

Speech Rate Metrics During Story Recall Correlate with Early Tau Pathology in Cognitively Normal Adults

Lauren Vetere^{1,2}, Ayelet Rosenberg^{1,2}, Alok Vedvyas¹, Simon Henin^{1,2}, Arjun Masurkar¹, Henry Rusinek³, Anli Liu^{1,2}

1. Neurology, NYU Grossman School of Medicine, New York, NY, USA

2. Neurology, NYU Langone Health, New York, NY, USA

3. Radiology, Psychiatry, NYU Grossman School of Medicine, New York, NY, USA

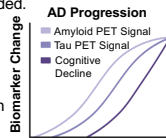


Department of Neurology

Introduction

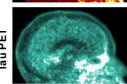
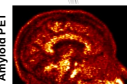
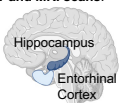
- Alzheimer's disease (AD) is characterized by episodic memory decline, with age as the greatest risk factor¹. New diagnostic criteria emphasize neuropathology (amyloid, tau, neurodegeneration)².
- Early diagnosis is critical to maximize the impact of disease modifying therapies, but current tests fail to detect preclinical AD by up to 2 decades, due to long wait times³ and outdated tests⁴. New methods to detect preclinical AD are needed.
- Speech-based metrics can distinguish patients AD from those with Mild Cognitive Impairment and healthy controls⁵⁻⁷, and correlate with regional tau pathology⁸.
- Tau in Hippocampus (Hipp) and Entorhinal Cortex (EC) emerges early in disease and correlates with cognitive decline⁹.

Can spoken story recall predict early regional tau pathology in cognitively normal subjects?

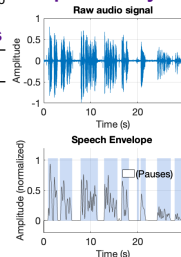


Methods

- For this preliminary analysis, we obtained speech recordings from 21 cognitively normal (CN, CDR = 0) subjects from the NYU Alzheimer's Disease Research Center (ADRC) Database with co-registered Tau PET and MRI scans.
- We analyzed speech during the Craft story task. Subjects listened to a short story and recalled it immediately and 20-minutes later.
- Transcripts were created using WhisperX and manually validated. Audio recordings were amplitude-normalized, smoothed, thresholded, and refined with published duration limits to identify speech and silences⁹ and extract rate and duration of utterances, pauses, and words.
- Brain scans were parcellated using Freesurfer to identify Hipp and EC.



