Speech Analysis as an Objective Measure for Cognitive and Affective Symptoms in Treatment Resistant Depression

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BACKGROUND:

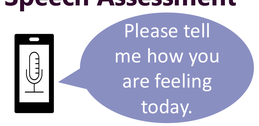
- Psychiatry lacks **objective biomarkers** for depression
- Current tools rely on **self- and clinician reported symptoms** (e.g., HAMD-17)[1]
- But these often miss key aspects —especially **cognitive difficulties**[2,3]
- Patients with depression exhibit different speech patterns compared to non-depressed individuals[4,5]. Therefore, automated speech assessment holds promise as an objective depression assessment tool.

Aim: To evaluate whether **speech features** can serve as objective markers of depression and cognitive difficulties.

METHODS:

MDD: N=66
Control: N = 54 → Patients with MDD complete HAMD-17

Speech Assessment



Executive Control Anti-saccade Task
N = 79

Speech Feature Extraction

WINTERLIGHT → Audio file → Acoustic features
→ Transcript → Linguistic features

ANCOVA Analyses *
- Assessing group differences

Linear Regression Analyses *
- Examining relationships between speech features and HAMD-17, between executive control performance and HAMD-17, and between speech features and executive control. * Controlling for age and sex

Patients with depression use distinct speech features, which correlate with executive control performance

Fig. 1: Differences in speech features between individuals with Major Depressive Disorder (MDD) controls.

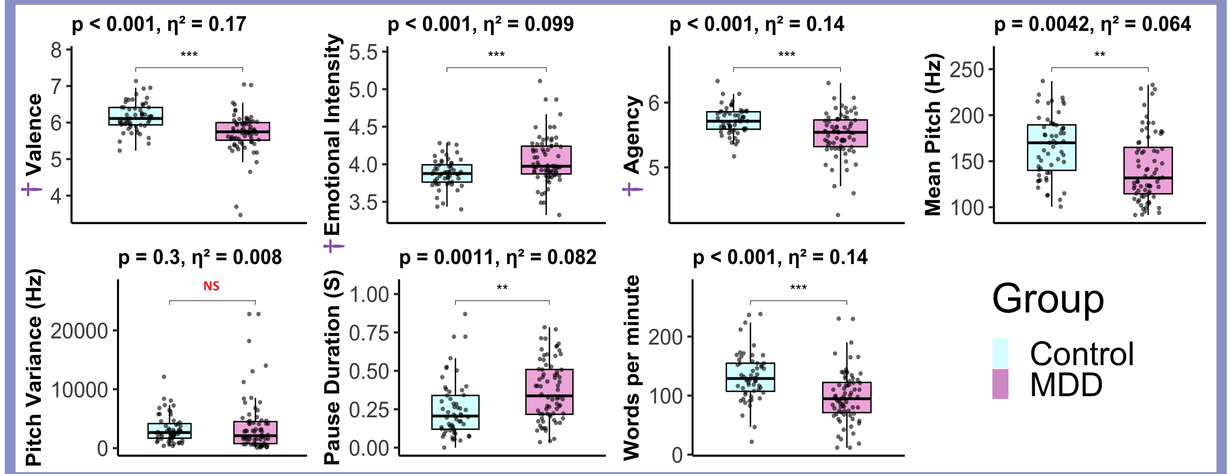
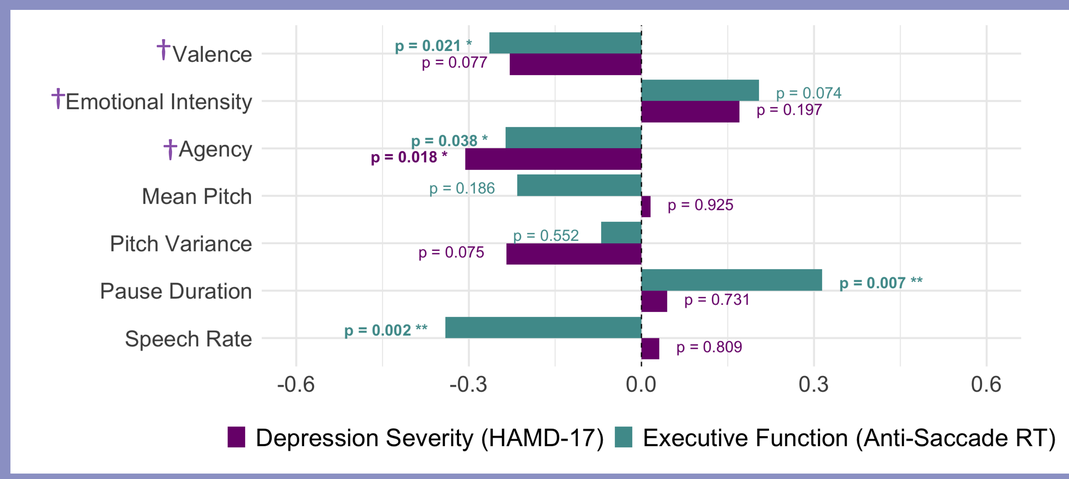


Fig. 2: Standardized beta coefficients from separate linear models predicting depression severity and executive function from individual speech features. Positive values indicate that higher speech feature values are associated with worse outcomes; negative values indicate that lower values are. RT = Reaction time to direct gaze away from target (ms).



† Scores based on standardized norms from psycholinguistic research[6]

RESULTS:

Participant characteristics

	MDD	Controls
N	66	54
Age, mean (SD)	45.2 (15.1)	44.5 (17.2)
Sex, no (% female)	36 (54.6)	41 (75.9)
HAMD-17, mean (SD)*	21.4 (4.2)	NA
Education, mean years (SD)	15.2 (2.3)	17.0 (1.8)

* Two participants were missing HAMD-17 (Hamilton Depression Rating Scale) data

- **Speech features differed significantly between individuals with depression and controls in the expected directions (Fig 1.)**
- The degree of agency denoted in patients' language was the only speech feature related to HAMD-17 scores. The remaining features were **not** associated with depression severity **(Fig 2.)**
- **As expected**, executive function performance (anti-saccade RT) differed significantly between individuals with depression and controls ($p = 0.002$, $\eta^2 = 0.19$). Performance was **not** related to HAMD-17 scores ($p = 0.36$, $f^2 = 0.04$).
- **Several features were associated with executive control** (anti-saccade RT) **(Fig 2.)**

Patients with depression show distinct speech features and executive control deficits. While neither was related to HAMD-17 scores, speech and executive control were linked to each other. **Speech markers offer a low-burden, scalable tool for assessing depression and cognitive dysfunction.**

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1. 2. Sunnybrook Research Institute 3. WINTERLIGHT

References