

Acoustic Prosodic Measures in Natural Speech of Progressive Supranuclear Palsy and Corticobasal Spectrum Disorders

Natalia Parjane¹, Sunghye Cho, PhD³, Sharon Ash, PhD^{1,2}, Mark Liberman, PhD³, Murray Grossman, MDCM, EdD^{1,2}, Naomi Nevler, MD^{1,2}

1. Penn Frontotemporal Degeneration Center, University of Pennsylvania, Philadelphia, PA
2. Department of Neurology, University of Pennsylvania, Philadelphia, PA
3. Linguistic Data Consortium, Department of Linguistics, University of Pennsylvania, Philadelphia, PA

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Groups of Interest: FTD-Spectrum Disorders

- **Progressive Supranuclear Palsy and Corticobasal Syndrome (PSP-CBS):**
 - Motor impairments: extrapyramidal motor impairments, voluntary/involuntary movement impairment, postural instability, falls
 - **Speech and language impairments:** slurred speech, hypophonia, dysarthria, apraxia of speech (AOS)
- **Nonfluent/agrammatic variant of primary progressive aphasia (naPPA):**
 - **Speech and language impairments:** agrammatism, effortful, halting speech, inconsistent speech sound errors, AOS

Although PSP-CBS commonly presents with naPPA (PSP-CBS+naPPA), not much is known about speech and language impairments in PSP-CBS and few studies directly compare PSP-CBS and naPPA. Further, no investigations have been done using automated analyses to compare these patients.

Study Aims

1. **Utilize novel automated analyses to characterize acoustic-prosodic patterns in PSP-CBS spectrum compared to normal speakers and naPPA**
2. **Better understand effects of underlying cognitive and motor impairments on speech patterns**
3. **Associate specific acoustic markers with grammatical impairment and pathology (CSF pTau)**

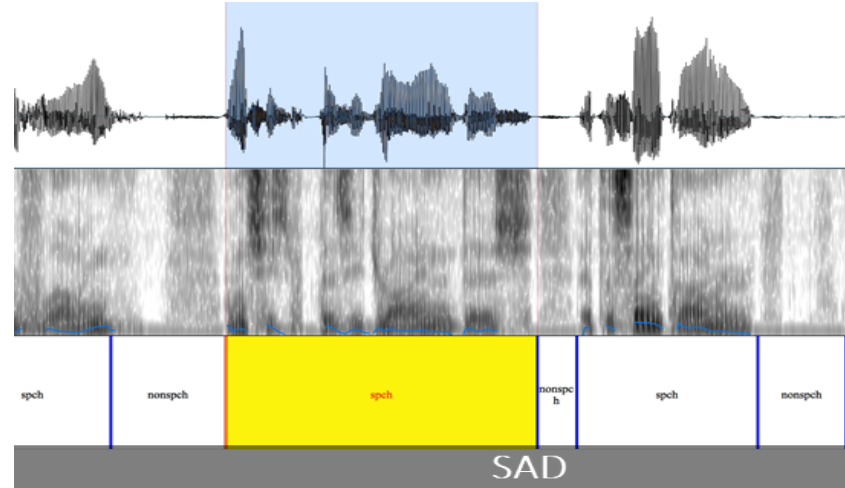
Hypothesis: PSP-CBS have impaired acoustic-prosodic speech patterns, exhibiting a subset of impairments found in naPPA.

Methods

- **Cookie Theft Audio Recordings** (~60sec)
- **SAD (Speech Activity Detector)**-Acoustic Measures Extracted:
 - Mean speech and mean pause durations (sec)
 - Pause rate (pauses per minute of speech time, ppm)
- **Pitch tracking (Praat)**: Fundamental Frequency (f0 range, in semitones, ST)

Exclusion criteria:

