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# Vocal Expression In Schizophrenia: Examining The Role Of Vocal Accommodation In Clinical Ratings Of Speech

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VOCAL EXPRESSION IN SCHIZOPHRENIA: EXAMINING THE ROLE OF VOCAL  
ACCOMMODATION IN CLINICAL RATINGS OF SPEECH

A Thesis

Submitted to the Graduate faculty of  
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## ABSTRACT

Diminished vocal expressivity, defined in terms of a diminution in speech production and intonation/emphasis, is a chronic symptom in schizophrenia. On interview-based measures of vocal deficits, clinicians typically rate patients with schizophrenia 4 to 6 SDs below their non-patient peers. However, recent studies utilizing objective computerized measures have failed to observe vocal expressivity deficits that approach this level. It may be that vocal deficits can only be understood within the boundaries of dyadic exchanges during interview-based assessments. Vocal accommodation, or the degree to which vocal characteristics (i.e., mean F0) between interlocutors synchronize over time, has been linked to enhanced social affiliation and may be useful for understanding this discrepancy in the literature. The current study sought to leverage computerized technologies to determine whether vocal accommodation during structured clinical interviews unduly influences clinical ratings of vocal expression in schizophrenia. Overall, both controls ( $n = 30$ ) and patients with schizophrenia ( $n = 57$ ) exhibited vocal accommodation of mean F0 with their respective partners during a clinical interview, though at varying degrees. Contrary to expectations, vocal accommodation during a clinical interview did not significantly predict clinical ratings of vocal deficits in schizophrenia. The current findings extend the literature on communicative and social skills in schizophrenia. Implications and directions for future research are discussed.

## INTRODUCTION

### Brief Overview of Current Study

Schizophrenia is a chronic and disabling disorder that affects virtually every function associated with the central nervous system. Among these abnormalities are deficiencies in communication and speech, and they can be disrupted in a number of different ways. For example, abnormalities in vocal expression are a staple of schizophrenia and serious mental illness more generally and are defined in terms of diminution of two separate channels of speech: production (i.e., alogia) and intonation/emphasis (i.e., blunted affect, affective lability). Diminished vocal expressivity has been linked to lower quality of life and poor prognosis (Hoekert, Kahn, Pijnenborg, & Aleman, 2007; Tan, Thomas, & Rossell, 2014). Moreover, these deficits are chronic and stable over time and medication resistant (Buchanan, 2007). Historically, investigators have measured vocal expression using interview-based measures and clinical judgement. These measures have a number of drawbacks that contribute to limited understanding of speech dysfunction in schizophrenia. Emerging computerized technologies provide an automated objective analysis of vocal symptomatology with near perfect “interrater” reliability (Cohen & Elvevåg, 2014). In a recent meta-analysis, Cohen and colleagues (2014) revealed that patients with schizophrenia versus non-patient controls showed profound vocal deficits on the order of 4 to 6 SDs when assessed with interview-based measures. However, studies utilizing computerized technologies fail to observe deficits in vocal expression that approach this level and, in many studies, show vocal expression that approximates the expression of controls (Cohen, Mitchell, Docherty, & Horan, 2016). It may be the case that vocal deficits can only be understood in the boundaries of dyadic exchanges during interview-based assessments. The current study leverages computerized technologies to explore vocal accommodation in structured

clinical interviews to determine the role of vocal accommodation in the profound vocal deficits in schizophrenia observed via interview-based measures.

The following sections will review a number of concepts within the extant literature as a prelude to the current study. First, a conceptual description of schizophrenia and key associated symptoms are provided. Particular focus is given to negative symptoms, and more specifically diminished vocal expression in schizophrenia. Historical and current assessment methodology of vocal symptomatology is discussed next. This will be followed by a broad review of vocal accommodation, and will end with a discussion on the possible role of vocal accommodation, or lack thereof, in the putative vocal deficits observed in schizophrenia. Aims, hypotheses, and methodology of the current study will follow this literature review.

## **Schizophrenia**

Schizophrenia is a severe brain disease and carries a profound burden of illness and disability, making it one of the most costly sources of chronic dysfunction in the world (World Health Organization [WHO], 2001). Individuals with schizophrenia commonly experience poor outcome in important treatment domains including interpersonal activities, educational, vocational, and recreational activities, among many others. These functional impairments are present in prodromal and first episode psychosis (Ventura et al., 2011), continue after psychotic symptom remission (Jääskeläinen et al., 2013), and persist into late life (Folsom et al., 2006). WHO named schizophrenia among the most disabling conditions in the world and as one of the leading causes of healthy years lost to disease (Lopez, Mathers, Ezzati, Jamison, & Murray, 2006). On average, individuals experience approximately 10-15 years of direct illness (Parks, Svendsen, Singer, Foti, & Mauer, 2006) and this leads to 5.66 million total years of healthy life

lost to schizophrenia (Lopez et al., 2006). Furthermore, individuals with schizophrenia exhibit a two-fold mortality rate over the general population (Parks et al., 2006). The difficulties associated with schizophrenia present enormous financial and social burden for patients with the disorder, their families, and society more generally as well. Individuals with schizophrenia often have difficulty getting their basic needs met, leading to heavy reliance on family members and disability payments. Accordingly, the annual cost of schizophrenia in the United States is estimated to exceed \$65 billion when factors such as family caregiving, lost wages, and treatments are considered (WHO, 2001).

Schizophrenia has a lifetime prevalence of approximately .5 to 1%, though schizophrenia-spectrum disorders and subclinical traits likely affect a much broader segment of the population (Lenzenweger, 2006). The Diagnostic and Statistical Manual of Mental Disorders – 5th Edition (DSM 5; American Psychiatric Association [APA], 2013) requires a minimum presentation of two out of five of the following core characteristics: delusions, hallucinations, disorganized speech, grossly disorganized behavior, and negative symptoms (e.g., anhedonia, asociality, blunted affect, and alogia). Additionally, in order to be diagnosed with schizophrenia, an individual must experience these symptoms for a significant portion of time within the preceding month and must also have experienced pronounced social or occupation dysfunction due to these disturbances for at least six months. It is important to note that an array of additional central nervous system functions is associated with schizophrenia in addition to the symptoms listed in the DSM-5. These symptoms include a disruption in a wide range of processes related to thought, behavior, and emotion. Individuals with schizophrenia also experience relatively severe cognitive impairments across a wide range of basic (e.g., attention, memory), social, and meta-

cognitive abilities (Heinrichs & Zakzanis, 1998; Savla, Vella, Armstrong, Penn, & Twamley, 2013).

Given the prohibitive economic and social tolls of schizophrenia, current efforts to understand the exact nature of these substantial and persistent symptoms and cognitive deficits has led to unprecedented cooperation between federal agencies, private pharmaceutical companies, and academia. For example, various stakeholders (e.g., researchers, the NIMH, and pharmaceutical industry) collaborated to start two initiatives -- the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) and the Cognitive Neuroscience Treatment Research to Improve Cognition in Schizophrenia (CNTRICS) -- that engendered the development of consensus cognitive test batteries aimed at improving clinical trials within schizophrenia (Carter & Barch, 2007; Nuechterlein et al., 2008). Researchers have also investigated common cognitive deficits (i.e., endophenotypes) shared by individuals with the disease and their healthy relatives. Studies such as Consortium on the Genetics of Schizophrenia (COGS) and The North American Prodrome Longitudinal Study (NAPLS) are longitudinal, multi-site NIMH sponsored collaboration, and are making pioneering discoveries on the genetic and neurological structure of schizophrenia (Addington et al., 2007; Swerdlow, Gur, & Braff, 2015). These advances in understanding of pathophysiology of schizophrenia can improve early identification of the illness and guide the development of preventive interventions.

### **Obstacles in Schizophrenia Research**

Despite vast public resources, schizophrenia remains a largely intractable disorder and there is presently no cure or good understanding of its cause or mechanism. One reason for this is that schizophrenia is an incredibly complex disorder whose heterogeneity has been evident since

the conception of the disorder (Meehl, 1962). While the DSM-5 provides a consensus-driven approach to characterizing the symptoms of schizophrenia, there have been researchers who have used a more empirical methodology to address the heterogeneity in schizophrenia. Auspiciously, factor analytic-studies converge modestly with the DSM-5 and the bulk of these studies map the symptoms associated with schizophrenia into three underlying factors (see Blanchard & Cohen, 2006; Peralta & Cuesta, 2001): positive symptoms, negative symptoms, and disorganized symptoms.

Briefly, positive symptoms are defined as an addition of symptoms not experienced by the normal population and include delusions and hallucinations. Negative symptoms are characterized as an absence or deficit in something that is typical present in normal functioning. These include deficiencies of motivation, emotional experience, and emotional expression. Disorganized symptoms are distinguished by bizarre speech and behavior, as well as thought disorder. Importantly, phenotypic (i.e., symptom) expression varies drastically between individuals with schizophrenia (Tandon, Keshavan, & Nasrallah, 2008). Thus, two individuals diagnosed with schizophrenia may exhibit completely distinct symptom profiles. Antipsychotic medications are relatively successful for positive symptom amelioration. Unfortunately, effective treatment for negative symptoms, and in particular abnormalities in communication and vocal expression, remains elusive.

Another issue that obfuscates our understanding of schizophrenia is that assessment of schizophrenia symptoms is almost exclusively conducted using measures of patient self-report or clinician impression. Such measures have three notable limitations that challenge both their reliability and validity (Green, Horan, Barch, & Gold, 2015; Trull & Ebner-Priemer, 2009). First, patients with schizophrenia show moderate to severe cognitive deficits across a number of

domains (e.g., delayed memory, attention, and executive functioning) that are pertinent to autobiographical recall and introspection (Green, Kern, Braff, & Mintz, 2000). Second, retrospective self-reports are vulnerable to a number of biases such that both psychiatric and healthy samples are more likely to report personally relevant, recently occurring, or mood congruent events (Trull & Ebner-Priemer, 2009). Third, clinical ratings scale rely on impressions from trained professional evaluating various aspects of symptomatology within schizophrenia based on observation during a clinical interview or interaction (Andreasen, 1986, 1989; Kring, Gur, Blanchard, Horan, & Reise, 2013; Lukoff, Liberman, & Nuechterlein, 1986). Unfortunately, these clinical rating scales fail to account for either the statistical properties or the structure of normal experiences, hence complicating definitions of “abnormal” experiences. These measures also employ ordinal based rating systems with a limited response set that are inappropriate for parametric statistics and include ambiguous operational definitions that lead to potentially skewed data and difficulties in detecting all but gross changes in symptom severity and clinical functioning longitudinally or between individuals (Alpert, Shaw, Pouget, & Lim, 2002; Cohen & Elvevåg, 2014; Elvevåg et al., 2016).

