Developing a multimodal digital phenotyping paranoia measure: Comprehensive psychometric evaluation

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What is the Methodological Question Being Addressed? Can multimodal smart phone data be used to measure clinical paranoia based on a comprehensive psychometric evaluation strategy?

Introduction Paranoia is a transdiagnostic and pernicious symptom of serious mental illnesses (SMI) that is typically measured using clinical ratings and self-report. Paranoia is a particularly challenging symptom to measure since patients are often reluctant to discuss their symptoms. Moreover, measurement of paranoia is complicated by cultural differences, mistrust of clinical professionals, and potential racial and gender biases. Efforts to digitally phenotype paranoia span over five decades. Like many digital phenotyping solutions, these measures lack comprehensive psychometric support, notably in test-retest reliability, divergent validity/specificity (e.g., addressing “generalized deficit” concerns), and evaluation of potential biases.

To address these concerns, we developed a multimodal digital phenotyping solution for tracking relatively subtle fluctuations in paranoia from brief, topically-flexible speech samples procured from a smart phone while individuals navigate their daily routines. The present study reflects a comprehensive psychometric evaluation of this measure.

Methods Thirty-seven patients with schizophrenia or bipolar disorder were recruited and tracked over a week using provisioned devices. A small Natural Language Processing (NLP) based feature set was derived from 477 recordings. Features were modeled on Clinically-Rate Paranoia using machine learning (i.e., ridge regression). Clinical Ratings were from the Positive and Negative Syndrome Scale conducted by trained research assistants. Our NLP procedures were based on sentiment and dependency analysis, the latter of which identifies subject-object pairs suggesting an interaction between the individual and their environment (e.g., subject: “The government”, object: “me”, relationship: “is tracking”).

We also considered three moderators that putatively exaggerate, or at least concomitantly occur with paranoia: whether the individual was away from home, whether they were around strangers, and whether they were alone at the time of recording. The former measure used geolocation timestamping, and the latter measures used concomitant self-report.

Results Nearly all recordings were appropriate for analysis. When moderators were considered, our NLP features showed good convergence with clinically rated paranoia (range of R values 0.25 to

0.33), with little evidence of overfitting from five-folds cross validation. Predicted scores from these models were integrated together. Test-retest reliability for the integrated measure was excellent. Criterion validity was high, as was convergence with “in the moment” self-report measures of paranoia and fear. Divergent validity, measured through independence from measures of depression and anxiety, was also high. There were systematic biases in the model, in part, reflecting whether patients submitted videos when they were away from home, around strangers, or alone.

Conclusion The present findings support our multimodal digital phenotyping measure for tracking paranoia. This measure was stable over time, was related to other measures of paranoia, and was unrelated to global measures of psychopathology. Potential demographic biases were observed in our measure, and the source appeared to be related to our moderators (i.e., whether subjects provided videos when away from their home or around strangers). Implementation will necessitate consideration of these moderators and their relevance across diverse communities.

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Disclosures Alex Cohen is a member of Quantic Innovations, a company providing digital phenotyping solutions for a wide range of healthcare applications.

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