2013

An examination of speech characteristics under conditions of affective reactivity and variable cognitive load as distinguishing feigned and genuine schizophrenia

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AN EXAMINATION OF SPEECH CHARACTERISTICS UNDER CONDITIONS OF AFFECTIVE REACTIVITY AND VARIABLE COGNITIVE LOAD AS DISTINGUISHING FEIGNED AND GENUINE SCHIZOPHRENIA

A Dissertation

Submitted to the Graduate Faculty of
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by
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December 2013

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ABSTRACT

Proper assessment of schizophrenia is complicated by the need for clinicians to be cognizant of the possibility of malingering, i.e., the intentional production of false or grossly exaggerated symptoms, motivated by external incentives. Current standardized schizophrenia malingering detection methods rely on endorsement of improbable or exaggerated, mainly positive, symptoms. However, these detection methods may be vulnerable to successful manipulation by sophisticated malingerers, particularly if coached regarding response style assessment strategies. This paper explored the utility of supplementalvariables to examine in schizophrenia malingering detection by using a simulation study design to compare schizophrenia patients, a community participant sample instructed to feign schizophrenia symptoms, and an honest responder control group on behavioral speech characteristics indicative of thought disorganization (i.e., referential disturbances) and negative symptoms (i.e., alogia and flat affect) under experimentally-manipulated conditions of affective reactivity and cognitive load. Results indicated that the feigning group was distinguishable from the schizophrenia group based on differences in magnitude of speech disorganization during conditions of affective reactivity, due to feigners' inability to mimic the schizophrenia group's referential failures, andin magnitude of flat affect during conditions of affective reactivity and cognitive load, due to feigners' excessively impaired use of formant inflection(i.e., vocal inflection related to tongue movement). Feigning and schizophrenia groups were also distinguishable due to feigners' excessive impairment in cognitive task performance, observed both in group comparisons and differential patterns of change in cognitive task accuracy across cognitive load conditions.

INTRODUCTION

This study examined the utility of analyzing behavioral speech characteristics indicative of thought disorganization (i.e., referential disturbances) and negative symptoms (i.e., alogia and flat affect) under experimentally-manipulated conditions of affective reactivity and cognitive load as a potential means to increase accuracy of identification of individuals feigning schizophrenia, using a simulation study design.The introduction begins with a brief overview of schizophrenia and its heterogeneous symptom factors. The introduction then goes on to discuss the issue of malingering of schizophrenia, its current methods of detection, and limitations of those methods. The paper then proposes an alternative method of schizophrenia malingering detection to supplement the focus of existing standardized measures on self-report of improbable or exaggerated, mainly positive, symptoms, by examining behavioral indications of disorganization or negative symptoms under variable conditions of affective and cognitive load, using the Communications Disturbance Index (Docherty, DeRosa, & Andreasen, 1996) and Computerized Assessment of Natural Speech (Cohen, Hong, & Guevara, 2010; Cohen, Minor, Najolia, & Hong, 2009).

Schizophrenia

Schizophrenia is a massively debilitating mental disorder, with lifetime population prevalence estimates ranging from .5 to 1%, and estimates of economic and societal burdens exceeding those of most other physical and mental illnesses (Bhugra, 2005). Typical age of onset ranges from late teens to mid-30s, with onset prior to adolescence very rare (American Psychiatric Association (APA), 2000).Schizophrenia is operationally defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; APA, 2000)by the presence of two or more of the following symptoms: delusions, hallucinations, disorganized speech, grossly disorganized or catatonic behavior, and negative symptoms. A well-accepted taxonomy of symptom clusters separates heterogeneous symptoms of schizophrenia into three empirically derived and validated factor domains representing positive, negative, and disorganization symptom complexes (see Buchanan & Carpenter, 1994, for a review of factor-analytic studies resulting in this general symptom cluster organization model). Positive symptoms include delusions, hallucinations, and inappropriate affect; negative symptoms include blunted affect, anhedonia, avolition, apathy, and alogia; and disorganization symptoms include inappropriate affect, and disorganized speech and behavior. Clinical presentation of these symptoms, though, is heterogeneous, with symptom focus varying across individuals within the disorder (e.g., Dollfus & Brazo, 1997; Tsuang, Lyons, & Faraone, 1990).

Researchers have not yetidentified a single disease process distinct to all schizophrenia patients, and various genetic and environmental risk factors identified thus far do not occur systematically among patients. Instead, most current etiological theories posit a multifactorial thresholdmodel of inheritance, whereby a large number ofpolygenes and nonshared environmental experiences, not yet completely identified, haveinterchangeable and additive effects on the risk for schizophrenia, which is thought to develop once some additive threshold is reached (see Lazar, Neufeld, & Cain, 2011, for a review). However, over the past two decades, researchers have begun searching for so-called endophenotypes—markers of schizophrenia that are stable across symptom presentation, are present in family members, and represent an underlying neurological vulnerability marker for the disorder (see Allen, Griss, Folley, Hawkins, & Pearlson, 2009; and Lazar, et al., 2011, for reviews). Such proposed endophenotypes include abnormalities in certain neuromotor functions such as smooth pursuit and saccadic eye movements,and deficits in neuropsychological performance onmeasures of attention and executive functioning such as the Continuous Performance Test (Cornblatt, Risch, Faris, Friedman, & Erlenmeyer-Kimling, 1988) and the Wisconsin Card Sorting Task(Heaton, 1981). As discussed in further detail below, although not yet recognized as endophenotypes, certainspeech characteristics such as referential disturbances(Docherty, Cohen, Nienow, Dinzeo, & Dangelmaier, 2003), flat affect, and alogia(Cohen, Kim, &Najolia, 2013), have shown promise as possible stable markers of underlying schizophrenia spectrum disorders, and may serve as tools to increase the accuracy of distinguishing individuals with genuine schizophrenia from malingerers.

