Measurement of schizophrenia symptoms through speech phenotyping from PANSS recordings: a cross-study validation

Submitter Michelle Worthington

Affiliation Brooklyn Health

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Methodological Issue Being Addressed Traditional speech phenotyping in psychiatry relies on specialized tasks and proprietary platforms. This study explores the use and validation of open-source tools for large-scale speech analysis in schizophrenia.

Introduction Speech is a clinically meaningful indicator of schizophrenia symptom severity and speech phenotyping often requires dedicated task paradigms on proprietary platforms using closed-source code to phenotype speech. Here, we use audio recordings of Positive and Negative Syndrome Scale (PANSS) interviews and open source code to calculate speech measures and evaluate them as meaningful indicators of schizophrenia symptom severity.

We previously demonstrated that such clinical interactions are a reliable source of audio for speech phenotyping (under review at Biological Psychiatry). Here, we report results from an expansion of this project using ~2,000 hours of PANSS interview recordings from three separate clinical trials, leading to what we believe is the largest study on speech-based digital phenotyping in psychiatry to date.

Methods Audio recordings of PANSS interviews from three schizophrenia clinical trials (NCT03697252, NCT04659161, NCT04738123) were analyzed. Speech features, including amount of speech, rate of speech, pause characteristics, emotional sentiment, and lexical richness, were extracted using the OpenWillis open-source Python library (github/bklynhlth/openwillis). Mixed effects models were used to examine the association between speech measures and PANSS scores, controlling for age, sex, and race.

Results Approximately 1,984 hours of audio data were analyzed from a total of 3,482 PANSS interviews.

PANSS positive symptom subscale scores were associated with a greater amount of speech (adjusted speech length in minutes $\beta=3.355$; p-value<0.01; adjusted speech length in words $\beta=0.027$; p-value<0.01), an increased rate of speech (words per minute $\beta=0.015$; p-value<0.01; syllables per minute $\beta=0.009$; p-value<0.01), a change in pause characteristics (pause length mean $\beta=-3.819$; p-value<0.01), and reduced lexical richness (moving-average token-type ratio (MATTR) $\beta=-13.008$; p-value<0.01).

By contrast, the score on the PANSS negative subscale was associated with a reduced amount of

speech (adjusted speech length in minutes β=-2.905; p-value<0.01; adjusted speech length in words β=-0.025; p-value<0.01), a decreased rate of speech (words per minute β=-0.017; p-value<0.01; syllables per minute β=-0.010; p-value<0.01), a change in pause characteristics (pause length mean β=4.969; p-value<0.01; increased pause between the clinician's question and the patient's response β=0.784; p-value<0.01), and increased lexical richness (MATTR β=5.302; p-value<0.01).

Conclusion This study demonstrates the feasibility and value of using clinical interview recordings for large-scale speech analysis in schizophrenia, confirming and expanding on previous findings linking specific speech patterns to symptom severity. This approach allows for efficient and scalable analysis of readily available data, potentially enhancing clinical assessment and treatment development.
Future research will explore higher-order linguistic features to capture more complex aspects of schizophrenia, such as disorganized thought. Speech measures may also be used to develop predictive models of disease severity and stratify patients for personalized interventions. This methodology can be extended to other psychiatric and neurological conditions where speech may be affected.

Co-Authors

Michelle Worthington[1], Anzar Abbas[1], Georgios Efstathiadis[1], Vijay Yadav[2], Tej Patel[3], Colin Sauder[3], Inder Kaul[3], Steve Brannan[3]

[1] Brooklyn Health

[2] Brooklyn Health; University of New South Wales

[3] Bristol Myers Squibb

Keywords

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Guidelines I have read and understand the Poster Guidelines

Disclosures AA, MW, GE, and VY are affiliated with Brooklyn Health, a private company that developed the open source software that was used in this study and indirectly benefits from its continued adoption. TP, CS, IK, and SB are employees of Karuna Therapeutics, a Bristol Myers Squibb company, a publicly traded pharmaceutical company that sponsored the clinical trial reported on here.

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