### **Vocal Expression Deficits in Schizophrenia**

Of the many symptoms associated with schizophrenia, negative symptoms are particularly pernicious. Though schizophrenia is most often recognized for its positive symptoms, negative symptoms are often the most disabling feature of the illness and affect at minimum roughly twenty-five percent of this population (Buchanan, 2007). Negative symptoms are a diminution of normal functioning and consist of avolition (reduced goal-directed behaviors), asociality (limited social engagement), anhedonia (diminished experience of pleasure), alogia (reduced verbal expression), and blunted affect (decreased emotional

expression; APA, 2013). As previously noted, negative symptoms have emerged as a distinct factor in factor analytic studies of schizophrenia symptoms. Investigators have focused on the structure of negative symptoms themselves and have identified reported two distinct negative symptoms factors (Blanchard & Cohen, 2006; Horan, Kring, Gur, Reise, & Blanchard, 2011). The first dimension is related to abnormalities in experience and typically manifest as diminished initiation of and persistence in recreational, vocational, social, and pleasurable activities (Blanchard & Cohen, 2006). In factor analytic studies, items loading on this dimension typically include avolition, asociality, and anhedonia.

The second dimension identified in factor-analytic studies of negative symptoms is diminished expressivity. These symptoms generally reflect a reduction of emotional expressivity and output in facial, vocal, and bodily channels of communication. Diminished expressivity is prominent feature in schizophrenia and, as such, is diagnostic criteria for schizophrenia and related disorders (APA, 2013). Factor analytic studies indicate that alogia and blunted affect typically load on this dimension. Alogia is a reduction in the quantity of words produced and failure to provide information beyond the bare minimum necessary to answer a question. Blunted affect, or restricted affect in subclinical form, entails of a reduction of facial, vocal, and bodily expressions of emotion. Specifically, reduced vocal affect can come in the form of diminished modulation of speed, volume, intonation, and emphasis of speech (Cohen, Alpert, Nienow, Dinzeo, & Docherty, 2008). Vocal expressive deficits are relatively stable, enduring beyond acute episodes, and reliably associated with a host of deleterious variables, including poor functioning and prognosis in individuals with schizophrenia-spectrum disorders (Gur et al., 2006; Tan et al., 2014). Furthermore, medications are minimally effective for reducing vocal deficits, and thus these symptoms remain an unmet treatment need (Mojtabai, Lavelle, Gibson, &

Bromet, 2003). Vocal expression has been included in the Research Domain Criteria (RDoC) as “Production of Non-Facial Communication” (Cohen & Elvevåg, 2014; Insel et al., 2010) due to their correlates with key treatment outcome measures and its prevalence across serious mental illnesses. Despite the wealth of empirical research into the ubiquity and burden of negative symptoms, and vocal expression deficits specifically, the understanding of their nature remains opaque.

### **Measurement of Vocal Expression - Paradox**

A plethora of negative symptoms measures exist and have been extensively employed by schizophrenia researchers for the last 30 years. These measures, such as the Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1989) and Brief Psychotic Rating Scale (BPRS; Lukoff, Liberman, & Nuechterlein, 1986), are almost exclusively based on clinician impression. While limitations associated with clinical rating scales have been previously listed, there are concerns specific to the SANS and BPRS that hinders progress in successfully treating negative symptoms. For example, constructs covered by the SANS and BPRS often tap a number of functionally distinct constructs, and are thus vague and overly complicated to meaningfully capture distinct channels of psychopathology. While these measures have been instrumental in attempts to understand schizophrenia and negative symptoms, it is clear that their imprecision contributes to our lack of clarity regarding the structure and etiology of these symptoms. There have been recent advances in the assessment of negative symptoms in the form of new clinical rating scales such as the Brief Negative Symptom Scale (BNSS) and Clinical Assessment Interview for Negative Symptoms (CAINS) to reflect the two factor structure of negative symptoms (Kirkpatrick et al., 2011; Kring et al., 2013) and to address concerns linked the previous generation of negative symptoms clinical rating scales. Unfortunately, these new

clinical interviews addresses general improvements in detecting the experiential deficits (e.g., avolition, anhedonia), while diminished expressivity remains contingent on clinician impression ratings.

Beyond clinical rating scales, acoustic based measures of vocal expression have been adapted and utilized in some schizophrenia research (Cohen, Mitchell, & Elvevåg, 2014). Acoustic analysis is a promising approach and allows investigators to characterize speech in an objective and quantitative manner, particularly with respect to vocal expression (e.g., alogia and blunted affect). Emerging computerized technologies allow for assessment of vocal symptoms with near perfect “interrater” reliability and greater sensitivity and specificity for isolating specific behaviors than interview-based rating scales (Alpert et al., 2002; Cohen & Elvevåg, 2014). For example, computerized acoustic analysis of speech allows for a more nuanced analysis of vocal characteristics such as pause and utterance length, volume of vocal expression, and variability in amplitude and fundamental frequency (i.e., “pitch”). These technologies are particularly appealing and can augment both clinical and research practices. For example, they are easy to administer and can be automated such that they are efficient, unobtrusive, and inexpensive for clinical use (Elvevåg et al., 2016). Moreover, they can be used in mobile assessments and telemedicine applications allowing for an extended assessment beyond the confines of a typical clinical setting and providing more ecologically valid data (Elvevåg et al., 2016). Finally, vocal variables have been associated with clinical measures of functioning in at least some studies (Cohen, Najolia, Kim, & Dinzeo, 2012).

A recent meta-analysis (Cohen et al., 2014) of thirteen studies highlights potential limitations with interview-based rating scales and our poor understanding of vocal abnormalities in schizophrenia more generally. Patients with schizophrenia versus non-patient controls showed

profound vocal expression deficits (e.g., blunted affect) on the order of 4 to 6 SDs on a widely used clinical rating scale, the Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1984). In contrast, Cohen and colleagues (2014) found that computerized analysis of vocal expression revealed more modest and variable vocal abnormalities in patients compared to controls. For example, patients showed normal vocal patterns in some variables (e.g., latency of response; fundamental frequency) and medium to large effect sizes in variables related to vocal production (e.g., number of words expressed; average pause length). Contrary to findings from decades of clinical rating based studies, these results suggest that only isolated aspects of speech production are abnormal in schizophrenia and these abnormalities fail to approximate the magnitude of deficits associated with symptom rating scales. The discrepancy is by no means benign as accurate assessment of vocal symptoms is paramount for understanding their mechanisms and developing effective treatment.

### **Communication Accommodation**

What then may explain this disparity in the literature on vocal expression? One possibility is vocal deficits arise in certain contexts, most notably during periods of depleted cognitive resources. For example, increasing load (e.g., driving) limits the cognitive resources available for other tasks (e.g., speaking) due to working memory's limited capacity, thus making it difficult to adequately attend to two tasks simultaneously. There is some evidence for this as experimental studies have manipulated speech tasks (i.e., by successively increasing cognitive demands) and observed that increased cognitive load was associated with a decrease with only select aspects of speech production (e.g., pause length, word count; Cohen, McGovern, Dinzeo, & Covington, 2014; Melinder & Barch, 2003). Unfortunately, findings from these studies remain unsatisfactory, especially when considering other vocal characteristics of speech (e.g., blunted

affect) remain unaffected amidst limited cognitive resources. Another possibility is that computerized measures somehow miss vocal deficits that are accurately captured by subjective clinical ratings scale and their administrators. Along these lines, it may be that the trained professionals administering the clinical rating scales are detecting a socioemotional disconnect during the course of the interview that directly influence their evaluations and subsequent ratings of vocal deficits.

Conversation requires significant coordination and accommodation (i.e., synchrony) between interlocutors (i.e., participants in a conversation) in both of content and non-content aspects of speech and nonverbal behaviors. Accommodation is defined as the “degree to which the behaviors in an interaction are nonrandom, patterned, or synchronized in both timing and form” (Bernieri, Davis, & Rosenthal, 1994) and is generally associated with feeling more “in tune” with another person (de Waal, 2009). Accommodation is subtle, often unconscious (Chartrand & Bargh, 1999), and reliably observed across variety of social settings including courtship (Ireland et al., 2011), interviews (Gregory & Webster, 1996), and collaborative settings (Kozlowski & Ilgen, 2006). There is broad evidence for accommodation of behavior in human dyads across both verbal and nonverbal channels of communication including word use, facial expressions, kinesics, and proxemics. For example, quantitative linguistic research has established language style and syntactic structure matching in the laboratory as well as naturalistic interactions (Gordon, Tranel, & Duff, 2014; Ireland et al., 2011; Niederhoffer & Pennebaker, 2009). Accommodation of body movement has also been explored and investigators have reliably observed synchrony of postures, mannerisms, and gestures between interlocutors (Chartrand & Bargh, 1999; Holler & Wilkin, 2011). Generally speaking, greater convergence of speech and behavior during dyadic exchanges is reliably associated with greater levels of rapport

(Bernieri et al., 1994; Hove & Risen, 2009), empathy (Chartrand & Bargh, 1999), social affiliation (Marsh, Richardson, & Schmidt, 2009), and perceived social connectedness from independent observers (Gordon, Rigon, & Duff, 2015). Furthermore, investigators have found that greater language style matching and nonverbal behavioral synchrony (e.g., orientation, smiling) were linked with greater emotional improvement during supportive conversation paradigms (Cannava & Bodie, 2016; Ireland & Pennebaker, 2010). In contrast, a lack of accommodation in total words and words per turn (Gordon et al., 2014) during a dyadic exchange between patients with brain lesions and unfamiliar partners was linked to poorer social perceptions by independent observers. In short, accommodation is a key component of communication and serves numerous purposes such as signaling active interest, developing mutual understanding, and facilitating social bonds (Vacharkulksemsuk & Fredrickson, 2012).