Malingering of Schizophrenia

In addition to schizophrenia's heterogeneous clinical presentation, proper assessment of the disorder is further complicated by the need for clinicians to be cognizant of the possibility of malingering, defined by the DSM-IV-TR as "the intentional production of false or grossly exaggerated physical or psychological symptoms, motivated by external incentives" (APA, 2000, p. 739). These external incentives fall across two broad categories: (i) circumvention of difficult situations (e.g., incarceration or military service); and (ii) acquisition of compensation (e.g., disability benefits) or medication(Resnick & Knoll, 2008).Exact prevalence rates of psychosis malingering are lacking (Rogers, 2008a), in part due to methodological limitations in establishing rates of inherently deceptive behavior, which requires specific systematic application of identification procedures. In other words, it is difficult to establish base rates of malingering of psychosis because only those who are unsuccessful in their attempts to malinger can be included in prevalence estimates, and there may be more or less of an emphasis on systematic detection in certain environments, such as forensic versus non-forensic populations(Resnick & Knoll, 2008). Standard deviations in reported base rates are quite high across forensic settings (SD = 14.4%; Rogers, Salekin, Sewell, Goldstein, & Leonard, 1998), with prevalence estimates ranging from 10-30% to as high as 50% when certain screening measures are used (Rogers, 2008c). Although direct costs of malingering of psychosis cannot be precisely quantified due to the difficulty in establishing prevalence rates, estimated costs of health insurance fraud (including malingering of physical and psychological disorders) ranges from $59 billion (in 1995) to $150 billion (reported in 2007) annually, resulting in $1050 - $1800 in increased premiums for the average family in America (Garriga, 2007; LoPiccolo, et al., 1999). In addition, malingering causes bottlenecks in the courts, and may prevent truly ill patients from accessing limited mental health resources (Garriga, 2007).

Furthermore, it has been suggested that regardless of its true prevalence, rates of malingering may be expected to increase. As larger numbers of mentally ill individualsfind themselves in situations in which mental health resources are scarce (e.g., homelessness, states in which community mental health funding has been drastically reduced, prison), such individuals may be incentivized to grossly exaggerate symptoms in order to secure treatment or housing (Resnick & Knoll, 2008). With regard to this issue, it is important for clinicians not to fall prey to the misconception that malingering precludes the possibility that a genuine underlying psychological disorder is present (Resnick & Knoll, 2008; Rogers, 2008c), an issue that further complicates differentiation of individuals who are truly in need of care from those without a genuine mental illness.

Current methods of assessment ofmalingering of schizophrenia

The DSM-IV-TR classifies malingering as an “additional condition[] that may be a focus of clinical attention” (i.e., a “v-code” classification) (APA, 2000, p. 739). It suggests that malingering should be “strongly suspected” if any combination of the following criteria is present: (i) medicolegal context of presentation; (ii) marked discrepancy between the person's claimed stress or disability and objective findings; (iii) lack of cooperation during the diagnostic evaluation and in complying with the prescribed treatment regimen; or (iv) the presence of antisocial personality disorder. However, this "criminological model," based on the assumption that malingering is an antisocial act likely to be committed by antisocial individuals, is logically flawed and unacceptably overestimates the presence of malingering because it merely identifies common characteristics of malingerers (which could also be present in non-malingering criminals) rather than factors that reliably distinguish malingerers from non-malingerers(Resnick & Knoll, 2008; Rogers, 2008b, 2008c). In fact, the actual false-positive rate that would result from identification of malingerers based solely on DSM-IV-TR criteria may exceed 200% (Rogers, 1990, 2008b).

Instead, Rogers (2008c)proposes that all response styles, including malingering, are best conceptualized within a framework of "predicted utility" of truthfulness versus deceptiveness (i.e., any attempts by individuals to distort or misrepresent self-report), which can vary from situation to situation. Due to this variability in predicted utility of deceptiveness across situations or even at various time points within a situation, patterns of dissimulation are therefore more appropriately termed "response sets," i.e., a temporary and context-specific style, than "response styles," a more enduring person-centered tendency to respond in a certain way across situations (Otto, 2008). However, in order to maintain consistency with the majority of the malingering literature, this paper will refer to these deliberate distortions in self-report as "response styles," regardless of variability across contexts.

Given the limitations of the assessment approach indicated by suggested DSM-IV criteria, Rogers(2008b) proposes that proper malingering detection strategies should instead utilize “a standardized method that is conceptually based and empirically validated [optimally through use of both simulation designs and known-groups comparisons, as explained in greater detail below] for systematically differentiating a specific response style (e.g., malingering or defensiveness) from other response styles (e.g., honest responding)” (p. 16, italics removed).(See also Rogers, 2008e, for an in-depth discussion of the limitations of unstandardized clinical malingering assessments.) Rogers’ proposal that malingering detection strategies should be based on empirically-validated standardized measures is consistent with the broader position of researchers (e.g., Grove & Meehl, 1996)who insist more generally that structured clinical measures are crucial for improving reliability and accuracy of diagnosis. The importance of utilizing such standardized measures to bolster the accuracy of clinical judgment in the assessment of malingering is highlighted by the classic Rosenhan (1973)study in which eight individuals feigning atypical auditory hallucinations were admitted as psychiatric inpatients diagnosed with schizophrenia and remained hospitalized for periods ranging from 9 to 52 days, despite the fact that they ceased simulating any psychotic symptoms upon admission.Yet a large portion of the literature directed to clinical practitioners regarding the detection of malingering of psychosis continues to focus on educating clinicians about informal detection strategies based on in-depth understanding of typical content and presentation style of positive psychotic symptoms (i.e., hallucinations and delusions) (e.g., Resnick, 1993; Resnick & Knoll, 2008).While understanding of typical positive symptom presentation has undoubtedly advanced since the Rosenhan (1973)study, many clinicians remain reluctant to identify malingering, which may be based in part on fear of litigation and the drastic negative consequences forindividuals misclassified, including denial of care and stigma (Resnick & Knoll, 2008). Again, the uncertainty surrounding identification of malingering of psychosis underscores the importance of a systematic detection approach, as opposed to relying on a global clinical impression (Resnick & Knoll, 2008). Improvement of standardized detection methods, including broadening of detection methods beyond the current focus of standardized measures on self-report of primarily positive symptoms, may alleviate some of this burden on subjective clinical judgment.

It is important to keep in mind, however, that even standardized test protocolsremain tools only, to which clinical expertise and idiopathic contextual knowledge must be applied in interpretation. Standardized measurescan only be used to suggestdissimulation or feigning, i.e., "the deliberate fabrication or gross exaggeration of psychological or physical symptoms *without any assumptions about its goals*" (Rogers, 2008c, p. 5, italics added; Rogers & Bender, 2003). Psychological tests therefore can only indicate the likely presence of an exaggerated or fabricated response style, and cannot be used to conclusively establish malingering, or provide a differential diagnosis with regard to the possibility of factious disorders (i.e., feigning motivated by the desire to assume a "sick role"), conversion disorders, or other disorders that might typically present with symptom endorsement styles of an exaggerated nature such as borderline personality disorder(APA, 2000). These diagnostic distinctions necessitate the application of clinical judgment regarding the likely motivation for a feigning response style(Otto, 2008). As such, the procedures proposed herein refer to detection of a feigning response style, not "malingering" per se. Furthermore, as noted above, even if malingering is clinically identified, malingering and mental illness are not mutually exclusive(Resnick & Knoll, 2008; Rogers, 2008c). One advantage of examining the variables measuredin this study, as described in greater detail below, is that it combines measurement of response style patterns that are both predicted to be present in malingerers but not genuine schizophrenia patients with response style patterns that are predicted to be present in genuine schizophrenia patients but not in malingerers, thus simultaneously providing a rich assessment ofevaluation presentation characteristics indicating both malingering and genuine presence of the disorder.