- Longitudinal data
- Non-native English speakers
- Identified pitch outliers



Statistical Analyses

Patients are Matched for Demographics

Mean(SD)	HC	PSP-CBS	naPPA	PSP-CBS+naPPA	p
n	41	87	25	8	
Age (y)	68.94 (7.57)	68.16 (7.53)	70.91 (8.93)	71.20 (6.15)	0.364
Education (y)	15.80 (2.42)	14.75 (2.69)	15.32 (3.00)	15.75 (1.98)	0.174
Disease Duration (y)	NA	4.13 (2.42) (n=86)	3.32 (1.91)	3.00 (1.07)	0.156
Sex (M, F)	18M, 23F	40M, 47F	11M, 14F	4M, 4FM	0.987
n	35	74	24	7	
MMSE Total	29.11 (0.99)	24.92 (4.75)*	23.04 (5.89)*	27.14 (2.41)	<0.001

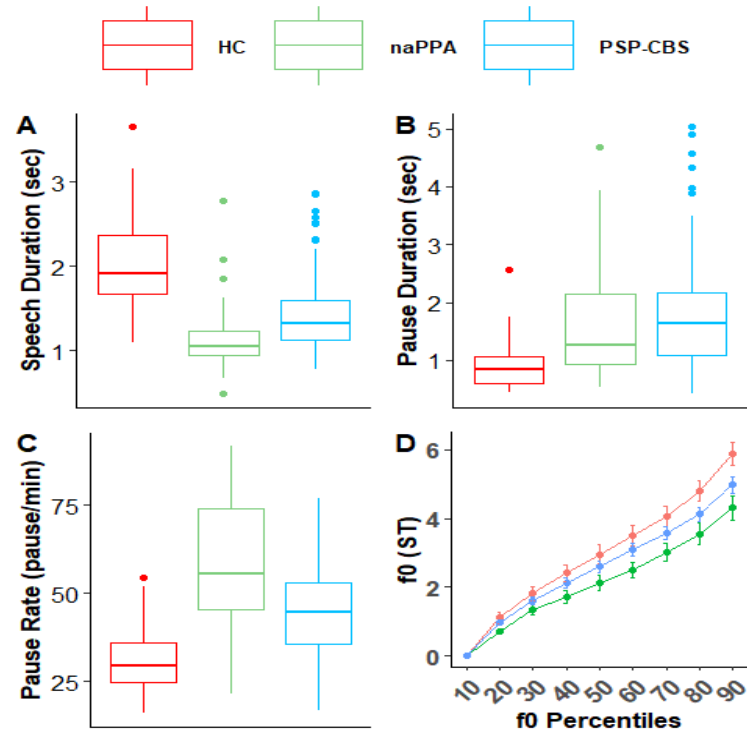
HC- Healthy controls; PSP-CBS- Progressive supranuclear palsy-corticobasal syndrome; naPPA- nonfluent/agrammatic variant of primary progressive aphasia; PSP-CBS+naPPA- PSP-CBS with concomitant naPPA; MMSE- mini mental status examination; SD- standard deviation; y- years; m- males; f- females.

*significance from controls (p<.05)

- **Group comparisons** on acoustic-prosodic measures (HC, PSP-CBS, naPPA)
 - Sub-analysis on group with PSP-CBS and concomitant naPPA (PSP-CBS+naPPA)
- **Correlations** between acoustic-prosodic measures and clinical impairment:
 - grammatical: number of dependent clauses per utterance (DC)
- **Linear regressions** on acoustic-prosodic measures and CSF-pTau pathology, controlling for demographics