### **Vocal Accommodation**

Vocal expression has also been the focus of accommodation studies. Similar to speech content, investigators have found that interlocutors become more comparable in the amount of utterances and length of speaking turns (Cappella & Panalp, 1981) and may adopt each other's accents (Giles, Coupland, & Coupland, 1991). However, with respect to vocal expression, the most commonly studied feature is vocal pitch, or how high or low a person's voice sounds (Babel & Bulatov, 2012; Gregory & Webster, 1996; Imel et al., 2014). Pitch is often measured by mean fundamental frequency (mean F0), which refers to the vibration created by the vocal folds in the throat and corresponds to the lowest harmonic produced during speech (Kappas, Hess, & Scherer, 1991). Mean F0 is highly correlated with perceived pitch and is widely interpreted as a measure of emotional activation conveyed by the voice (e.g., high = excited, angry, or nervous; low = bored, calm, or content; Kappas et al., 1991). Accordingly, pitch and

other vocal characteristics function as biomarkers for the speaker's emotional state (Bachorowski, 1999; Hammerschmidt & Jürgens, 2007), such as experiencing stress (Tolkmitt & Scherer, 1986), disgust (Sauter, Eisner, Calder, & Scott, 2010), and clinical depression (Cannizzaro, Harel, Reilly, Chappell, & Snyder, 2004). Higher levels of F0 have also been linked to higher levels of physiological (e.g., higher heart rate, higher systolic and diastolic blood pressure, and greater cortisol output; Weusthoff, Baucom, & Hahlweg, 2013) and self-reported emotional arousal (Bachorowski, 1999). A series of studies indicate that F0 converges over the course of a dyadic exchange (Gregory & Webster, 1996), and this accommodation is linked to greater emotional synchrony and social affiliation (Babel & Bulatov, 2012) and perceived quality of the interaction (Weidman, Breen, & Haydon, 2016). Conversely, a lack of vocal accommodation indicates poor communication and rapport (Gregory, Dagan, & Webster, 1997). Beyond the general phenomenon of vocal accommodation during social interactions, recent evidence suggests that vocal synchrony is also related to quality interactions and empathy ratings in clinical dyads (therapist - client; Imel et al., 2014; Reich, Berman, Dale, & Levitt, 2014). Thus, vocal accommodation amongst interlocutors seems to be a necessary component of successful communication, and inability to converge vocal characteristics may indicate an inability to match affect and establish rapport.

### **Vocal Accommodation in Schizophrenia**

Though vocal expressivity in schizophrenia has been subject to measurement and evaluation in more recent years (Cohen, McGovern, et al., 2014; Cohen et al., 2016; Martínez-Sánchez et al., 2015; Mueser et al., 2010), only one study, to our knowledge, has examined these vocal variables within the confines of a dyadic exchange between a schizophrenia patient and another person. Dombrowski and colleagues (2014) used an experimental paradigm to examine

the role of stress in the quality of emotional exchange (i.e., accommodation of mean F0) in conversations with patients with schizophrenia. Computerized technologies were employed to measure fundamental frequency during the course of a conversation as patients discussed positively affective (no stress condition) and negatively affective topics (stress condition) with a clinical interviewer. Importantly, results revealed that greater severity of illness (defined as a composite score of positive and negative symptom ratings) in patients with schizophrenia were associated with less vocal accommodation during a dyadic exchange with a clinical interviewer. Though Dombrowski and colleagues (2014) were unable to fully establish vocal accommodation abnormalities in schizophrenia relative to a healthy population (i.e., failure to include control group), they did effectively establish a relationship between vocal accommodation and clinical rating scales.

### **The Present Study**

As noted earlier, patients with schizophrenia are rated as having high levels of vocal deficits, on the order of 4 to 6 SDs below their non-patient peers (Cohen, Mitchell, et al., 2014). However, recent studies utilizing objective computerized measures have yielded vastly different results; namely, vocal characteristics in schizophrenia are only abnormal in select aspects of speech, and none of these abnormalities approach the magnitude of deficits often found in subjective interview-based studies (Cohen et al., 2016). Several investigators have attempted to address this discrepancy in the literature, but currently there is a paucity of satisfactory explanations for this divergence on vocal expression in schizophrenia. The current study, the first to our knowledge, sought to evaluate and compare the quality of exchange of vocal characteristics in conversations of a clinical researcher with schizophrenia patients or non-patient controls. Our primary aims were to investigate the nature of vocal accommodation in

schizophrenia and whether a lack of convergence may account for the vocal deficits observed with interview-based rating scales.

Vocal accommodation is useful for understanding communication and social skills in schizophrenia, but has not yet been examined as an explanation for the divergence of interview based measures and computerized analysis of vocal expression. Investigators have observed that decreased vocal accommodation is related to poor rapport and social affiliation. It is plausible then that vocal accommodation, or lack thereof, may bias interviewer perceptions and therefore influence their clinical judgements. Alpert and colleagues (1995) previously investigated clinical imprecision in evaluating patient speech by manipulating the pause times of pre-recorded patient speech, but no other vocal characteristics, and asked clinicians to evaluate the recordings using interview-based rating scales. Increased pause time was found to be related to inappropriate inflated ratings of blunted vocal affect, raising the question of whether pause time disproportionately steers vocal expression and negative symptoms ratings more generally. Additionally, a host of studies have reliably observed that computerized technology derived pause measures are significantly correlated with clinician rated facial blunted affect as well as composite negative symptom scores, neurocognitive abilities, and extrapyramidal side effects (Alpert et al., 1995; Cohen et al., 2008; Cohen, Morrison, & Callaway, 2013). Consequently, Alpert and colleagues have proposed that clinical ratings of vocal deficits may in part be derived from “global” impressions of patient behavior.

To date, there are no studies that have simultaneously examined vocal accommodation in both schizophrenia and non-patient control groups. Furthermore, the degree to which clinicians are actually rating patients on vocal accommodation, rather than absolute vocal features in speech, remains unclear. The current study addressed these gaps by utilizing computerized

technologies to assess vocal accommodation during structured clinical interviews on a turn by turn basis. By assessing vocal accommodation during the course of a clinical interview, we can more clearly explore the role of vocal accommodation as they pertain to communication in schizophrenia and clinical ratings of vocal deficits. Considering the importance of conversational accommodation for effective communication and the development of rapport, we suspected that clinical ratings of vocal expression may be unduly influenced by disruptions in conversational synchrony.

### **Aims/Hypotheses**

A series of studies have reliably demonstrated that vocal characteristics, most notably fundamental frequency, converge across individuals over the course of a social interaction (Gregory et al., 1997). Of importance, accommodation of fundamental frequency has also been found to occur during clinical interactions of therapist and client (Imel et al., 2014; Reich et al., 2014). Vocal accommodation is associated with greater levels of rapport and is a useful metric for understanding successful communication during dyadic exchanges. The first aim of the current study was to extend prior findings that vocal accommodation of mean fundamental frequency (F0) occurs. It was hypothesized that the phenomenon of vocal accommodation occurs in both patient and non-patient groups.

Abnormalities in vocal expression, defined in terms of decreased speech production (e.g., alogia) and intonation (e.g., blunted affect), are a staple of schizophrenia. Studies examining vocal expression using clinician rated scales consistently produce data that suggests patients with schizophrenia have profound negative symptoms and vocal deficits compared to non-patient controls (Cohen, Mitchell, et al., 2014; Emmerson et al., 2009). Conversely, recent studies

utilizing computerized technologies have failed to observe deficits in vocal expression that approach this level. The second aim of the current study was to extend prior findings regarding computerized measurement of vocal expression in schizophrenia by assessing speech from conversations during structured clinical interviews. It was hypothesized that computerized technologies will yield modest differences that fails to approach the large differences ( $d = 4 - 6$ ) observed in studies using symptom rating scales.

Previous studies have found that patients with schizophrenia display significant impairment in behavioral affiliative skills (e.g., verbal, nonverbal, affiliation, and overall social skill) compared to non-patient controls during highly positive and affiliative role-playing tasks (Blanchard et al., 2015). Furthermore, Dombrowski and colleagues (2014) observed an association between vocal accommodation and degree of illness in schizophrenia such that patients exhibiting more psychopathology achieved less accommodation with their clinical interviewer. The third aim of the current study was to compare patients with schizophrenia and non-patient controls on their ability to synchronize vocal characteristics (e.g., mean F0) during a segment of a clinical interview. It was hypothesized that non-patient controls will exhibit a significantly greater degree of vocal accommodation in their respective dyad than patients with schizophrenia.

Investigators have examined vocal expression in schizophrenia chiefly using clinical scale ratings. This has led to inconsistent findings with recent literature utilizing computerized technologies. Clarifying the vocal abnormalities associated with schizophrenia is an essential step toward understanding the nature of vocal expression and negative symptoms, and aiding the development of effective treatment. Alpert and colleagues (1995) deftly demonstrated that clinicians' ratings of vocal expression (i.e., blunted affect, alogia) are susceptible to "global"

impressions of patient behavior by manipulating pause length in speech. Moreover, they propose that clinicians may be grounding their evaluations based on inferences from highly salient features. Thus, it is plausible clinicians are actually rating patients on vocal accommodation, and not on absolute vocal features in speech. The fourth and primary aim of the current study was to evaluate whether vocal accommodation is related to clinical ratings of vocal deficits. It was hypothesized that decreased vocal accommodation will be related to elevated clinician rated vocal deficits (i.e., SANS Blunted Affect subscale).