Currently utilized assessment tools. Current standardized methods to assess malingering of psychosis generally examine content of self-report in relationship to positive symptoms of psychosis (i.e., hallucinations and delusions). These measures seek to identify one of two broad categories of response styles thought to be indicative of malingering: unlikely presentations (including rare symptoms, quasi rare symptoms, improbable symptoms, symptom combinations, and spurious patterns of psychopathology); and amplified presentations in terms of frequency and intensity of symptoms and endorsement of symptoms that may appear plausible to malingerers based on general misconceptions about mental illness (including indiscriminant symptom endorsement, symptom severity, obvious symptoms, reported versus observed symptoms, and erroneous stereotypes) (see Rogers, 2008b, for an in-depth description of the strengths and limitations of each of these assessment strategies).

Rogers (2008a)cites the unlikely presentation of rare symptoms, which focuses on a high endorsement rate among malingerers on self-report items that are endorsed by less than 5% of individuals with actual disorders and yields large to very large effect sizes, as the "work horse" among currentmethods of assessment of feigned mental disorders(p. 392). Examples of scales using this approachcontained in measures designed specifically to detect malingering of mental disorders include the Rare Symptoms scale of the Structured Interview of Reported Symptoms (SIRS; Rogers, Bagby, & Dickens, 1992)and Unusual Hallucinations scale of the Miller Forensic Assessment of Symptoms (M-FAST; Miller, 2001). (For an in-depth discussions of the more extensive SIRS, which utilizes several of the response style assessment methods cited above, see Rogers, 2008e.For a review ofbrief screening measures such as the M-FAST, as well as theM Test (Beaber, Marston, Michelli, & Mills, 1985)and Structured Inventory of Malingered Symptomatology(Smith & Burger, 1997), seeSmith, 2008.)In addition, identification of unlikely presentation of rare symptoms is also the key detection method of theNegative Impression Management scale of the Personality Assessment Inventory (NIM scale of the PAI; Morey, 2007) and the F-psychiatric scale of the Minnesota Multiphasic Personality Inventory-2 (MMPI-2;Hathaway, McKinley, & Butcher, 1990)(Rogers, 2008b). (For a more in-depth review of malingering assessment using the embedded scales of the MMPI-2 and PAI, see Greene, 2008, andSellbom & Bagby, 2008, respectively.) The rare symptoms method is contrasted with the "quasi-rare symptoms" method, such as is utilized by the MMPI-2 F and F-back scales, which focuses on symptoms that are rare in normative populations, and may result in unacceptable levels of false positives due to the fact that individuals with genuine disorders may also endorse such symptoms. It may also be contrasted with the improbable symptom method, such as is utilized by the SIRS Improbable and Absurd Symptoms scale, which represents an extreme version of rare symptoms by focusing on fantastic or preposterous symptoms, but may lead to a high rate of false negatives among sophisticated malingerers due to the high face validity of these items(Rogers, 2008b). Projective measures, such as the Rorschach(Rorschach, 1921), while once thought to be impervious to deliberate response distortion due to their lack of face validity, have been generally demonstrated to be wholly unsuccessful at identifying malingering (see Sewell, 2008, for a review).

Self-report of improbable or grossly exaggerated positive symptomology may be most useful in detecting unsophisticated obvious attempts at malingering. While "[m]alingerers with relatively poor understanding of the phenomenology of genuine psychosis may be readily detected…malingerers who possess shrewdness and detailed knowledge of psychosis may deceive even seasoned forensic clinicians"(Resnick & Knoll, 2008, p. 51). For example, the specificity and positive predictive power of the SIRS, which has been termed the "gold standard" in malingering detection (Rogers, 2008e), are reported as 99.5% and 99%, respectively; but sensitivity and negative predictive power are reported at only 48.5% and 64.9% (in a population with a malingering base rate of 51%), respectively (Green, Rosenfeld, Dole, Pivovarova, & Zapf, 2008; Rogers, Bagby,& Dickens, 1992;see also Sellbom & Bagby, 2008, discussing the limitations of the PAI NIM scale in detecting sophisticated malingerers).

Importantly, coaching about response style detection methods can affect the results of many of these tests (Chesterman, Terbeck, & Vaughan, 2008;Rogers, 2008a).For example, many studies have found that being provided with information about the validity scales of the MMPI-2 helps simulators avoid detection (Greene, 2008).Furthermore, increased dissemination of strategies to avoid detection via the Internet continues to increase the risk that coaching may adversely affect the sensitivity of these existing measures that rely solely on explicit symptom endorsement (an issue suggested for future research by Smith (2008)). As illustration, a simple online search for "schizophrenia malingering" using Google's search engine revealed publicly-accessible, easily-understandable detailed information about symptoms endorsed by individuals with genuine psychosis, and a test-by-test description of specific malingering detection strategies, including feigned symptomsthat distinguish malingerers, within the first three search results (e.g., Detecting Malingering,retrieved 8/17/11).

Examining Behaviorally-Based Speech Characteristics Under Controlled Conditions of Variable Affective and Cognitive Load to Identify Feigning of Schizophrenia

It has been noted by anecdotal clinical observation(Resnick, 1993; Resnick & Knoll, 2008)that the self-reported content of delusions and hallucinations are generally the focus of malingerers' self-report as they are easier to feign due to their obvious nature; but malingerers rarely attempt to feign other important symptoms of schizophrenia, such as formal thought disorder or more subtle negative symptoms such as flat affect and alogia. Yet despite the emphasis placed on clinical recognition of the incongruence of reporting significant positive symptomsin the absence of these other signs of schizophrenia as a red flag for the identification of malingering (e.g., Resnick & Knoll, 2008), there is very little research examining the usefulness of capitalizing on this phenomenon in malingering detection in a more structured manner, and no indication that any standardized assessment of disorganization or negative symptoms has been incorporated into malingering assessment in clinical practice as part of anyroutinely utilized systemized procedures.