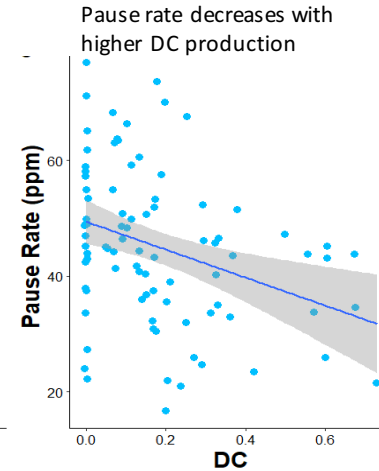
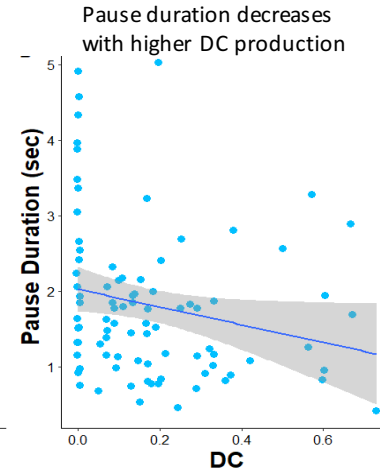
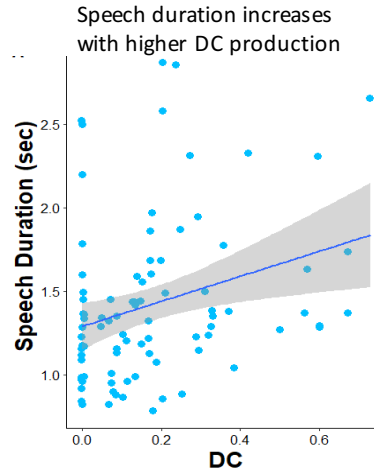
Results: Acoustic-Prosodic Measures

- **PSP-CBS** and naPPA were impaired compared to HC for speech duration, pause duration, pause rate, and f0 range
- **naPPA** was more impaired than PSP-CBS for speech duration and pause rate
- **Sub-analysis: PSP-CBS+naPPA** was impaired for most measures, resembling naPPA, and exhibited the most impaired f0 range



Results: Grammatical Correlations in PSP-CBS

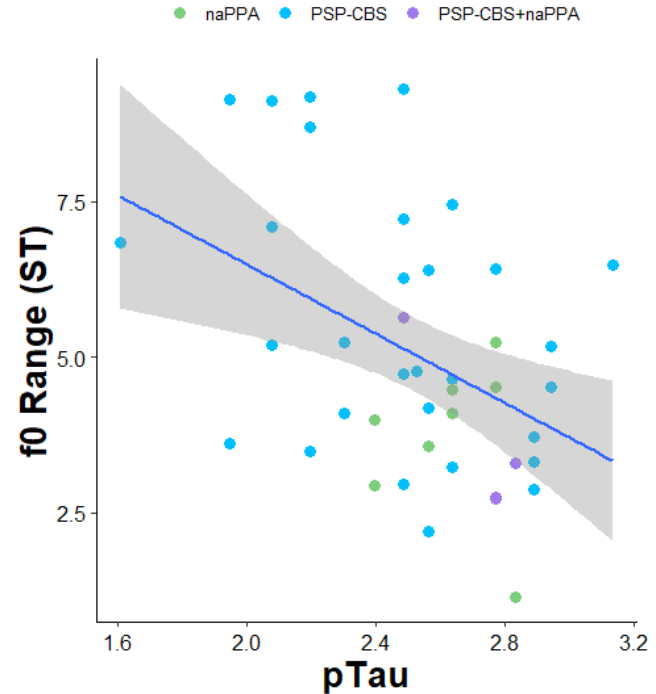
- In PSP-CBS, DC (dependent clauses per utterance) was correlated with speech durations ($r=0.29$, $p=.007$), pause durations ($r=-0.22$, $p=.045$), and pause rate ($r=-0.34$, $p=.0015$)



Results: CSF pTau Regressions

f0 range was a significant predictor of CSF pTau levels (beta= -0.064, p=.0052) in a subset of all patients (naPPA, PSP-CBS, PSP-CBS+naPPA)

CSF Analysis



Conclusions

- Automatically derived acoustic measures characterize speech in PSP-CBS in an objective and reliable manner.
- PSP-CBS has an impaired acoustic-prosodic speech pattern, similar to naPPA, which is related to grammatical impairment and tau pathology. However, naPPA is more severely impaired for some properties (higher pause rates and lower speech durations). In PSP-CBS+naPPA, speech pattern is more similar to naPPA, and even more impaired for f0 range, indicating that the combination of motor and cognitive deficits can result in more severe impairments.

If you have questions or comments, please
contact the corresponding author:

nparjane@sas.upenn.edu

[Back](#)

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[Next](#)