## METHODS

### Participants

The current study analyzed archived audio data from both patients with schizophrenia and controls from prior studies. The patient group included adults with Diagnostic and Statistical Manual of Mental Disorders 4th edition (APA, 1994) diagnosed schizophrenia (n = 57) and were recruited from community outpatient mental health clinics and residential facilities. Diagnoses were made based on information obtained from the patients' medical records and from Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders (SCID-IV; First, Spitzer, Gibbon, & Williams, 1997). All diagnostic determinations were made by trained graduate-level psychology students according to DSM-IV criteria (APA, 1994), and confirmed by consensus meeting with the principal investigator of the parent study. Exclusion criteria included the following: a) Global Assessment of Functioning (APA, 1994) rating below 30, indicating symptom levels that could interfere with participation in the study, b) documented evidence of intellectual disability from the medical records, c) current or historical DSM-IV diagnosis of alcohol or drug abuse suggestive of severe physiological symptoms (e.g., delirium tremens, repeated loss of consciousness), and d) history of significant head trauma (requiring overnight hospitalization). At the time of testing, all patients were clinically stable and currently in treatment under the supervision of a multi-disciplinary team. Patients participated in a larger study protocol that took approximately four hours for each participant to complete. The test battery included measures described in the current proposal as well as several other measures administered for additional research purposes. Data gathered from schizophrenia group was collected over the time period from January 2008 through July 2012.

Non-patient participants (n = 30) were recruited as part of a larger parent study, with the goal of obtaining a control sample that closely matched the schizophrenia group on demographic characteristics such as age, ethnicity, education, and socioeconomic status. In addition to the exclusionary criteria described above, control participants were interviewed with the SCID-IV (First et al., 1997) to rule out the presence of current and past psychotic and affective disorders. The non-patient control group participated in a larger study protocol that lasted approximately four hours for each participant to complete. The test battery included measures described in the current proposal as well as several other measures administered for additional research purposes. Data from the non-patient group was collected over the time period of January 2008 through July 2012.

## **Measures**

**Clinical Symptom Ratings.** The Brief Psychiatric Rating Scale. The Brief Psychiatric Rating Scale (BPRS; Lukoff et al., 1986) was used to measure general psychopathology. The BPRS is a 24-item clinician-rated measure that assesses clinical psychiatric symptomatology experienced over the past week. Items are rated on a 7-point Likert scale with higher scores indicating elevated psychopathology. BPRS ratings were made using information obtained from medical records, the patients' treatment teams and self-report and behavioral observations made during the research interview. Factor subscale scores reflecting positive, depression/anxiety and mania/excitement symptoms were computed (Ventura, Nuechterlein, Subotnik, Gutkind, & Gilbert, 2000). Ratings were made by one of four doctoral-level students who were trained to criterion (ICC > 0.82).

**Negative Symptoms.** The Scale for Assessment of Negative Symptoms. The Scale for Assessment of Negative Symptoms (SANS; Andreasen, 1989) is a 25 item semi-structured

interview that is divided into the following 5 subscales: Blunted Affect, Alogia, Avolition-Apathy, Anhedonia-Asociality, and Attention. Each of the subscales had a global severity item for that symptom domain. Each item was rated from 0 (not at all) to 5 (severe), with higher scores representing more severe negative symptomatology. The SANS Blunted Affect subscale, which represents restricted affect in across several channels of communication, was used as our measure of clinical ratings of vocal deficits for the purposes of the current study. At the time of the data collection, the SANS was the most often used negative symptom measure in clinical practice and remains the most cited negative symptoms measure in the schizophrenia-spectrum literature. The SANS is recognized for its good reliability and validity (Kirkpatrick et al., 2006). Ratings were made by one of four doctoral-level students who were trained to criterion (ICC > 0.70).

**Speech Samples.** Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders. The Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders 4<sup>th</sup> Edition (SCID-IV; First et al., 1997) is a widely used semi-structured interview for making the major DSM-IV Axis I diagnoses, and was utilized in the current study to primarily confirm a schizophrenia spectrum diagnoses in the patient group or to rule out the presence of current and past psychotic and affective disorders in the control group. The SCID is broken down into separate modules corresponding to categories of diagnoses. Most sections begin with an entry question that would allow the interviewer to "skip" the associated questions if not met. In the current study, Module A, reflecting mood disorders such as depression and mania, and Module B, reflecting psychosis, were administered sequentially to all participants. Due to the standardized nature of the SCID, each clinical interview started with the following question: "In the past month, has there been a period of time when you were feeling depressed or

down most of the day, nearly every day?” For all diagnoses, symptoms are numerically coded as present (2), subthreshold (1), or absent (0). The SCID was developed for use in research by trained clinicians and includes obligatory questions, operation criteria from the DSM-IV, a categorical system for rating symptoms, and an algorithm for arriving at a final diagnosis. The clinical interviews were conducted by one of four doctoral-level students that were comprised of two female and two male students.

**Acoustic Analysis.** The Computerized Assessment of Affect from Natural Speech Protocol. The Computerized Assessment of Affect from Natural Speech Protocol (CANS; (CANS; Cohen et al., 2008; Cohen, Renshaw, Mitchell, & Kim, 2015), developed by our lab to assess vocal expression from natural speech, will be used assess the behavioral manifestation (i.e., diminished expressivity) of negative symptoms. The CANS is a computer program that computes speech variables relevant to normal and abnormal speech such as utterances (vocal statements), pause length, prosody (i.e., inflection), and speech volume. The CANS has shown temporal stability across acoustic measures and moderate stability across prosodic measures during repeated administrations, demonstrating overall statistically significant reliability (Cohen et al., 2008). The primary acoustic variable of interest was mean F0, which as noted earlier, is the commonly used acoustic variable within the accommodation literature (Babel & Bulatov, 2012; Gregory & Webster, 1996). Mean F0 standard deviation, which partly reflects diminished expression of emotion characterized by reduced vocal inflection (e.g., blunted affect), was also examined where indicated.

Speech provided from the SCID interviews was processed for analysis as follows. Speech samples, which have already been collected from the larger study from 2008-2012, were digitally recorded at 16 bits per second at a sampling frequency of 44,100 hertz. The CANS was then used

to organize digital sound files into “frames” for analysis, which will be set at a rate of 100 per second. During each frame, fundamental frequency (F0) was quantified every 10 milliseconds. Fundamental frequency values were log-transformed to control for their nonlinear distribution.

### **Procedure**

The primary aim of this study was to examine vocal accommodation during a clinical interview (SCID) within a dyad composed of an interviewer and a research participant. Digital recordings of the SCIDs have previously been collected and was analyzed with the CANS protocol to extract acoustic analysis variables of interest. Because the original SCID interviews were not recorded with separate microphones, all audio files were manually decomposed (segmented) and stored in separate files that contained only interviewer or participant speech. Following similar procedures established by studies examining vocal accommodation (Babel & Bulatov, 2012; Levitan & Hirschberg, 2011; Reich et al., 2014), we examined the dynamic nature of communication on a turn-by-turn basis. Turn-by-turn basis is defined as isolating interviewer speech and participant speech from each SCID, with each turn spoken by an interlocutor being a separate file. A turn is defined as a segment of speech bounded by the other speaker. It begins exactly when the other individual has stopped talking, and it ends exactly before the pause preceding the other speaker’s utterance. An individual turn could be less than a second (e.g., answering a question with a “Yes” or “No”) or as long as 30 seconds or more and can only occur when the other interlocutor is not talking. We also qualified an utterance as a turn if an interlocutor clearly responds to a question posed by the other interlocutor (usually interviewer) with a one-word answer (e.g., “OK”) or with a non-verbal utterance (e.g., “uh-huh”). Importantly, we did not qualify typical back channel speech (e.g., “uh-huh”) as a turn as

they often occur during the other interlocutor's turn. In such cases of back channel speech, we deleted them, but not the pauses on either side.

Furthermore, we acoustically analyzed the first 5 minutes of every SCID interview for two primary reasons. First, examining vocal characteristics within the first 5 minutes of the SCID interview, as opposed to the whole interview, is optimal because the participants (i.e., patients and non-patients) and interviewers are in the beginning stages of establishing rapport. However, as the SCID interview gets prolonged, both participants and interviewer may become more disengaged from each other due to a multitude of factors (e.g., fatigue). Of note, SCID interviews with patients tend to have longer time duration compared to interviews with non-patient controls simply as a function of endorsing more psychopathology. Second, though the SCID is a semi-structured interview, every interview in the proposed study begins with the same question (“In the last month, has there been a period of time when you were feeling down most of the day, nearly every day?”). While there are other standardized questions that must be asked during every SCID (e.g., entry questions pertaining to experiencing manic and psychotic episodes), they will be difficult to locate because every SCID varies in length of administration (i.e., typically within a range of 10 – 60 minutes). Thus, analyzing the first five minutes of every SCID interview allowed for the best consistency across all participants.

### **Statistical Analyses**

**Analysis 1: Data distribution, demographic variables, and potentially confounding variables.** First, continuous demographic and dependent variables were examined for normality of distribution. Variables were transformed to correct for skew and outlying data points where necessary, as indicated. All analyses in this study were two-tailed and extreme scores ( $> 3.5$  SD) were trimmed (i.e., replaced with values  $< 3.5$  SD). Next, the two groups were compared on

demographic variables (e.g., age, ethnicity, gender, and education) to examine potential confounding variables that may need to be controlled for in the primary analyses listed below. Of note, Stemple and colleagues (2000) reported that mean F0 for males voices ( $M = 106$  Hz) was lower than female voices ( $M = 193$  Hz). Age has also been found to have an effect on F0 such that younger individuals exhibit higher F0 than older individuals (Russell, Penny, & Pemberton, 1995).

**Analysis 2: Manipulation Check - Establishing vocal accommodation.** To address our first aim, we examined if the magnitude of vocal accommodation is greater than chance levels (i.e.,  $r = 0$ ). As stated earlier, the mean F0 accommodation measure was created by correlating (Pearson) the mean F0 of each interviewer speech turn with the mean F0 of the participant speech turn that comes immediately afterward across the first 5 minutes of each SCID. We then normalized the distribution of these correlations by converting them to Fisher's z scores (Fisher, 1921). Similar methods to compute the vocal accommodation scores have been used in prior studies (Reich et al., 2014). Using the newly created transformed scores, we aimed to extend prior findings that the magnitude of vocal accommodation of F0 is greater than chance level (i.e., test value = 0) by using one sample t-tests. More specifically, we conducted separate one sample t-tests for mean F0 accommodation in healthy controls and in patients with schizophrenia.

