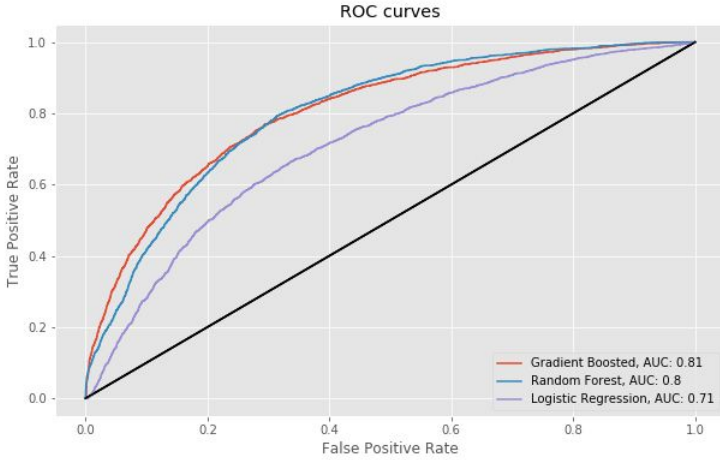
Identity Confounding



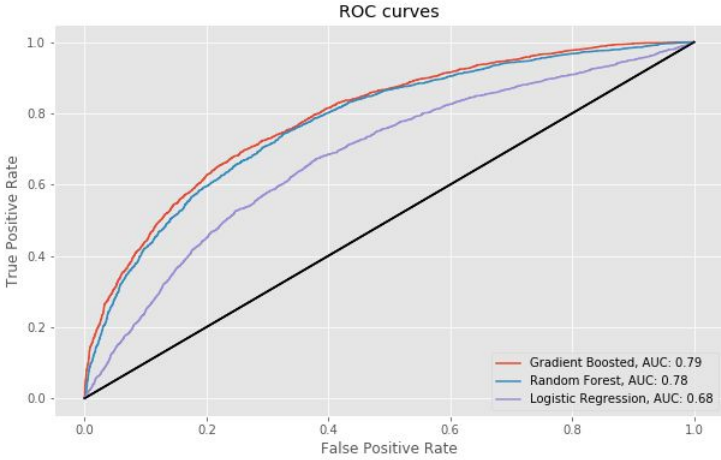
50 permutations

GroupKFold - Temporal Summarization

Mean



Variance



Conclusions

- Results suggest differences in voice features can be detected between Controls and a Mild Stage Parkinson’s subgroup
- Identity Confounding highlights the need for new strategies to help balance participation in mobile studies
- Limitations
  - MDS - proxy for severity, no clinical validation provided
  - Future studies should provide clinical validation of severity