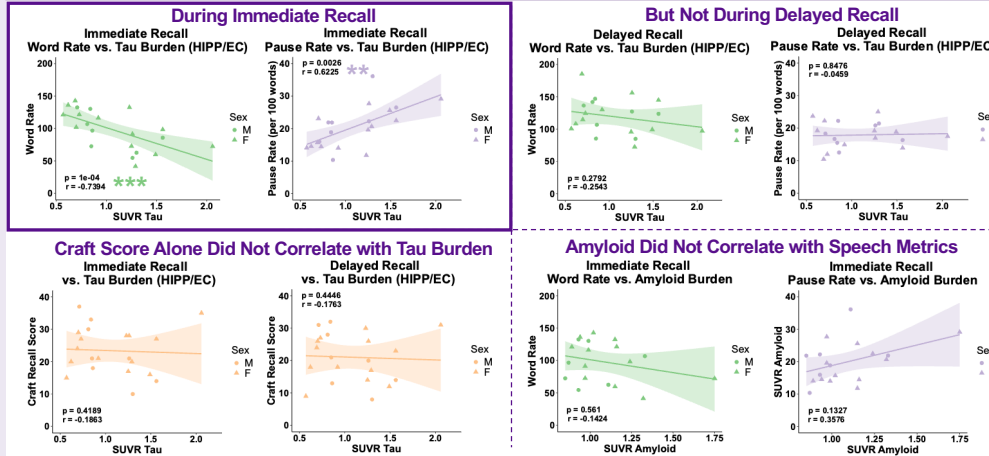
Speech Analysis



Subject Demographics

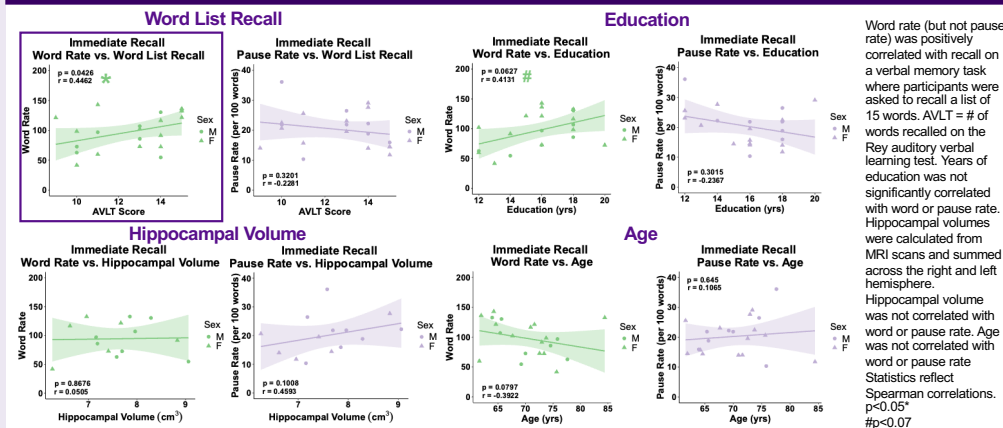
	Overall (N=21)
Age (years)	
Mean (SD)	70.3 (5.81)
Median [Min, Max]	70.9 [61.6, 84.4]
Sex	
M	8 (38.1%)
F	13 (61.9%)
Education (years)	
Mean (SD)	15.9 (2.34)
Median [Min, Max]	16.0 [12.0, 20.0]

Reduced Word Rate and Increased Pause Rate Were Associated With Greater HIPP/EC Tau



We quantified words spoken per minute (green) and pause rate per 100 words (purple) during story recall based on acoustic analysis and speech transcripts. Craft recall score (orange) was calculated as number of story elements successfully recalled. SUVR Tau = Standardized Uptake Value Ratio calculated from Tau PET within MRI regions defined as hippocampus and entorhinal cortex. Statistics reflect Spearman correlations; $p < 0.01^{**}$, $p < 0.001^{***}$. SUVR Amyloid = Standardized Uptake Value Ratio calculated from whole-brain Amyloid PET.

Word Rate Correlates with Verbal Memory but Not Age or Hippocampal Volume

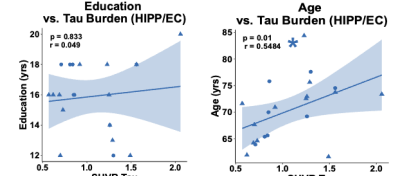


References

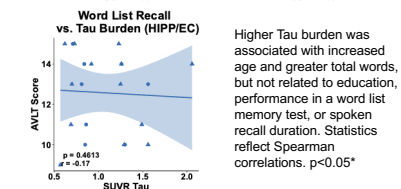
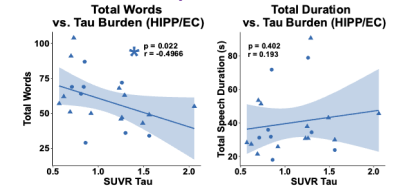
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Tau and Other Speech and Demographic Metrics

Tau correlates with age but not education or word list recall



Tau correlates with total words but not total speech duration



Higher Tau burden was associated with increased age and greater total words, but not related to education, performance in a word list memory test, or spoken recall duration. Statistics reflect Spearman correlations. $p < 0.05^{*}$

Linear Model: Tau Burden ~ Word Rate + Pause Rate + Age + Sex + Education + Word Rate*Education
Adj. R² = 0.775, $p = 6.49e-05$, Main effects: Pause Rate ($p = 0.00423$), Sex ($p = 0.00790$)

Conclusions

- Decreased word rate and increased pause rate during story recall were associated with increased hipp/ec tau burden in cognitively normal subjects.
- Acoustic speech-based metrics (word rate, pause rate) are highly sensitive to tau burden in Hipp/EC regions.
- These preliminary findings support a growing body of literature highlighting speech metrics as a potential tool for detecting early neuropathology and cognitive decline.
- Next steps include obtaining and analyzing remaining voice recordings from 100+ cognitively normal NYU ADRC subjects.

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