This paper thus examinedthrough empirical means this persistent clinical observation that malingerers self-report assumed content of positive symptoms but rarely exhibit thought disorganization or negative symptoms, by analyzing speech characteristics indicative of thought disorganization, alogia, and flat affect under experimentally-manipulated conditions of affective reactivity andcognitive load. A particular strength of this approach to malingering assessment is that it makes use of two detection strategies—symptom combinations and spurious patterns of psychopathology—which have been proposed asespecially useful in combating the effects of coaching, as the complex *patterns* of symptoms found in genuine disorders may be too difficult for even sophisticated malingerers to effectively deliberately feign (Rogers, 2008a). Furthermore, increasing cognitive load may have a similar effect to the recommend lengthy interview (i.e., intended to capitalize on the fact that as malingerers become fatigued it is more difficult to consistently maintain feigned symptoms) (e.g., Resnick, 1993; Resnick & Knoll, 2008); but within a much shorter time frame and in a more structured manner. In addition, while the behavioral pattern of speech performance under variable levels of cognitive load provides the key elements for this proposed method of malingering detection, research indicates that individuals feigning psychosis frequently also attempt to feign cognitive impairment (Resnick & Knoll, 2008). Thus, the cognitive tests themselves may provide yet another dimension of malingering assessment, based on a detection strategy with elements of the performance curve (i.e., based on the finding that genuine patients produce predictable patterns of errors with increased item difficulty, while malingerers usually demonstrate much less of a distinction between easy and difficult items) and floor effect (i.e., based on the finding that some malingerers do not recognize that simple cognitive tasks could be completed by impaired individuals) methods of assessment of feigned cognitive impairment (see Rogers, 2008b, for an in-depth review of the strengths and limitations of detection strategies used to assess feigned cognitive impairment).

Communication Disturbances Index

Communication disturbances are a fundamental symptom ofdisorders marked by disordered thought processes, including schizophrenia and mania(Docherty, DeRosa, et al., 1996). Docherty's(2005) research supports a model whereby communication failures are a behavioral manifestation of speech disorder that results from the overlapping but conceptually distinct constructs of thought disorder, disorganization, and neurocognitive impairments.

This paper measured communication disturbance(CD) in terms of deficits in clarity of meaning of speech through use of the Communication Disturbances Index (CDI; Docherty, DeRosa, et al., 1996), a method of identifying subtle forms of referential failuresin natural language that has revealed consistent differences between schizophrenia patients and controls, particularly under conditions of emotional stress. The CDI rates severity of communication disturbance along six dimensions of referential failure (vague references, confused references, missing information, ambiguous word meanings, wrong word references, and structural unclarities), to arrive at a total communication disturbances score, as described in greater detail below (see Methods). It has been proposed that these types of referential failures may reflect: (1) lack of awareness or attention to the listener's needs in understanding a communication—i.e., an assumption that the listener will understand the speaker's thoughts without being told, (2) errors in distinguishing between previous communications and previous thoughts, or (3) confusion among referents; all of which may reflect disturbances in the patient's understanding of boundaries between the speaker and listener, between the patient's inner world and the outer world, or among people or objects(Docherty, 1995).

In affectively-neutral conditions (i.e., interviews using open-ended questions about daily activities, routines, hobbies, leisure activities),use of the CDI has revealed significantly higher rates of CD among schizophrenia patients as compared to nonpsychiatriccontrols (Docherty, 2005; Docherty, et al., 2003), with effect sizes (Cohen's *d*)ranging from .98 – 1.14. It is noteworthy that this magnitude of difference is consistent with effect sizes suggested by Rogers (2008b) as key for obtaining systematic differentiation of response styles (moderate = Cohen's $d \geq 0.75$; large ≥ 1.25; very large ≥ 1.50).CDI scores have been shown to be correlated with formal thought disorder and conceptual disorganization ratings, in addition to cognitive deficits (Docherty, 2005). CDI scores have demonstrated good temporal stability over two weeks and nine months, regardless of positive or negative symptom fluctuations(Docherty, et al., 2003). It is notable that CD in the Docherty, et al. (2003) study showed greater stability than broader clinical formal thought disorder ratings. In addition to the possibility that CDis more trait-like than formal thought disorder, these differences in stability also raise the possibility that the standardized method of examining referential failures using the CDI may provide important psychometric improvements over subjective clinician ratings, which may be subject to issues such as halo effects.

Communication disturbances under conditions of variable affective load. "Affective reactivity" refers to the phenomenon that speech disturbances have been shown to increase among schizophrenia patients under conditions of emotional stress (i.e., when discussing affectively negative topics) (e.g., Docherty, Rhinewine, Nienow, & Cohen, 2001). Importantly, use of the affective reactivity paradigm in examining CD has revealed specific patterns of CD exacerbation under affective strain that are unique to schizophrenia. While the temporal stability of CD in schizophrenia (Docherty, et al., 2003) and similarities between schizophrenia patients and first-degree relatives (Docherty, 1995) under affectively neutral conditions may "support the idea that referential disturbances reflect stable, trait-like cognitive characteristics of patients, characteristics that may actually be related to vulnerability more than to overt illness" (Docherty, et al., 2003, p.474), schizophrenia patients show more affective reactivity (i.e., increased CD under unpleasant emotion conditions) than their parents or controls(Docherty, Hall, & Gordinier, 1998). These results have been interpreted to suggest that "reactivity of referential communication disturbances may reflect normal processes that are exaggerated in schizophrenia" (p. 465). Interestingly, while controls in the Docherty et al. (1998) study did demonstrate some increase in CD in the affectively unpleasant condition, parents did not demonstrate any significant differences in going from the pleasant to unpleasant condition, which the authors note may reflect a protective factor among non-psychiatric individuals with possible genetic vulnerability to schizophrenia spectrum disorders. Similarly, while depressed patients demonstrated higher levels of CD than controls using the CDI, schizophrenia patients still demonstrated more frequent total referential failures than depressed patients; and only schizophrenia patients, but not depressed patients,demonstrated increased CD due to affective reactivity(Rubino et al., 2011). Relatedly, while baseline rates of CD are not associated with positive symptom severity, magnitude of increase in CD under conditions of affective reactivity are (Docherty & Hebert, 1997).