**Analysis 3: Vocal expressivity comparison via acoustic analysis.** To address the second aim of the study, we compared vocal expressivity via acoustic analysis in controls and patients with schizophrenia. More specifically, we used a hierarchical logistic regression to compare acoustic variables in schizophrenia and non-patient controls. The hierarchical logistic regression tested the hypothesis that while acoustic variables can be used to predict group membership (i.e., controls vs. schizophrenia), the effect size would not approach those of clinical

ratings of vocal deficits. We tested this hypothesis by entering demographic variables (Step 1) and mean F0 standard deviation (Step 2) as predictors and entering group membership (control = 0; SZ = 1) as the criterion variable.

#### **Analysis 4: Vocal accommodation in schizophrenia and non-patient control groups.**

We used a hierarchical logistic regression to compare the degree of magnitude of mean F0 accommodation in schizophrenia and non-patient controls. The hierarchical logistic regression tested the hypothesis that vocal accommodation of mean F0 can be used to predict group membership (i.e., controls vs. schizophrenia). We tested this hypothesis by entering demographic variables (Step 1) and mean F0 accommodation (Step 2) as predictors and entering group membership (control = 0; SZ = 1) as the criterion variable.

We also used independent samples t-test to test the hypothesis that non-patient controls would exhibit a greater degree of vocal accommodation than patients with schizophrenia. More specifically, we used an independent samples t-test with the index of mean F0 accommodation as the dependent variable.

**Analysis 5: Relationship between vocal accommodation and clinical ratings of vocal expressivity deficits.** The primary aim of the current study was to determine if lack of vocal accommodation unduly influences clinical ratings of vocal expressivity deficits (i.e., blunted affect). More specifically, we sought to determine if the degree of mean F0 accommodation could help explain the discrepancy between clinical ratings and objective (i.e., acoustic analyses) measures of vocal expressivity deficits (e.g., blunted affect) in schizophrenia. To address this aim of the study, we used a hierarchical linear regression model to examine the relationship between schizophrenia, vocal accommodation, and clinical ratings of vocal expressivity deficits (i.e., Blunted Affect subscale of the SANS). The hierarchical linear regression tested the

hypothesis that vocal accommodation of mean F0 will be significantly related to clinical ratings of blunted affect. We tested this hypothesis by entering demographic variables (Step 1) and mean F0 accommodation (Step 2) as predictors and entering clinical ratings of the blunted affect subscale of the SANS as the criterion variable.

**Exploratory Analyses.** A set of exploratory analyses examining the effect of the gender matched dyads and gender mismatched dyads on vocal accommodation in patients with schizophrenia were performed. Previous literature have demonstrated that accommodation varies by gender match or mismatch dyads partly as function of gender differences in communication (Namy, Nygaard, & Sauerteig, 2002; Stupka & Winterrowd, 2011). Moreover, female therapists often engender greater therapeutic alliance than male therapist regardless of the gender of the patient (Bhati, 2014). In these analyses, we performed a 2x2 factorial ANOVA with the first factor being gender of the interviewer, the second factor being the gender of the research subject, and the dependent variable being mean F0 accommodation.

Additionally, we explored the influence of a second type of accommodation measure on clinical ratings of vocal expressivity deficits. This exploratory analysis would determine if the interviewer accommodating to the subject would have undue influence on clinical ratings of vocal expressivity deficits. This exploratory analysis was motivated by the hypothesis that patients with schizophrenia, and especially those with elevated negative symptoms, may exude apathy and withdrawn behaviors during clinical interviews. To compensate, the interview may attempt to accommodate to the patient in order to establish rapport and obtain meaningful response and data. As such we created a *subject leading* mean F0 accommodation measure wherein the mean F0 of each subject speech turn was correlated (Pearson) with the mean F0 of the interviewer speech turn that comes immediately afterward. Next, we used a hierarchical

linear regression model similar to the one utilized in Analysis 5, but with the *subject leading* mean F0 Accommodation entered in Step 2 instead.

### **Power Analysis**

G\*Power 3.1.5 (Faul, Erdfelder, Buchner, & Lang, 2009) was used in order to compute the minimum number of participants to be needed for the present study to detect the expected correlations and differences with power ( $1 - \beta$ ) of .80, two-tailed tests, and  $\alpha = .05$ . Effect sizes for turn-by-turn mean F0 accommodation in previous research are in the large range when compared to null hypothesis value of  $r = 0.00$ . For example, an effect size of  $d = .92$  in mean F0 accommodation was observed in Reich and colleagues (2014) when they tested their mean F0 accommodation value (Mean  $r = .12$ ,  $SD = .13$ ) against zero in a one sample t-test. A brief literature review of turn-by-turn mean F0 accommodation yields similar findings (i.e., range of mean  $r = .08 - .28$ ; Levitan & Hirschberg, 2011; Lubold & Pon-Barry, 2014a, 2014b). Thus, a minimum sample of 12 total participants from each group is needed to establish that vocal accommodation would be observed during a clinical interview. To our knowledge, no study has directly compared vocal accommodation in schizophrenia versus healthy controls. However, Dombrowski and colleagues (2014) observed a medium effect size ( $r = .43$ ) when examining the relationship between vocal accommodation and clinician rated severity of illness (i.e., composite score representing positive and negative symptoms) in a sample of patients with schizophrenia. Therefore, the current study requires a minimum sample of 40 participants from the schizophrenia group to achieve this medium effect size when comparing mean F0 accommodation to the clinical rating of vocal expressivity deficits. As noted earlier, data has been previously collected and the present study achieved a total sample size of 94 participants (schizophrenia group,  $n = 57$ ; non-patient group,  $n = 30$ ).

## RESULTS

### Demographics and Other Potentially Confounding Variables

Table 1 presents descriptive statistics for demographic, clinical, and acoustic variables.

No serious violations in normality were observed.

Table 1. Descriptive statistics for demographic, clinical, and acoustic variables for the control and schizophrenia (SZ) groups.

Variable	Control (n = 30)		SZ (n = 57)		Statistic
	%		%		$\chi^2$
Females	50%		28%		4.12*
Ethnicity (% Caucasian)	50%		39%		1.05
	M	SD	M	SD	T
Age (years)	41.27	13.17	40.58	11.68	.25
Education (years)	14.20	2.16	11.21	1.91	6.62*
Brief Psychiatric Rating Scale (BPRS)					
Positive Symptoms			11.67	5.09	
Depression/Anxiety			8.14	4.70	
Manic/Excitement			10.32	4.07	
Negative Symptoms (SANS)					
Flat affect			0.80	1.44	
Alogia			1.04	1.35	
Avolition			0.82	1.19	
Anhedonia			0.80	1.10	
Acoustic Variables					
Mean F0	84.16	3.93	83.75	3.15	
Mean F0 SD	2.61	1.02	2.23	0.79	-
F0 Accommodation	0.16	0.34	.07	0.24	-

\* $p < 0.05$

Significant differences were found for sex,  $\chi^2 (1, N = 87) = 4.12, p = .04$ , and education  $t(85) = 6.62, p < .001$  between the control and patient groups; no other significant group differences were observed for the demographic variables. As previously noted, mean F0 for male voices are lower than female voices (Stemple et al., 2000) within the general population. As

such, gender was considered a potential confound and therefore used as a covariate, where noted, in the primary analyses listed below.

### **Manipulation Check – Establishing Vocal Accommodation**

One sample t-tests for the control and schizophrenia groups were run to determine whether vocal accommodation of mean F0 occurs at greater than chance levels, defined as  $r = 0$ . Analyses revealed that, for controls, the degree of mean F0 accommodation ( $M = .16$ ,  $SD = .34$ ) was greater than zero,  $t(29) = 2.59$ ,  $p = .02$ . Similar results were observed the schizophrenia group ( $M = .07$ ,  $SD = .24$ ),  $t(56) = 2.04$ ,  $p = .04$ . Replicating previous studies vocal accommodation, both groups exhibited accommodation of mean F0 with their respective partner during their clinical interview.

### **Vocal Expressivity Comparison via Acoustic Variables**

A hierarchical logistic regression analysis was performed with group membership (i.e., control vs. schizophrenia) as the outcome variable and the following variables as predictors: Subject Gender (Step 1) and mean F0 standard deviation (step 2). The results are presented in Table 2. The final logistic regression model with both predictors revealed that the model approached statistical significance,  $\chi^2(2, N = 87) = 4.90$ ,  $p = .09$ , indicating that the predictors, as a set, trended towards distinguishing between controls and patients with schizophrenia. Nagelkerke's  $R^2$  of .08 for the final model indicated a modest relationship between predictors and the grouping variable. Nonetheless, using a cut value of .5, classification and sensitivity were unimpressive, with 23.3% of observed controls correctly predicted, for an overall success rate of 71.3%. The Wald criterion demonstrated that subject gender (Wald = 2.18,  $p = .14$ ) and mean F0 standard deviation (Wald = .84,  $p = .36$ ) were not significant predictors of group membership in the final model. Replicating previous studies, we failed to observe vocal deficits via acoustic

analysis between control and patient groups that are routinely and robustly observed in clinical ratings of vocal deficits.

Table 2. Logistic regression for prediction of group membership (i.e., control vs. schizophrenia) by subject gender and mean F0 standard deviation (n = 87).

	R <sup>2</sup>	$\chi^2$	B (SE)	Wald	p	Odds Ratio
Step 1	.06	4.06*				
Subject Gender			.94 (.47)	4.02	.04	2.56
Step 2	.08	4.90 <sup>†</sup>				
Subject Gender			.75 (.51)	2.18	.14	2.13
Mean F0 SD			-.26 (.29)	.84	.36	.77

\* < .05

<sup>†</sup> < .10

### Vocal Accommodation in Schizophrenia and Non-Patient Control Groups

A hierarchical logistic regression analysis was performed with group membership (i.e., control vs. schizophrenia) as the outcome variable and the following variables as predictors: Subject Gender (Step 1) and mean F0 accommodation (step 2). The results are presented in Table 3. The final logistic regression model with both predictors revealed that the model approached statistical significance,  $\chi^2 (2, N = 87) = 5.89, p = .052$ , indicating that the predictors, as a set, trended towards distinguishing between controls and patients with schizophrenia. Nagelkerke's R<sup>2</sup> of .09 for the final model indicated a modest relationship between predictors and the grouping variable. Nonetheless, using a cut value of .5, classification and sensitivity were unimpressive, with 13.3% of observed controls correctly predicted, for an overall success rate of 64.4%. The Wald criterion demonstrated that subject gender approached significance as a predictor (Wald = 3.65,  $p = .06$ ) of Group Membership in the final model. Mean F0 accommodation was not did emerge as significant predictor of Group Membership (Wald = 1.81,  $p = .18$ ).

