Review

What do we really know about blunted vocal affect and alogia? A meta-analysis of objective assessments

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ABSTRACT

Deficits in nonverbal vocal expression (e.g., blunted vocal affect, alogia) are a hallmark of schizophrenia and are a focus of the Research Domain Criteria initiative from the National Institute of Mental Health. Results from studies using symptom rating scales suggest that these deficits are profound; on the order of four to six standard deviations. To complement this endeavor, we conducted a meta-analysis of studies employing objective analysis of natural speech in patients with schizophrenia and nonpsychiatric controls. Thirteen studies, collectively including 480 patients with schizophrenia and 326 nonpsychiatric controls, were identified. There was considerable variability across studies in which aspects of vocal communication were examined and in the magnitudes of deficit. Overall, speech production (reflecting alogia) was impaired at a large effects size level ($d = -.80$; $k = 13$), whereas speech variability (reflecting blunted affect) was much more modest ($d = -.36$; $k = 2$). Regarding the former, this was largely driven by measures of pause behavior, as opposed to other aspects of speech (e.g., number of words/utterances). On the other hand, ratings of negative symptoms across these studies suggested profound group differences ($d = 3.54$; $k = 4$). These data suggest that only certain aspects of vocal expression are affected in schizophrenia, and highlight major discrepancies between symptom rating and objective-based measures. The discussion centers on advancing objective analysis for understanding vocal expression in schizophrenia and for identifying and defining more homogenous patient subsets for study.

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1. Introduction

Negative symptoms—defined in terms of behavioral deficits (e.g., blunted affect, alogia, avolition), are considered central to schizophrenia pathology (American Psychiatric Association, 2013) and are included in the National Institute of Mental Health's (NIMH) Research Domain Criteria initiative (RDoC) (e.g., "production of non-facial communication"; NIMH, 2014). Despite the term "negative" symptoms entering the clinical lexicon during the 19th century, research on these symptoms was slow to develop. This changed, in large part, during the 1980s when validated measures of these symptoms were introduced into psychiatry research (e.g., Scale for the Assessment of Negative Symptoms [SANS]; Andreasen, 1984; Schedule for the Deficit Syndrome; Kirkpatrick et al., 1989). Consider Fig. 1, which highlights the dramatic increase in peer-reviewed publications using the terms "negative symptoms" and "schizophrenia" over the last 3 decades. There is no question that these negative symptom rating scales, and those developed more recently (e.g., Kirkpatrick et al., 2011; Kring et al., 2013) have been

instrumental in attempts to understand schizophrenia. Not surprisingly, data yielded by these measures suggests that patients with schizophrenia, as a group, are rated as being much higher in negative symptoms than nonpsychiatric populations. The exact magnitude of group differences is difficult to estimate because few studies report negative symptoms in nonpsychiatric participants. Nonetheless, there is reason to think that it is profound. In comparing SANS global scores from a recent meta-analysis of nonpsychiatric individuals (i.e., M = 1.39, SD = 1.63 for healthy adults; $n = 213$; Emmerson et al., 2009) to SANS global scores from a large, multisite psychometric study (i.e., M = 12.04, SD = 1.66; $n = 207$; Mueser et al., 1994), one finds a difference on the order of six standard deviations (Cohen's $d = 6.48$). Negative symptom rating scales have also been found, within schizophrenia samples, to be stable over time, and correlated with a broad range of functional, outcome, premorbid, neurocognitive, neurobiological, genetic and other variables (Buchanan, 2007; Kirkpatrick and Galderisi, 2008).

Symptom rating scales are not without their limitations, many of which are well documented in the literature (e.g., Cohen and Elvevåg, 2014). For example, symptom rating scales employ broad categories in ordinal scale with relatively few response options. In doing so, they are relatively insensitive to change over time, particularly change that might occur during the relatively brief interview-assessment window.

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Relatedly, scores generally have an extreme "right" skew such that the vast majority of people in the population receive the lowest score possible on these measures (Emmerson et al., 2009). In this regard, the data produced by symptom rating scales are not normally distributed or linear and thus not appropriate for parametric analysis. Also, it is fairly well documented that trained clinical experts are particularly poor at isolating specific facets of behavior when using symptom rating scales (e.g., Alpert et al., 2002).

There are three other concerns about symptom rating scales that, to our knowledge, are less well documented in the literature. First, many symptom ratings, particularly those that involve evaluating natural behavior, require raters to compare patients' behavior to a putative "normal" baseline. Unfortunately, clear objective norms for most common forms of behavior have not been established and, due to their highly variable nature both within and across individuals, are unlikely to be established. Second, contextual factors are not generally considered when making ratings. This is important because natural behavior often varies dramatically as a function of environmental variables. Finally, the constructs covered by symptom rating scales often tap a number of functionally distinct constructs, and are thus imprecise and overly complicated for meaningfully capturing distinct channels of psychopathology. As an illustration of these concerns, consider the "blunted vocal affect" rating from the SANS:

> "While speaking, the subject fails to show normal vocal emphasis patterns. Speech has a monotonic quality, and important words are not emphasized through changes in pitch or volume. Subject also may fail to change volume with changes of subject so that he does not drop his voice when discussing private topics nor raise it as he discusses things which are exciting or for which louder speech might be appropriate." (Andreasen, 1984)

Explicit in this definition is a putative "normal vocal pattern," which is difficult to quantify given the tremendous variability across individuals in speech. Moreover, outside of acknowledging vocal modulations as a function of broad content themes (e.g., privacy), no regard is given to the wide variety of variables that could potentially influence a participant's vocal expression; for example, in terms of setting (e.g., professional office, forensic facility, home, party, social setting), who is conducting the interview (e.g., a curmudgeonly elderly doctor with a lab coat, an enthusiastic young research assistant), length of interview, extrinsic compensation, complexity of interview questions, and individual difference factors such as ethnicity, geographic region, age, and sex. Finally, the definition includes both changes in "pitch" and "emphasis"; two mechanistically distinct facets of vocal expression that are often unrelated

in studies of healthy adults (Cohen et al., 2009, 2010) and for which a consensus on objective measurement does not exist. While we acknowledge that symptom rating scales have been integral to schizophrenia research and treatment more generally, it is clear that they lack precision for meaningfully understanding how distinct channels of behavior are affected by the disorder.

Technological advances have paved the way for objective assessment of natural behavior using automated algorithms. One particularly promising approach involves computerized acoustic analysis of natural speech to understand blunted vocal affect and alogia. While a rich history of acoustic analysis has been established as part of speech pathology and communication disorders more generally (e.g., Kent and Kim, 2003), its use has been modest in schizophrenia research. This is unfortunate because acoustic analysis offers the ability to objectively compare many different and distinct facets of speech across individuals and, in part because of its sensitivity (i.e., changes in vocal expression with near millisecond accuracy), across subtle or rapid changes in context. The present article conducted a review of studies employing acoustic analyses of natural speech in patients with schizophrenia with two specific aims in mind: (a) to evaluate the magnitude of objective deficits in schizophrenia across a wide range of vocal characteristics—thus providing insight into which aspect(s) of vocal expression are most affected in schizophrenia, and (b) to clarify how vocal expression deficits differ as a function of acoustic analytic and symptom rating scales (when employed in the same study). Regarding this second point, the magnitude of vocal deficits using data for the Emmerson et al., (2009) meta-analysis and multisite psychometric study (Mueser et al., 1994) are quite large (i.e., Cohen's d values of 4.09, 3.42, and 4.39 for SANS Lack of Vocal Inflections, Poverty of Speech, and Increased Latency of Speech ratings, respectively). A recent meta-analysis (Hoekert et al., 2007) of six studies of vocal expression also bears mention here. These studies employed trained raters (e.g., undergraduate research assistants, speech therapists) to evaluate various aspects of vocal expressions in archived recordings of schizophrenia patients, and reported vocal deficits in the large range (Cohen's $d = 1.11$, range of d's $= .87$ to -1.95; $N = 186$), although much lower than those observed using symptom rating scales. When interpreting these data, it is noteworthy that these studies employed subjective ratings as opposed to objective analysis, and thus suffer from many of the inherent limitations of symptom rating scales more generally (e.g., imprecision regarding isolated dimensions of behavior, lack of ratio or interval scaling). In the present study, we sought to complement this effort by answering the questions "What does objective assessment tell us about the magnitude of speech deficits in schizophrenia?" and "How does that inform assessment, understanding and treatment of these symptoms?"
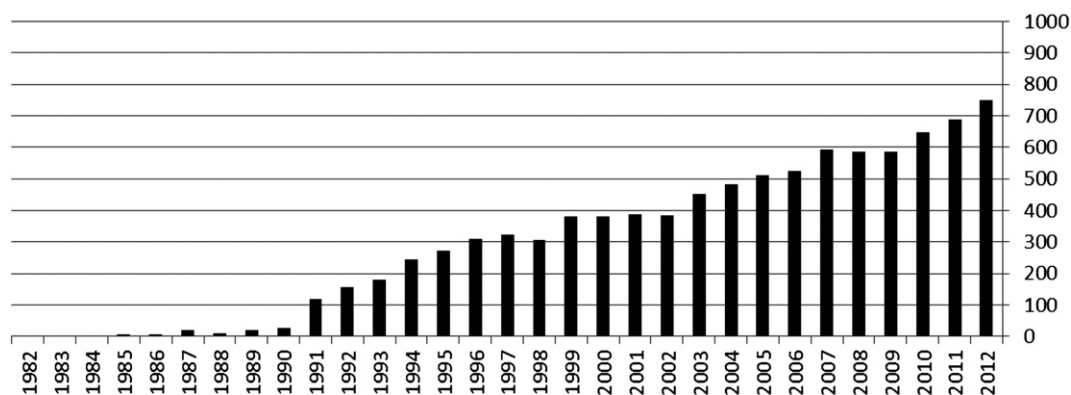
"Negative Symptom" Citations by Year

Fig. 1. Citations per year using the terms "negative symptoms" and "schizophrenia."