With regard to its potential utility as a tool to assist in the detection of malingering, examination of referential failures using the CDI maybe a more sensitive measure than other communication disturbance measures that focus on broad manifestations of thought disorder, such as topic changes and circumstantiality(e.g., the Scale for Assessment of Thought, Language, and Communication (Andreasen, 1986)). (See Docherty, 2005, for a more in-depth comparison of communication disturbances as examined through referential failures with measures of thought disorder and disorganization that focus on speech behavior more likely to reflect loose associations, such as topic derailment; see also Kerns, 2007.) Broad disorganization symptomssuch as blatant tangentiality may be more likely to be seen in malingerers attempting to "[t]alk stupid, dumb, and crazy…[and not] complete sentences…" (quoted from a letter from an identified malingerer to his incarcerated girlfriend, instructing her to "[s]tart talking about any- and everything. Keep changing subjects," (Resnick & Knoll, 2008, p. 65)). By contrast, malingerers may be less likely to understand how to feign more subtle referential failures. Thus, whenResnick and Knoll (2008) have cautioned clinicians to be alert to the possibility of malingering in the absence of signs of formal thought disorder, these more subtle signs of communication disturbance may have also contributed to their clinical impressions. The CDI provides a useful means to quantify such clinical impressionsof subtle behavioral signs to allow for rigorous empirical comparison between groups.

Communication disturbances under conditions of variable cognitive load. Another standardized conditional manipulation that could reveal important differences between malingerers and genuine schizophrenia patients is cognitive load manipulation. First, with regard to the cognitive tasks themselves, Kertzman et al.(2006) compared performance of genuine schizophrenia patients and suspected malingers on two tasks of variable cognitive load—the first was a simple visual reaction time task that required participants to press a red key every time a red square was displayed on a screen, and the second was a visual choice reaction time task required participations to press a red key if a red square was displayed and a black key if a black square was displayed. Not only did the malingering group perform significantly worse than the schizophrenia group across the dependent variables (reaction time, variability in reaction time, and accuracy) in both conditions; but, more importantly, the malingering group demonstrated the opposite pattern from the schizophrenia group when comparing the lower to higher cognitive load. While the schizophrenia group's performance was worse on the second, more difficult task, the malingerers' performance was worse on the first, easier task. These results are consistent with research indicating that individuals feigning psychosis frequently also attempt to feign cognitive impairment (Resnick & Knoll, 2008). Furthermore, this design takes advantage of more sophisticated methodology by comparing malingerers and genuine patients not just on severity of cognitive deficits, but also on *patterns* of cognitive performance on tasks of varying difficulty. Only *t*-tests were performed in this study comparing the two groups, and thus significance of the directional within-group between tasks differences and the group by task condition interaction are unknown; but the direction of the low-to-high load condition cognitive performance patterns suggests an interesting element of information that could be added to a malingering assessment procedure. The presentstudy expanded on this paradigm by simultaneously assessing patterns of cognitive performance and verbal behavior under variable loads of working memory demand.

Pursuant to “cognitive load theory,” subtle forms of communication disturbances characteristic of schizophrenia should be exacerbated under conditions of high cognitive load.Cognitive load theory originated as a framework for maximizing the efficiency of the learning process by facilitating changes in long term memory through minimization of extraneous working memory load (see Paas, Van Gog, & Sweller, 2010; and Sweller, 2010, for reviews). The theory is based, in part, on recognition of the well-established fact that working memory, the site of conscious information processing, is very limited in capacitywhen processing novel information(Baddeley, 1986; Miller, 1956). Thus, reducing working memory load provides for more efficient cognitive processing. Over the past decade, a handful of schizophrenia-spectrum disorder researchers have begun to use this concept of manipulation of working memory load to achieve the opposite goal—i.e., straining cognitive processing capacity—in order to experimentally exacerbate and thus gain greater understanding of language and prosody dysfunction in the disorder (e.g., Melinder & Barch, 2003). While increased working memory load has been shown, to some extent, to decrease amount, rate, inflection, and intensity of speech in even healthy controls (Cohen, Morrison, Brown, & Minor, 2011), examination of speech dysfunction in schizophrenia under variable conditions of working memory load has revealed specific patterns in magnitude of exacerbation of diminished expressivity (Cohen, McGovern, Dinzeo, & Covington, manuscript in preparation; Melinder & Barch, 2003). Additionally, although patterns of referential failures have generally been studied more extensively in the context of affective reactivity, research on the specific relationship between working memory and communication disturbances in schizophrenia spectrum disorders supports the proposition that examination of communication disturbance patterns under variable levels of cognitive load may also provide rich information in distinguishing genuine schizophrenia patients from feigners.

Melinder and Barch(2003) found thatwhat they termed “negative thought disorder” (i.e., verbal productivity, syntactic complexity, poverty of speech, pausing, and blocking) increased among schizophrenia patients in a condition of high cognitive load (answering neutral open-ended questions while completing a forced-choice continuous performance task whereby participants pressed one key in response to a target word stimulus and another in response to other stimuli), as compared to a condition of low cognitive load(answering neutral open-ended questions, such as “describe a typical day for you”), butclinically-rated formal thought disorder (discourse coherence and fluency deficits) did not. In addition, they found that negative thought disorder and formal thought disorder were inversely relatedin the high load condition. The authors reasoned that this supports the theory that both types of speech disturbance reflect different manifestations of coping with basic working memory deficitsunder cognitively taxing situations. Relatedly, discourse coherence in this study (but not fluency) was correlated with performance during a non-speaking trial on the category monitoring task, which relies on maintenance of a target stimulus in memory, and negative thought disorder was correlated with performance on a speaking span task requiring generation of a sentence for provided word stimuli, which places demands on the ability to generate a message plan. This is consistent with previous research noted by the authors indicating that language production requires the simultaneous performance of several tasks, including generating a message plan, maintaining the message plan and prior discourse facts, and monitoring ongoing speech for errors (Levelt, 1989), some or all of which may require working memory performance (Daneman, 1991).

One limitation to the Melinder and Barch (2003) study that was addressed by the present study relates to how CD was measured. Formal thought disorderin the Melinder and Barch(2003) study was rated according to the Scale for the Assessment of Thought, Language, and Communication (Andreasen, 1986), which asks clinicians to rate the frequency of disturbances in discourse coherence (nonsequiturs, tangential responses, derailments, loss of a goal, distractibility, and pronominal reference errors), disturbances in fluency (neologisms, word approximations, incoherence), disturbances in content (perseverations and illogicality), and disturbances in social convention (poverty of content, circumstantiality).As noted, the CDI, by contrast, measures more subtle referential failures. Thus, difference in these more subtle referential failures could potentially be revealed by CDI scores across cognitive load conditions. In addition, the Melinder and Barch(2003) study compared performance on a free speech task to speech performance during a cognitive task with a single level of difficulty. By contrast, the "cognitive load" task used in this study compared speech performance during a free speech condition to speech performance during two separate cognitive tasks of varying working memory demand (one similar to that used in the Melinder and Barch(2003) study, and a second 1-back task that poses even higher working memory demands; see Methods), which could potentially reveal more intricate group difference in patterns of CD across cognitive load conditions. It also must be recalled that a key issue in this study was comparison of patterns of speech disturbance under varying levels of working memory load between genuine patients and feigners, whereas the Melinder and Barch(2003) study examined only within-group differences across cognitive load conditions among schizophrenia patients.

