



Prosodic cues to psychosis risk

Emily Cibelli¹, Jennifer Cole¹, Vijay Mittal², Matthew Goldrick¹

Northwestern University Department of Linguistics¹, Department of Psychology²

Introduction

Psychotic disorders

Psychotic disorders (e.g. schizophrenia) impact 1-2% of the population [1], and result in severe disruptions to cognition and emotional well-being.

Atypical prosody is a classic behavioral symptom in psychosis.

- **Qualitatively:** described as “flat affect”
- **Quantitatively:** F0 variability, intensity, and pause metrics (duration, frequency, and proportion of silence) shown to differ between clinical and control populations [2-4]
- Intonational flatness may reflect reduced emotional expression, while increased hesitations could be due to phonological or semantic/pragmatic impairments [5].

Signs prior to diagnosis

Young adults at **ultra high risk (UHR)** for psychosis show changes to behavior, perception, and motor control, reflecting early vulnerability [6]

- Up to 36% receive a psychosis diagnosis within 3 years [7]
- Early detection can greatly improve outcomes or even halt development of a psychotic disorder [8]

But: there is currently no biomarker to unambiguously identify individuals at highest risk of transition.

Project goals: Prosodic speech measures are untested in the pre-diagnosis population. This project is an exploratory investigation into whether prosodic features may represent a novel, easily-collected biomarker for vulnerability to psychosis.

Current study questions

1. Group classification: Are atypical prosodic features also present in the speech of UHR individuals?

Prediction: These features will reliably separate the speech of UHR and control speakers, replicating the acoustic correlates of flat affect found in the diagnosed population [2-4].

2. Symptom variance: Does prosody co-vary with symptoms?

Prediction: Variability in clinically-assessed psychological symptoms can be predicted in part by variability in prosodic features in the UHR group.

Methods and Materials

Participants

- 18 **UHR*** and 18 **control** individuals (age 15-21, 18 female)
- UHR group inclusion criteria: prodromal symptoms or first-degree relative with psychotic disorder

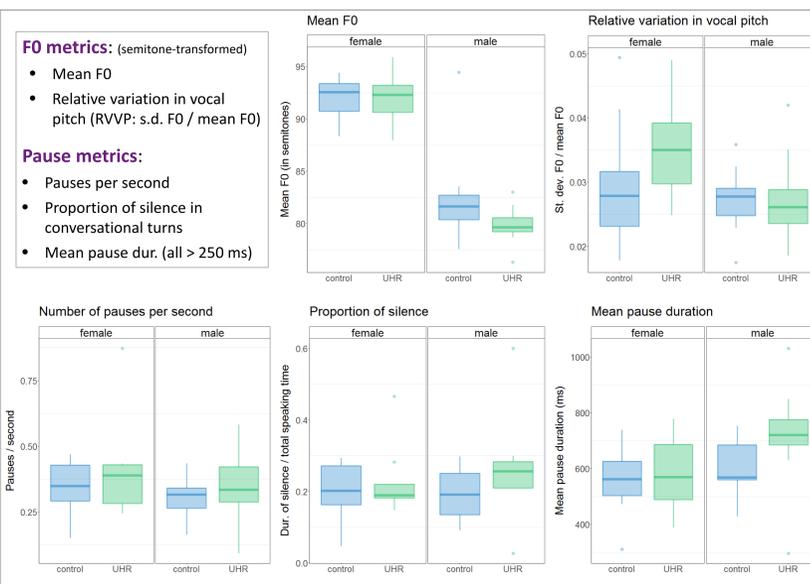
Clinical assessment: Structured Interview of Prodromal Syndromes [9]. Positive (P1-P5) and negative (N1-N6) subcomponents (scored from 0 - 6) sum to two scores:

- **Negative symptom score:** includes apathy, blunted emotion, impaired social functioning (**UHR mean: 10.56, s.d. 5.68; control mean: 0.39, s.d. 1.42**)
- **Positive symptom score:** includes hallucinations, delusions, thought and movement disorders (**UHR mean: 12.56, s.d. 4.10; control mean: 1.42, s.d. 0.61**)
- For 11 UHR speakers, a 12-month follow-up of symptom scores was available (average change in positive symptoms: -2.64, s.d. 4.01; negative symptom change: -0.91, s.d. 7.50)

Data processing

- 10-minute segments of clinical interviews (when possible, personal background questions), annotated to identify participants’ speech
- Automatic extraction of F0, speech/silence labels using Praat [10], summarized across conversational turns, within-participant

* One UHR participant was excluded from pause analyses due to poor SNR.



Analysis 1: group classification

Linear discriminant analysis: classify participants as **UHR** or **control** as a function of combinations of prosodic features

- **Best model:** 61.1% of participants accurately classified ($p = 0.052$) as a function of **relative variation in vocal pitch (RVVP)**, driven by *higher* variation in UHR female speakers. No improvement in classification with other F0 or pause measures.

Analysis 2: symptom variance in UHR speakers

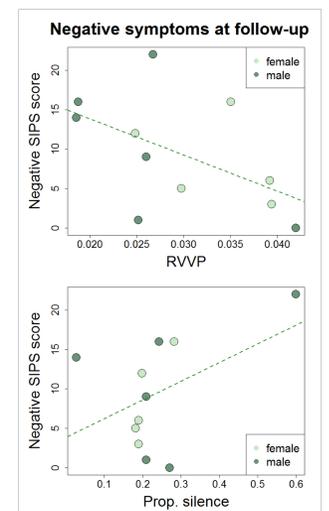
Linear models with prosodic features as predictors were unable to significantly predict variance in symptom scores (positive or negative).

Symptom subcomponent classification:

- **LDA:** classifying binary split (low – 0:1; high – 2:6) of individual symptom subcomponents by prosody
 - Higher **N5** score predicted by lower RVVP, higher proportion of silence (75% accuracy, $p = 0.050$)
 - No other subcomponents reached significance
 - N5 (ideational richness): difficulty with discourse comprehension; reduced complexity in production

Negative symptoms, 12-mo. follow-up: (11 UHR participants)

- **Linear model** predicting symptom scores at time 2 from RVVP and proportion of silence at time 1 (see figure at right)
 - **RVVP** ($\beta = -4.51, t = -3.09, p = 0.047$): less F0 variability at T1 → higher symptoms at T2
 - **Proportion of silence** ($\beta = 15.61, t = 3.68, p = 0.021$): more silence at T1 → higher symptoms at T2 – driven by 1 speaker



Summary

Discussion

- **Group classification** is promising using variation in F0 – but pattern (*greater* RVVP for UHR females) goes against “flat affect” predictions.
 - Modest compared to diagnosed population (61% vs. ~80% [3], 95.2%, [4]), but UHR is not a homogenous group – not all individuals receive a diagnosis.
- **Symptoms** show co-variance with prosodic measures
 - Subcomponents of negative score sensitive to variation in F0, proportion of silence
 - Prosody at time 1 may signal negative symptom severity at time 2

Future directions

- Replication of current exploratory analyses in novel set of 36 participants
- Examination of outlier individuals for possible correlations with conversion to psychosis, or significant change in symptoms at 12-month follow-up session
- Extension to new dataset of neutral, read speech

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Acknowledgments

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CONTACT: EMILY.CIBELLI@NORTHWESTERN.EDU