Table 3. Logistic regression for prediction of group membership (i.e., control vs. schizophrenia) by subject gender and mean F0 accommodation (n = 87).

	R <sup>2</sup>	$\chi^2$	B (SE)	Wald	p	Odds Ratio
Step 1	.06	4.06*				
Subject Gender			.94 (.47)	4.02	.04	2.56
Step 2	.09	5.89 <sup>†</sup>				
Subject Gender			.90 (.47)	3.65	.06	2.48
Mean F0 Accommodation			-1.23 (.80)	1.81	.18	0.32

\* < .05

<sup>†</sup> < .10

An independent samples t-test was run to determine whether non-patient controls exhibit a greater degree of vocal accommodation of mean F0 than patients with schizophrenia. Analysis revealed that vocal accommodation for the non-patient control group did not significantly differ from the vocal accommodation value for patients with schizophrenia,  $t(85) = 1.26$ ,  $p = .21$ . Results for group comparison on vocal accommodation via independent samples t-test are similar to those obtained using the hierarchical linear regression.

### **Vocal Accommodation and Clinical Ratings of Vocal Deficits**

Clinical ratings of vocal expressivity deficits were not significantly correlated with mean F0 accommodation, ( $r = .17$ ,  $p = .11$ ; see Figure 1).

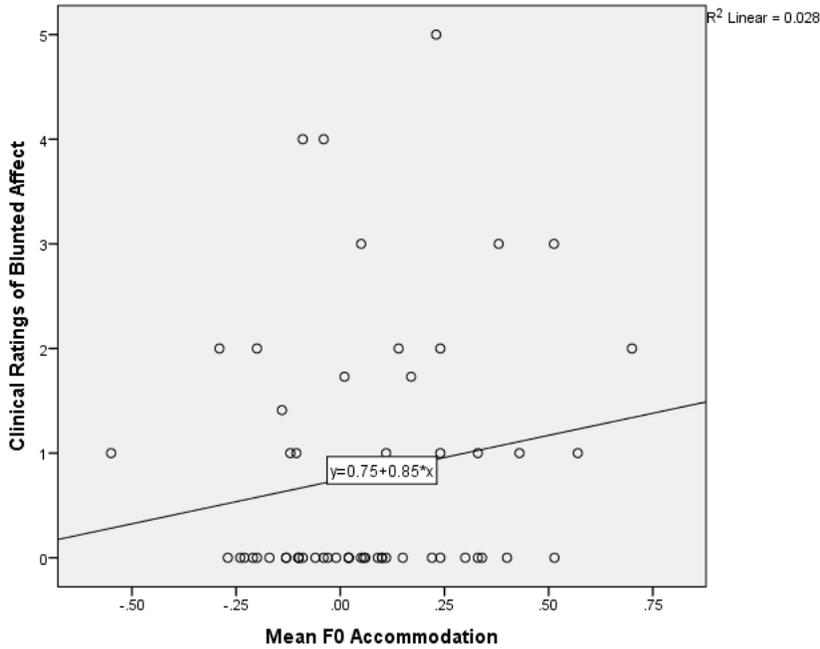


Figure 1. Relationship between clinical ratings of vocal deficits and mean F0 Accommodation.

Hierarchical linear regression analysis was used to examine the relationship between clinical ratings of vocal deficits (i.e., SANS Blunted Affect) and mean F0 Accommodation (Step 2) controlling for subject gender (Step 1). The results of these analyses are presented in Table 4. The overall model with clinical ratings of vocal deficits as the criterion variable was not significant,  $F(2, 53) = .91, p = .41$ , with both predictors (e.g., gender, mean F0 Accommodation) accounting for 3% of the variance in clinical ratings of vocal deficits. As shown in Table 4, mean F0 accommodation was not a significant predictor of clinical ratings of vocal deficits ( $\beta = .17, p = .21$ ). Surprisingly, the coefficient for mean F0 Accommodation was positive, indicating a positive relationship (though not significant) between clinical ratings of blunted affect and mean F0 accommodation. This is counter to our initial hypothesis as these results suggest that greater mean F0 accommodation was associated with elevated clinical ratings of vocal deficits.

Table 4. Hierarchical regression for prediction of clinical ratings of vocal deficits by subject gender and mean F0 Accommodation in schizophrenia (n = 55).

	R <sup>2</sup>	F	β
Step 1	.003	.19	
Subject Gender			.06
Step 2	.03	.91	
Subject Gender			.07
Mean F0 Accommodation			.17

### Exploratory Analyses

A two-way between-subjects ANOVA was run to examine the potential influence of gender matched dyads (i.e., female interviewer – female subject) and gender mismatched dyads (i.e., female interviewer – male interviewer) on vocal accommodation in schizophrenia. Mean and standard deviation for each permutation of gender pairs are presented in Table 5. Gender matched pairs of “Female Interviewer – Female Subject” and “Male Interviewer – Male Subject” exhibited a greater magnitude of vocal accommodation than a gender mismatched pair of “Female Interviewer – Male Subject” and “Male Interviewer- Female Interviewer”. However, a two-way between subjects ANOVA did not generate a significant interaction,  $F(1, 53) = 1.23, p = .27$ . Main effects for gender of the interview [ $F(1, 53) = .02, p = .89$ ] and gender of the subject [ $F(1, 53) = .01, p = .93$ ] did not reach significance as well. While these results (i.e., non-significant interaction) suggest that mismatch of gender within dyads did not have a significance influence on vocal accommodation, our lack of significance are mostly like due to small and unequal sample size among the four permutations of gender matched and mismatched dyads.

Table 5. Descriptive statistics for Mean F0 accommodation [Mean (SD); n] for gender matched and mismatched dyads in schizophrenia subjects.

	Female Subject	Male Subject
Female Interviewer	.12 (.28); 10	.03 (.23); 30
Male Interviewer	.05 (.22); 6	.12 (.26); 11

Hierarchical linear regression analysis was used to examine the relationship between clinical ratings of vocal deficits (i.e., SANS Blunted Affect) and the subject leading mean F0 accommodation (see Table 6). Subject gender was entered in the first step and subject leading mean F0 accommodation was entered in the second step. The overall model with clinical ratings of vocal deficits as the criterion variable was not significant,  $F(2, 53) = .09, p = .91$ , with the two predictors (e.g., gender, subject leading mean F0 Accommodation) accounting for only .003% of the variance in clinical ratings of vocal deficits. Moreover, the subject leading mean F0 Accommodation was not a significant predictor of clinical ratings of vocal deficits ( $\beta = .0002, p = .99$ ). These results suggest that the degree to which the interviewer accommodates vocal patterns to the subject does not influence clinician's rating of vocal deficits.

Table 6. Hierarchical regression for prediction of clinical ratings of vocal deficits by subject gender and mean F0 Accommodation in schizophrenia (n = 55).

	R <sup>2</sup>	F	$\beta$
Step 1	0.003	.19	
Subject Gender			.06
Step 2	0.003	.09	
Subject Gender			.06
Subject Leading Mean F0 Accommodation			.00002

## DISCUSSION

Prior research suggests that patients with schizophrenia are rated 4 to 6 SDs below their non-patient counterparts on clinical ratings of vocal deficits on clinical interviews (Cohen, Mitchell, et al., 2014). Yet, recent studies employing objective computerized acoustic analyses routinely fail to observe these large effect sizes (Cohen et al., 2016). The current study sought to explain this large discrepancy by evaluating vocal accommodation in patients with schizophrenia and controls. Decreased vocal accommodation is related to poor rapport and social affiliation (Bernieri et al., 1994; Hove & Risen, 2009). In support of a link between reduced accommodation and clinician ratings, findings from the schizophrenia and general population literature support the notion that clinician ratings of symptomatology are vulnerable to “global impression” (Alpert et al., 2002; Moran & Tai, 2001). Thus, we hypothesized that decreased vocal accommodation in schizophrenia may bias interviewer perceptions and subsequently influence their clinical ratings of vocal deficits. This is the first study to our knowledge to evaluate and compare the degree of dynamic exchange of vocal characteristics in conversations between a clinical researcher and schizophrenia patients or non-patient controls.

To this end, the current study adopted a turn-by-turn paradigm to examine how disruptions in conversational synchrony of mean F0 may unduly affect ratings of vocal deficits on a widely used measure of negative symptoms. We restricted our analyses to mean F0 as it is the most commonly used acoustic feature in the vocal accommodation literature (Gregory & Webster, 1996; Levitan & Hirschberg, 2011; Reich et al., 2014). Contrary to expectations, our results do not indicate that vocal accommodation has a significant influence on clinician based ratings of vocal expression. Patients with schizophrenia appeared to accommodate less with their respective partner during a clinical interview compared to non-patient controls, though this

difference was not significantly different. Nonetheless, mean F0 accommodation did not account for a significant amount of variance of clinician rated vocal expressivity deficits. The current findings extend the literature on communicative and social skills in schizophrenia.

### **Link between Vocal Accommodation and Clinician Ratings**

Prior literature suggests that vocal accommodation between interlocutors may be a necessary ingredient for successful communication, and the inability to accommodate may signify a failure to match affect in speech. We are the first study to consider the degree of this dynamic exchange of communication in both schizophrenia and controls. Unfortunately, the results do not support our primary hypothesis as mean F0 accommodation did not emerge as a significant predictor of clinical ratings of vocal deficits. Several explanations exist for this null finding. First, it could be that there is no true relationship between vocal rating deficits and vocal accommodation. Greater accommodation of acoustic variables appears to be related to mutually beneficial outcomes and may not necessary linked with outcomes related to deficits (i.e., negative symptoms). For example, vocal accommodation has been robustly linked to empathy, social affiliation, and collaboration (Babel & Bulatov, 2012; Gregory & Webster, 1996). Moreover, increased vocal accommodation has been previously associated with greater collaborative effort and learning within the educational interactions (Lubold & Pon-Barry, 2014, 2014). and linked to the quality of interactions and empathy ratings in clinical dyads during psychosocial treatment (Imel et al., 2014; Reich et al., 2014). Thus, the majority of studies examining vocal accommodation typically within the context of positive outcomes (e.g., increased learning, empathy, quality of communication) and less so on negative outcomes (e.g., symptomatology, poor social skills). The current study did not have an empathy or degree of quality of social interaction measure, and these represent potential avenues for future research.