Research examining the cognitive correlates of CD using the CDI indicates that CD is strongly related to working memory deficits, and may thus be vulnerable to exacerbation under manipulation of working memory load. The CDI has been shown to be related to more basic cognitive deficits in schizophrenia, including sustained attention on two visual continuous performance tasks on which participants were instructed to press a button every time a target digit appeared (one with difficulty level increased by visual degradation of the stimuli), two trail-making sequencing tasks of variable working memory load(one requiring participants to link numbers sequentially, e.g., 1…2…3…, the second requiring participant to alternately link numbers and letters sequentially), and the conceptual sequencing subtest of the Shipley Institute of Living Scale(Shipley, 1940), which requires participants to complete sequences of numbers or letters based on different implicit conceptual organization methods(Docherty, 2005; see also Kerns, 2007; andKerns & Berenbaum, 2003, finding a link between working memory/n-back task performance deficits and CD in schizophrenia). Interestingly, neither clinically-rated formal thought disorder, as measured using the Global Thought Disorder subscale from the Scale for Assessment of Positive Symptoms(Andreasen, 1983), which measures broad manifestations of thought disorder such as derailment, pressure of speech, tangentiality, circumstantiality, illogicality, distractibility, clang associations, and incoherence, nor clinically-rated conceptual disorganization, measured using Conceptual Disorganization subscale of the Brief Psychiatric Rating Scale(Overall & Gorham, 1962), which asks clinicians to rate the extent to which speech is structurally disorganized, were correlated with these basic working memory measures. Only the two trail-making sequencing tests were correlated with CDI scores among controls—the two sustained visual attention tasks, which are much more similar to the cognitive tasks that were utilized in this study, were not.Similarly, in a prior study, Docherty et al.(1996) found that among schizophrenia patients referential failures were associated with working memory deficits but not concept formation and verbal fluency; whereas among individuals with bipolar disorder or non-psychiatric controls, referential failures were associated with concept formation and verbal fluency, but not working memory deficits. Furthermore, Docherty(2005) found that simple working memory deficits remained significantly related to CDI scores even after ratings of global level of functioning and global severity of illness were controlled for using hierarchical regression analysis. (After entering low-load attention measures into the hierarchical model, high-load versions of the same task did not explain significant amounts of additional variability in the Docherty (2005) study, but this is likely due to the large amount of shared variance attributed to the low-load condition.)

Interestingly, research among schizotypal participants, i.e., individuals who are theorized to be at-risk for development of schizophrenia-spectrum disorders, suggests that the increase in CD found when discussing unpleasant memories using the affective reactivity paradigm (see above) may actually reflect underlying attention deficits. Kerns and Becker (2008) found that working memory deficits were associated with affective reactivity of CD in individuals with elevated disorganized schizotypy symptoms, and that after controlling for working memory deficits schizotypy and control group differences in CD were no longer significant. Therefore, manipulating working memory load by having participants provide free speech samples while simultaneously completing cognitive tasks that deplete working memory resources may provide a more direct means of exacerbating schizophrenia-spectrum related CD than the affective reactivity paradigm, which requires participants to subjectively appraise the unpleasant emotional condition as “stressful” in order for group differences in CD to be revealed (Docherty & Grillon, 1995).

Flat affect and alogia as measured using the CANS procedure

Examination of negative speech-related schizophrenia symptoms may provide yet another dimension of richness to assessment of malingering in schizophrenia. Such symptoms include alogia (e.g., poverty of speech) and flat affect (e.g., lack of prosodic expressivity in speech). While these symptoms have traditionally been measured using Likert-type clinician rating scales such as the Scale for the Assessment of Negative Symptoms (Andreasen, 1984), over the past decade refinements have been made in utilizing more sophisticated computerized analysis protocols to more precisely measure verbal expressivity through examination of acoustic properties of speech, including alogia (operationalized by measuring periods of speech production versus pauses), and flat or blunted affect (operationalized by examining variability of volume and frequency) (Computerized Assessment of Natural Speech, or "CANS"; e.g., Cohen, et al., 2009, 2010).Generally, these variables have demonstrated moderate to good temporal stability over a week's period (Cohen, et al., 2013).

Utilization of computerized acoustic analysis to examine verbal expressivity provides significant improvement over use of clinical ratings, which are more vulnerable to imprecision due to global impression (Alpert, Shaw, Pouget, & Lim, 2002). Furthermore, computerized acoustic analysis of verbal expressivity may provide psychometric benefits for precision in use of parametric statistics, as it can produce normally-distributed ratio-level data, as compared to clinical ratings that often form skewed data distributions, are ordinal in nature, and are generally restricted in range (Cohen, Alpert, Nienow, Dinzeo, & Docherty, 2008).

Flat affect and alogia under conditions of variable affective load. In contrast to CD, a literature review revealed no existing published studies examining changes of in-the-moment vocal prosody or clinically-rated verbal expressivity in schizophrenia under experimentally-manipulated conditions of affective load. However, among healthy adults, high-arousal affectively-valenced autobiographical tasks have been associated with such prosody changes of small effect sizes (Cohen, et al., 2010). Furthermore, given the relationships in schizophrenia between working memory load and diminished verbal expressivity (Kerns, 2007), and between working memory deficits and affective reactivity of CD (Docherty, 2005; Docherty, Hawkins, et al., 1996; Kerns, 2007; Kerns & Berenbaum, 2003), it is logical that diminished expressivity may be subject to similar principles of affective reactivity.

Flat affect and alogia under conditions of variable cognitive load. As discussed above, Melinder and Barch(2003) found that clinician ratings of negative speech characteristics are exacerbated under conditions of higher cognitive load. Similarly, clinically-rated blunt affect and alogia are associated with exaggerated reduction in computer-analyzed expressivity in conditions of increased cognitive load among individuals with both schizophrenia and depression (Cohen, et al., 2013, manuscript in preparation). Furthermore, working memory deficits are associated with negative speech symptoms (see Kerns, 2007—working memory and controlled retrieval interacted to predict poverty of speech).

