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The burgeoning role of speech and language assessment in schizophrenia spectrum disorders

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Dear Editor,

Advances in automated speech assessment and natural language processing (NLP) have drastically improved our ability to objectively detect and characterize alterations in speech and language. These technologies have growing applications for individuals with psychiatric disorders, particularly schizophrenia spectrum disorders (SSD). NLP methods have proven to be a sensitive, objective, and accurate means to quantify language organization and impoverishment in SSD. While the results in the literature have been mixed, some promising research has shown that acoustic speech parameters may be linked to negative symptoms of SSD and can differentiate individuals with SSD from controls with high accuracy (Bernardini et al., 2016).

We read with enthusiasm the recently published study by de Boer and colleagues (de Boer et al., 2021) using acoustic speech parameters to classify individuals with SSD and healthy controls. The authors set out to overcome the limitations of previous studies by including a large sample ($n = 284$) and standardized acoustic speech measures, developed to promote easy replication and comparability of acoustic parameters across studies. To address symptom heterogeneity in SSD, machine learning speech classifiers evaluated how accurately patients with predominantly positive v. predominantly negative symptoms could be classified. The results revealed that individuals with SSD and controls could be classified with 86.2% accuracy using acoustic speech features alone. Furthermore, SSD patient subtypes could be distinguished with 74.2% accuracy. The high accuracy achieved using this approach adds to the mounting evidence that speech can provide an objective way to not only accurately detect individuals with SSD but also to differentiate among SSD subtypes.

Despite previous successful applications of speech and language assessment in predicting SSD diagnosis (Elvevåg, Foltz, Weinberger, & Goldberg, 2007; Tang et al., 2021), few studies have differentiated among SSD subtypes. The current study by de Boer et al., is arguably the first to do this by using speech to characterize participants with predominantly positive or negative symptoms. Delineating between these subtypes has important clinical implications given the greater resistance of negative symptoms to treatment and strong associations with poor functional outcomes (Correll & Schooler, 2020). The authors also explored stratifying participants based on high and low dopamine receptor (DR2) occupancy drug profiles. An interesting follow-up analysis in the context of medication effects may be to separately assess individuals on clozapine, given its unique profile as the preferred treatment for individuals with treatment-resistant schizophrenia (TRS).

The identification of patients with TRS has high clinical relevance. TRS is typically defined as a failure to respond to multiple antipsychotic drugs from at least two different classes prescribed in adequate dosages and durations. This group is estimated to account for 20–30% of all patients with schizophrenia and is one of the most disabling and costly psychiatric conditions, conservatively estimated to account for $34 billion in annual direct medical costs (Kennedy, Altar, Taylor, Degtiar, & Hornberger, 2014).

Tools that aid in the classification of SSD subtypes, including TRS, warrant further research to facilitate early identification and objective monitoring of symptoms. In particular, underlying biological differences may differ between patients with TRS compared to other SSD subtypes (Potkin et al., 2020) that can be informed by speech. For example, brain alterations spanning white matter tracts involved in ventral language processing (Smits, Jiskoot, & Papma, 2014) have recently been reported in TRS compared to healthy controls and other treatment-response subtypes (McNabb et al., 2020). Based on these observations, individuals with TRS may have unique speech and language symptoms which can be detected early in the course of illness, and which may inform treatment strategies.

Future studies may also examine how the inclusion of both acoustic and linguistic speech parameters impacts classification model performance. As noted by the authors, previous studies have evaluated linguistic content, including measures to quantify coherence, syntactic complexity, and language connectedness. However, acoustic and textual linguistic measures may

capture positive and negative psychotic symptoms with different degrees of accuracy. The inclusion of diverse, standardized acoustic and language measures may further improve SSD and SSD subtype classification models.

The ability to objectively detect and monitor symptoms as well as to predict SSD treatment response has important clinical and economic implications. Predicting treatment responsivity is critical for informing prognosis and may help guide clinical decision making around antipsychotic selection, especially clozapine. Moreover, the increased precision of speech analysis compared to clinical reports may offer more precise symptom monitoring, and may herald improvements for predicting clinical deterioration, which can prompt timely mobilization of treatment resources to prevent rehospitalization.

In summary, recent developments using speech to classify SSD diagnosis are highly encouraging. This technology has far-reaching potential for improved monitoring of SSD and identifying individuals with TRS. Further research in this area offers the opportunity to reduce the disease and economic burden of SSD.

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