Alternatively, it could be that vocal accommodation is related to *elevated* clinician ratings of vocal deficits in at least some circumstances. Patients with elevated negative symptoms often appear apathetic or indifferent during a clinical interview. As a result, clinicians may attempt to compensate for this emotional withdrawal by mirroring the patient's vocal characteristics to increase the emotional output of the client. Relatedly, it is also possible that clinicians may match mean F0 with the patient in an attempt to express empathy with the client's possible heightened emotional state elicited during a clinical interview (i.e., "Have you ever had thoughts of suicides?"). Of note, Reich and colleagues (2014) found that clinician matching a client's pitch was associated with elevated ratings of the client's depressive symptomatology. We attempted to explore this latter possible explanation by creating a subject leading vocal accommodation measure. However, we did not find that this alternative measure of mean F0 accommodation predicted clinical ratings of vocal deficits. Future research could expand on this notion exploring the context on which high or low vocal synchrony occurs over the course of a clinical interview.

While these may be plausible explanations, they do not account for the findings by Dombrowski and colleagues (2014). Dombrowski and colleagues (2014) were primarily interested in examining accommodation of mean F0 under different conditions of stress (i.e., low vs high stress) in schizophrenia. However, the investigators also examined the relation of vocal accommodation to greater severity of illness. In contrast to present study, they did observe a significant association between increased vocal accommodation and decreased psychopathology (i.e., composite score of positive and negative symptoms) in the expected direction with moderate effect size ( $r = .43$ ). However, our study differs from Dombrowski and colleagues (2014) in notable two respects. First, they examined vocal accommodation using a different methodology than the turn-by-turn paradigm utilized in the current study. Briefly, the

investigators isolated nine speech segments (1-4 seconds) from each dyad on their respective 10 minute speech sample (i.e., discussing affectively positive or negative topics). The nine segments for each interlocutor were randomly selected from each third of the interview that contained sufficient and appropriate speech (i.e., three segments from the first third, three segments from second third, etc.). Finally, Pearson correlation coefficients were computed for each dyad similar to methods used in the present study. While this methodology has been used in a few prior studies (Gregory et al., 1997; Gregory & Webster, 1996), the turn-by-turn paradigm used in the current study represents a more ecologically valid examination of interpersonal synchrony with greater temporal precision and has been used extensively in the vocal accommodation literature (Levitan & Hirschberg, 2011). However, the methodology utilized by Dombrowski and colleagues (2014) did allow the investigators to examine vocal accommodation (albeit limited) as it unfolds over the entire speech sample. As noted earlier, the current study sampled only the first 5 minutes of the clinical interview due to a variety of reasons (e.g., standardization, time intensive) and future work should focus on examining vocal accommodation across the entirety of a clinical interview. Second, as noted earlier, Dombrowski and colleagues (2014) procured their speech samples via participants discussing affectively resonant topics. It could be that affective speech topics (i.e., “Talk about a bad, unpleasant, or stressful life experience”) are very conducive for conversational synchrony. Clinical interviews on the other hand are more standardized with question and response format that may evoke trepidation from patients with schizophrenia. As previously discussed, clinician ratings are vulnerable to “global impressions” and a number of clinical biases (Alpert et al., 1995; Moran & Tai, 2001); therefore, scores on clinical symptoms measures such as the SANS may reflect the degree of accommodation that occurs *outside* the confounds of a structured clinical interview. Future research may expand the

vocal accommodation literature by examining mean F0 matching during clinical interviews and a variety of other open-ended speech conditions, and investigate if there are differential relationships between speech task and clinical ratings of vocal deficits.

### **Vocal Accommodation and Social Skills in Schizophrenia**

Another aim of the current study was to compare the degree of vocal accommodation in patients with schizophrenia and non-patient controls. Contrary to hypothesis, mean F0 accommodation did not emerge as a significant predictor of group membership. Moreover, non-patient controls did not significantly differ on vocal accommodation compared to patients with schizophrenia. Nonetheless, patients with schizophrenia did accommodate with their respective interviewee partner to a smaller, though not significant, degree than their non-patient counterparts ( $d = .31$ ). Consistent with prior literature, the vocal accommodation exhibited by patients with schizophrenia ( $M = .07$ ) was lower than the accommodation within the general population found in other studies via turn-by-turn analyses ( $M = .11 - .28$ ; Levitan & Hirschberg, 2011; Lubold, Nichola; Pon-barry, 2014; Lubold & Pon-Barry, 2014). Our finding supports the notion that the capacity for emotional and social connection in speech is likely impaired in schizophrenia. The literature is robust with evidence that patients with schizophrenia have marked impairment in social and behavioral affiliative skills (Bellack, Brown, & Thomas-Lohrman, 2006; Blanchard, Park, Catalano, & Bennett, 2015) and social functioning more broadly (Cohen, Forbes, Mann, & Blanchard, 2006). Successful social interactions play an instrumental role in many domains daily functioning. Vocal accommodation reflects the ability to be “in tune” with another person, facilitates mutual understanding, and is likely a core component of successful social interactions (de Waal, 2009). Moreover, poor ability to synchronize paralinguistic abilities with another partner during conversation may lead

deleterious outcomes across a wide swath of social interactions including romantic courtship, vocational interviews, learning, and collaboration. Moreover, previous studies have shown that blind, independent raters possess the ability to distinguish between low and high accommodating dyads (Gordon et al., 2015). Importantly, these blind raters also reported less desire to converse with subjects who demonstrated poor accommodation ability if given the opportunity. This is especially relevant for schizophrenia as this population frequently experiences elevated social stigma and exclusion (Perry, Henry, Nangle, & Grisham, 2012). As such, deficits in dyadic synchrony may stymie the development of social networks and may contribute to the challenges that many patients with schizophrenia encounter in creating and maintaining social relationships and reintegrating into the general community. While groups did not significantly differ on our index of vocal accommodation, an accumulation of studies suggests that poor vocal accommodation is likely an important individual difference characteristic that could be targeted in future clinical trials of psychosocial treatments aiming to improve social competence.

### **Limitations**

Several limitations are worth noting. First, our small number of female participants with schizophrenia coupled with a small sample size and selection criteria limit the generalizability to the larger population of patients with schizophrenia. In addition, analyses conducted in this study were correlational. Future studies would benefit from experimental manipulation of vocal accommodation and subsequent clinical ratings of vocal deficits. The sample of patients with schizophrenia had relatively low clinical ratings of negative symptoms with a small standard deviation. Restricted range of clinical ratings of vocal expressivity deficits as our primary criterion variables may have influenced our study results. We did not account for the potential confounds of pharmacological medication or psychosocial interventions. Thus, we cannot

comment on the potential influence of medication and treatments effects on speech and vocal accommodation in schizophrenia. Lastly, we did not control for interviewer differences such as gender and interviewer style. Our explanatory analyses provide partial support that mixed gender dyads may potentially influence the degree of accommodation. Furthermore, the doctoral students may each have different interviewer styles (i.e., compassionate and highly affiliative vs. detached) that could have influenced the degree of accommodation from the research participants.

### **Future Directions**

The current study evaluated one aspect (i.e., mean F0) of non-verbal communication accommodation. As previously noted, there is much evidence for accommodation across both verbal and other non-verbal channels of communication. Of note, Kupper and colleagues (2015) examined accommodation of head and body gestures in patients with schizophrenia and found that low nonverbal synchrony was related to increased positive symptoms, negative symptoms, social functioning deficits. Future research could examine accommodation across various channels of communication and investigate their relationship to important outcomes related to schizophrenia pathology. An emerging and exciting line of research within the accommodation literature has been the examination physiological accommodation. Recent studies have demonstrated increased pupil dilation synchrony between interlocutors during one speaker's highly affective personal narrative (i.e., death of a friend), indicating an implicit shared attention facilitating mental coupling (Kang & Wheatley, 2017; Wheatley, Kang, Parkinson, & Looser, 2012). Moreover, studies employing electroencephalography have observed inter-brain synchronization of neural activity (e.g., alpha and theta bands) on relative simple speech tasks, indicating increased social coordination (Kawasaki, Yamada, Ushiku, Miyauchi, & Yamaguchi,

2013; Mu, Guo, & Han, 2016). Thus, future studies would benefit from pupillary and neural accommodation in schizophrenia as it may aid in revealing the physiological and neurophysiological underpinnings of the ubiquitous social and communicative skills within this population.