Study Design

Studies of feigning assessment measures generally utilize one of two main designs—the simulation design and known-groups comparisons (see generally Rogers, 2008c). Most research employs the simulation paradigm, an analog design by which community (or more often, undergraduate) participants are randomly assigned to an honest or feigning (i.e., instructed to attempt to present oneself "as if" a certain disorder were present) condition. The performances of these groups are then compared to the performance of a genuine clinical sample(i.e., individuals believed to actually have the disorder at issue). The simulation design provides strong internal validity due to its standardized method and partially experimental design, but weak external validity due to the low personal stakes of the artificial situation and resulting lack of motivation to successfully feign a disorderthat might be present in a true malingering context.

By contrast, a known-groups paradigm compares a genuine clinical sample and actual suspected malingerers, as identified by independent experts. As such, its validity rests on accurate *a priori* identification of malingering and clinical groups, and blindness of the researchers administering the target assessment test to participants' group membership. Assuming accurate classification of participants, although internal validity is weak due to the lack of experimental control, the known-groups comparison design provides strong external validity. Somewhat similar to the known-groups comparison is a bootstrapping comparison; but in the bootstrapping comparison design participants are placed in high-probability groups of feigners and genuine patients using stringent cut scores on previously-established measures of feigning instead of independent expert identification. However, malingering assessment methods supported by such designs run the risk of being clinically useful only in cases of extreme, unsophisticated malingering presentations. Alternatively, some researchers have utilized a differential prevalence design in an attempt to approximate the known groups design. This design compares performance on measures by individuals in different assessment or referral contexts (i.e., litigation v. non-litigation), based on the assumption that base rates of malingering will be higher in one group than the other, and therefore differences between the groups reflect differences in malingerers and non-malingerers. As noted by Rogers(2008c), "[s]uch simplistic thinking should not be tolerated in clinical research [and should not purport to identify utility estimates of a measure], although it may play a marginal role in advancing theory" (p. 11-12; see also Rogers, 2008d).

The present study employed a simulation design, which is consistent with Rogers' (2008d) recommendation that "[t]he logicalsequence of development of an assessment method[is] with simulation studies [which provide the advantages of comparative ease in obtaining participants and the ability to refine measures under systematic conditions] followed by known-groups comparisons…[which] are best used to cross-validate results of simulation studies"(p. 427).

Hypotheses

This study compared the speech characteristics of "honest" healthy controls (i.e., individuals instructed to complete the speech and cognitive performance tasks without special instruction), "feigners" (i.e., healthy controls instructed to complete the speech and cognitive performance tasks as if to convince an evaluator that they have schizophrenia), and a genuine schizophrenia group, under conditions of variable affective and cognitive load. It was expected that feigners would attempt to exaggerate cognitive deficits by intentionally performing poorly on the cognitive performance tasks, but would not be able to successfully feign the more subtle referential failures and expressivity deficits found in the schizophrenia group on either speech task. In both tasks, overall group differences and group differences in patterns of behavior when comparing conditions of low to high affective and cognitive load were examined. Specifically, it was hypothesized that:

I. When participants wereasked to speak about affectively-valenced topics, there would be:

a. significant main effectsfor participant group, such that the schizophrenia group would demonstrate significantly more overall referential failures on the CDI and expressivity deficits on the CANS than both the honest control group(Docherty, et al., 1998)and feigners (based on Resnick and Knoll's(2008)clinical observations), who would not differ from one another; and

b. significant interactions between group and affective condition variables, such that the magnitude of increase in referential failures on the CDI and expressivity deficits on the CANSfor the schizophrenia group in comparing the pleasant condition to the unpleasant condition and/or the low-arousal to high-arousal conditionwould be significantly largerthan for controls (Docherty, et al., 1998)orfeigners(Resnick & Knoll, 2008).

II. Similarly, when participants were asked to provide neutral speech samples while either performing no cognitive task or simultaneously performing cognitive tasks of variable working memory demand, there would be:

a. significant main effects for participant group, such that the schizophrenia group would demonstrate significantly more overall referential failures, alogia, and vocal prosody deficits than the honest control group(Docherty, 2005; Melinder & Barch, 2003) and feigners (Resnick & Knoll, 2008), who would not differ from one another; and

b. significant interactions between group and condition, such that the magnitude of increase in referential failuresfor the schizophrenia group as working memory load increased by task would be significantly larger than for controls

(Docherty, 2005) or feigners (Resnick & Knoll, 2008), as would the magnitude of increase in alogia and prosody deficits (Cohen, et al., manuscript in preparation; Melinder & Barch, 2003; Resnick & Knoll, 2008).

III. In addition, when participants were asked to complete cognitive performance tasks of variable working memory demand, there would be:

a. a significant group effect, such that the feigners would demonstrate poorer overall cognitive performance compared to the schizophrenia group (Kertzman, et al., 2006), who would in turn demonstrate poorer overall cognitive performance compared to the honest control group (Melinder & Barch, 2003); and

b. a significant interaction, such that the schizophrenia and honest control groups would perform worse during conditions of higherworking memory load than a lower working memory load condition; but feigners would perform worse during thelower load condition than a higherworking memory load condition (Kertzman, et al., 2006).

Thus, consistent with most current methods of malingering detection (Rogers, 2008b),cognitive performance outcome variables were expected to aid in identification of feigners because the feigners' deliberate attempts to appear mentally ill would reveal patterns that distinguish them from both genuine schizophrenia patients and controls, as they were expected to behave in ways that were irrelevant to or excessive in severity when compared to individuals with schizophrenia. By contrast, it was expected that vocal pattern differences under conditions of variable affective and cognitive load would differentiate feigners from individuals with schizophrenia because feigners would not be able to deliberately exhibitsubtle verbal behavior that is persistent in and specific to schizophrenia, and thus feigners would not perform significantly differently than honest controls. In this manner, vocal pattern differences would be similar to EEG potentials examined byZarkowski, Esparza, and Russo (2007), who found thatmalingerers failed to show EEG potentials that are present in genuine schizophrenia patients, and thus looked more like controls (see also Anderson, Trethowan, and Kenna's(1959) study of feigning of pseudo-dementia, in which patients demonstrated perseveration but feigners did not, and thus the authors suggested that this pattern of perseveration could be used to rule out malingering).This approach—i.e., including measurement of behavioral markers specific to schizophrenia which may support the presence of a genuine disorder—mayprovide the added benefit of lowering the risk of false-positive errors among individuals with schizophrenia who exaggerate their positive symptoms in an unsophisticated manner (the most likely to be detected, e.g., on the SIRS)—as individuals may do when they actually are in need of treatment, but resources are scarce (e.g., in prison;Resnick & Knoll, 2008). For example, by examining EEG potentials specific to schizophrenia patients,Zarkowski, et al. (2007) identified one likely genuine patient who, upon detailed re-examination of the participant selection process, appeared to have been placed in the "malingering" group based on false positive resultson the SIRS. Furthermore, combining these two strategies for detection of feigning of schizophrenia may reveal patterns that bolster the accuracy of detection of feigning by even sophisticated malingerers(Rogers, 2008a).