As noted earlier, the current utilized a turn-by-turn paradigm to analyze the degree of accommodation during the first five minutes of a structured clinical interview. This approach has been used extensively throughout the accommodation literature (Levitan & Hirschberg, 2011). However, alternative and more sophisticated accommodation analytic techniques (e.g., cross-correlations, time aligned) exist and have been utilized to examine accommodation across the entirety of a speech sample (Bonin et al., 2013; Savelkoul, Zebrowski, Feldstein, & Cole-Harding, 2007). Cross-correlations are a type of time series analysis that analyzes a sequence of data points in successive time intervals to understand coordination patterns across time. More specifically, correlation-coefficients are produced for each pair of data points at different time lags (i.e., lag-1, lag-0, lag+1, etc.). Time aligned analyses meanwhile analyzes speech with overlapping fixed window spaces that allows for the examination of the effect of one speaker's speech characteristics (i.e., mean F0) on their partner's speech characteristic after some delay. Both advanced accommodation analytic techniques are more temporally dynamic compared to the relatively "local" and strict turn-by-turn paradigm and may unveil more subtle patterns with regards to vocal accommodations and potentially yield larger effect sizes (i.e., higher degree of vocal accommodation). Another avenue for future research involves experimental manipulation and investigating subsequent vocal accommodation. As evidenced by Dombrowski and colleagues (2014), the degree of vocal accommodation may depend on context. Thus, future studies can examine the degree of vocal accommodation between interlocutors while participants

discuss unambiguous affective topics (i.e., discussing positive or negative personal experiences) as done in Dombrowski and colleagues (2014). Studies can also move away from therapeutic or symptoms-oriented speech tasks and examine vocal accommodation under different contexts such as conflict-oriented (Bellack et al., 2006) or highly-affiliative (i.e., gregarious confederate; Blanchard, Park, Catalano, & Bennett, 2015) role playing tasks that are common in the schizophrenia literature. Lastly, it would be interesting to examine the ability of patients with schizophrenia and non-patient controls to accommodate to their respective partner in either remote conversations or simulated conversations. Telemedicine is becoming increasingly common and connects patients, who may live in geographically remote areas, with their healthcare provider via electronic communications and information technology in lieu of face-to-face appointments. Clinical trials involving telemedicine have been conducted with veterans with posttraumatic stress disorder (PTSD) with promising results, but have yet to be conducted in patients with serious mental illness (Morland et al., 2013). Furthermore, patients with schizophrenia often struggle with academic functioning (e.g., poor attendance, failing courses). Online courses represent one avenue to increase academic attainment for this population as it has increased educational opportunities for countless students. However, online learning outcomes and progressions associated with online learning still lag behind face-to-face courses (Jaggars & Bailey, 2010). Thus, it is important to examine the potential communication challenges within increasingly common remote conversations as it may guide and improve future applications of remote interventions for schizophrenia.

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**APPENDIX A. SCALE FOR THE ASSESSMENT OF NEGATIVE SYMPTOMS –  
AFFECTIVE FLATTENING SUBSCALE**

0=None 1=Questionable 2=Mild 3=Moderate 4=Marked 5=Severe

- |  |   |   |   |   |   |   |
|--|---|---|---|---|---|---|
| <b>1. Unchanging Facial Expression</b>   | 0 | 1 | 2 | 3 | 4 | 5 |
| The patient's face appears wooden--changes less than expected as emotional content of discourse changes. |   |   |   |   |   |   |
| <b>2. Decreased Spontaneous Movements</b>  | 0 | 1 | 2 | 3 | 4 | 5 |
| The patient shows few or no spontaneous movements, does not shift position, move extremities, etc.       |   |   |   |   |   |   |
| <b>3. Paucity of Expressive Gestures</b>   | 0 | 1 | 2 | 3 | 4 | 5 |
| The patient does not use hand gestures or body position as an aid in expressing his ideas.               |   |   |   |   |   |   |
| <b>4. Poor Eye Contact</b>   | 0 | 1 | 2 | 3 | 4 | 5 |
| The patient avoids eye contact or "stares through" interviewer even when speaking.                       |   |   |   |   |   |   |
| <b>5. Affective Nonresponsivity</b>  | 0 | 1 | 2 | 3 | 4 | 5 |
| The patient fails to laugh or smile when prompted.   |   |   |   |   |   |   |
| <b>6. Inappropriate Affect</b>   | 0 | 1 | 2 | 3 | 4 | 5 |
| The patient's affect is inappropriate or incongruous, not simply flat or blunted.                        |   |   |   |   |   |   |
| <b>7. Lack of Vocal Inflections</b>  | 0 | 1 | 2 | 3 | 4 | 5 |
| The patient fails to show normal vocal emphasis patterns, is often monotonic.                            |   |   |   |   |   |   |

## 8. **Global Rating of Affective Flattening**

0 1 2 3 4 5

This rating should focus on overall severity of symptoms, especially unresponsiveness, inappropriateness and an overall decrease in emotional intensity.

## APPENDIX B. IRB APPROVAL

### Project Report and Continuation Application

(Complete and return to IRB, 130 David Boyd Hall.  
Direct questions to IRB Chairman Robert Mathews 578-8692.)



Institutional Review Board  
Dr. Robert Mathews, Chair  
130 David Boyd Hall  
Baton Rouge, LA 70803  
P: 225.578.8692  
F: 225.578.5983  
irb@lsu.edu | lsu.edu/irb

IRB#: 2679 Your Current Approval Expires On: 3/10/2014

Review type: Full Risk Factor: Minimal Date Sent: 1/3/2014

PI: Alex Cohen Dept: Psychology Phone: (225) 578-7017

Student/Co-Investigator:

Project Title: Understanding Negative Symptoms in Schizophrenia Using Novel Technologies

Number of Subjects Authorized: 200

Please read the entire application. Missing information will delay approval!

I. PROJECT FUNDED BY: LA Board of Regents-RCS LSU proposal #: 39812

II. PROJECT STATUS: Check the appropriate blank(s); and complete the following:

- 1. Active, subject enrollment continuing; # subjects enrolled: \_\_\_\_\_
- 2. Active, subject enrollment complete; # subjects enrolled: \_\_\_\_\_
- 3. Active, subject enrollment complete; work with subjects continues.
- 4. Active, work with subjects complete; data analysis in progress.
- 5. Project start postponed
- 6. Project complete; end date 1/1/14
- 7. Project cancelled: no human subjects used.

III. PROTOCOL: (Check one).

- Protocol continues as previously approved
- Changes are requested\*
  - List (on separate sheet) any changes to approved protocol.

IV. UNEXPECTED PROBLEMS: (did anything occur that increased risks to participants):

- > State number of events since study inception: 0 since last report: \_\_\_\_\_
- > If such events occurred, describe them and how they affect risks in your study, in an attached report.
- > Have there been any previously unreported events? Y/N N?  
(if YES, attach report describing event and any corrective action).

V. CONSENT FORM AND RISK/BENEFIT RATIO:

- Does new knowledge or adverse events change the risk/benefit ratio? Y/N N;
- Is a corresponding change in the consent form needed? Y/N N

VI. ATTACH A BRIEF, FACTUAL SUMMARY of project progress/results to show continued participation of subjects is justified; or to provide a final report on project findings.

VII. ATTACH CURRENT CONSENT FORM (only if subject enrollment is continuing); and check the appropriate blank:

- 1. Form is unchanged since last approved
- 2. Approval of revision requested herewith: (identify changes)

Signature of Principal Investigator: \_\_\_\_\_

Date: 1-3-14

IRB Action:	<input type="checkbox"/> Continuation approved; Approval Expires: <u>2/3/15</u>
	<input type="checkbox"/> Disapproved
	<input checked="" type="checkbox"/> File closed
Signed _____	Date <u>2/4/14</u>

Form date: April 16, 2008

February 3, 2014

To Whom It May Concern:

This letter is meant to detail our completion of the project entitled "Understanding Negative Symptoms in Schizophrenia Using Novel Technologies". We have successfully recruited subjects for this study, and have concluded the bulk of the data processing and analysis. It is the case that analysis of our data will likely continue, however, no new data will be collected. There have been no changes to the protocol or problems.

Please do not hesitate to contact me if you need any additional information,

Thanks,



Alex Cohen, Ph.D.  
Associate Professor  
Department of Psychology  
Louisiana State University  
224 Audubon Hall  
Baton Rouge, LA 708080

email: [acohen@lsu.edu](mailto:acohen@lsu.edu)  
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fax: 225.578.4125



Kathleen Babineaux Blanco  
GOVERNOR

STATE OF LOUISIANA  
DEPARTMENT OF HEALTH AND HOSPITALS



Frederick P. Cerise, M.D., M.P.H.  
SECRETARY

Louisiana Department of Health and Hospitals  
Institutional Review Board  
Notice of Review: Projects Using Human Subjects

**Project Title:** Computerized Assessment of Negative Symptoms

**Principal Investigator:** Alex S. Cohen, Ph.D.

**Date:** 02/13/2007

- 
1. In accordance with Louisiana Department of Health and Hospitals Institutional Review Board guidelines and practices the above research has been reviewed and APPROVED on this date. The research is subject to continuing review and any conditions listed in the comments section below.
2. In accordance with Louisiana Department of Health and Hospitals Institutional Review Board guidelines and practices the above research has been reviewed and found to be DEFICIENT for reasons listed in comments section below.
3. In accordance with Louisiana Department of Health and Hospitals Institutional Review Board guidelines and practices the above research has been reviewed and APPROVED via Expedited Review procedures.
4. In accordance with Louisiana Department of Health and Hospitals Institutional Review Board guidelines and practices the above research has been reviewed and found to be EXEMPT from further IRB review.

COMMENTS: Project is approved by the Louisiana State University Institutional Review Board and is supported by the Baton Rouge Mental Health Center.

Thank you for your submission. Please contact me at (225) 342-6401 or [JDNewsom@dhh.la.gov](mailto:JDNewsom@dhh.la.gov) if we can be of any further assistance.

John D. Newsom, II, MA, CPM  
Chair, DHH IRB

c: Sheila Bridgewater

OFFICE OF THE SECRETARY  
1201 CAPITOL ACCESS ROAD • P.O. BOX 629 • BATON ROUGE, LOUISIANA 70821-0629  
PHONE #: 225/342-9509 • FAX #: 225/342-5568  
"AN EQUAL OPPORTUNITY EMPLOYER"

## VITA

Thanh P. Le, originally from Los Angeles, California, completed his Bachelor of Science in Psychology from the University of California, San Diego in 2011. During his undergraduate studies, he worked in two research labs examining the effects of alcohol and substance use in adolescents. Prior to attending graduate school at Louisiana State University, Thanh worked as a Research Assistant for Dr. Eric Granholm's Recovery Research Center at the Veterans Affairs San Diego Healthcare System studying the efficacy of Cognitive Behavioral Social Skills Training as an intervention for patients with schizophrenia. Thanh's interest in clinical psychology, social functioning, and schizophrenia led him to Louisiana State University where he is currently studying to complete his Doctor of Philosophy in Clinical Psychology under the supervision of Dr. Alex S. Cohen. Thanh's current research interests include utilizing a multimodal approach (i.e., behavioral, digital, and objective measures) to investigate the cognitive and affective mechanisms underlying communication and social functioning deficits in individuals with schizophrenia.