METHODS

Participants

Participants in the present study comprised the following groups: individuals with schizophrenia,control participants recruited from the community surrounding Louisiana State University (i.e., "honest responders"), and a feigning group composed of individuals also recruited from the community but provided with additional information about schizophrenia symptoms and instructed to complete the speech tasks "as if" they were attempting to convince the examiner that they have schizophrenia. All diagnostic determinations were made by trained graduate-level psychology students according to DSM-IV criteria (APA, 2000), and confirmed by consensus meeting with Alex Cohen, Ph.D. Exclusionary criteria included: a) Global Assessment of Functioning rating below 30, indicating symptom levels that could interfere with participation in the study, b) documented evidence of mental retardation 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).The study was approved by the appropriate Human Subject Review Boards and all participants provided informed consent prior to participating in the study.

Schizophrenia group

Schizophrenia patients were recruited from outpatient community mental health clinics and residential facilities in the Baton Rouge and Lafayette, LA, areas as part of a larger study. Diagnoses werebased on information obtained from the patients' medical records and a structured clinical interview adopted from the Structured Clinical Interview for DSM Disorders (SCID; First, 1996). At the time of testing, all patients were clinically stable and currently in treatment under the supervision of a multi-disciplinary team. Patients received $40 for participation in the larger studyprotocol, which took approximately four hours for each participant to complete and included administration of the measures described herein, as well as several other measures administered for additional research purposes. Data from the schizophrenia group was collected over the time period of December 2010 through July 2012.

Honest control group

Community control participantswere recruited from the Baton Rouge area as part of a larger study, with the goal of obtaining a control sample as closely matched as possible to the schizophrenia group on demographic characteristics such as age, ethnicity, education, and socioeconomic status. In addition to the exclusionary criteria set forth above, control participants wereinterviewed using the relevant modules of the SCID(First, 1996) to rule out the presence of any severe mental illnesses (i.e., psychosis, major depressive disorder, or bipolar disorder).Participants in the honest control group received $40 for participation in the larger study protocol, which took approximately four hours for each participant to complete and included administration of the measures described herein, as well as several other measures administered for additional research purposes. Data from the honest control group was collected over the time period of April 2010 through July 2012.

Feigning group

Like community control participants, participants in the feigning group were recruited from the Baton Rouge area. Participants were not excluded if they were current students of Louisiana State University, although participants were not recruited through the university's psychology experiment pool.Participants in the feigning group were interviewed using the relevant modules of the SCID (First, 1996) to rule out the presence of any severe mental illnesses (i.e., psychosis, major depressive disorder, or bipolar disorder). To maintain parity with the schizophrenia and honest control group participants, who received approximately $10 per hour for participation in the larger data collection process (which required approximately four hours to complete), participants in the feigning group received $20 for their participation in this supplemental component of the study, which requiredapproximately one and a half to two hours to complete, as it comprised only a subset of the data collection procedures from the larger study protocol, which included several additional measures administered for other research purposes. Data from the feigning group was collected over the time period of November 2011 through May 2012.

In addition to the below-described speech task instructions that were given to all participants, prior to administration of the speech tasks individuals in the feigning group werealso provided information about schizophrenia symptoms, couched in non-technical terms (see Appendix A; as excerpted from National Institute of Mental Health, 2009, p. 3-5), which they were given 10 minutes to review prior to administration of the speech tasks.Additionally, individuals in this group were provided with the following directions, based on malingering research methodology suggestions by Rogers(2008d):

> "Malingering"refers to the purposeful attempt by individuals to fake a psychological disorder in order to gain some reward, such as social security benefits, or avoid something unpleasant, such as criminal prosecution or incarceration. As such, malingerers pose a significant unfair burden to society by increasing insurance premiums and utilizing public funds provided by lawful taxpayers intended to assist the truly mentally ill, and may even wrongfully evade criminal responsibility for serious offenses. In light of this burden posed to society by malingering, special techniques have been developed to distinguish between individuals who are truly mentally ill and those who are attempting to fake a disorder. In order to test some potential methods of detecting malingering, we would like you to complete the following tasks *as if* you were trying to convince an examiner that you have schizophrenia, based on the information about schizophrenia that we have provided to you, as well as

> anyother knowledge you might have about schizophrenia from whatever source. Please imagine that the consequences of being identified as faking are very serious (such as receiving a criminal sentence of life in prison or the death penalty), and try your best to perform in a manner on the upcoming tasks that would convince an examiner that you truly have schizophrenia. In doing so, please keep in mind that the test was developed specifically to indicate whether someone is faking, so your performance must be believable enough to avoid detection.

Speech Tasks

For each speech task, participants were seated in front of a computer monitor while wearing a head-mounted microphone, on which they were instructed to focus their attention, with the research assistant out of view. The experiment was run using Eprime software version 2.0 (Psychology Software Tools, 2002).For all groups, the cognitive load speech task was presented prior to the affective reactivity speech task, which allowed for examination of group differences in speech characteristics when responding to the open-ended, affectively-neutral speech instructions of the cognitive load speech task without prior suggestion or priming of emotional tone by the subsequently-administered affective reactivity task.

Cognitive load speech task

As adapted from the procedure as set forth in Cohen, et al. (2011) for obtaining speech samples under variable conditions of cognitive load for analysis using the CANS, participants were instructed to provide speech samples of neutral topics (hobbies, living arrangements, food) while completing either a "medium load" cognitive task, a "high load" cognitive task, or no cognitive task (i.e., the "low load" baseline condition). The baselinecondition lasted 90 seconds. Each voiced cognitive task condition contained 30 stimulus items, taking 90 seconds or more to complete, with the first 90 seconds of speech recorded for analysis of speech variables. Stimulus items comprised six simple visual symbols from a common computer keyboard (e.g., "@," "%," "$"), which were presented consecutively and randomly on the computer screen at interstimulus intervals of 2000 milliseconds. Speech instructions for the voiced conditions were open-ended and broad, which is also consistent with prior non-affective reactivity-based CDI research (e.g., Docherty, 2005;Docherty, et al., 2003). Neutral speech topic instructions are included in Appendix B.

Based on Baddeley's (1992) model of attention, visual stimuli chosen for the cognitive tasks should divide cognitive resources without directly affecting verbal expression (except through depleting working memory stores more generally)(Cohen, et al., 2011). Response instructions differed between the low- and high-load tasks, as indicated below.If no response choice was made within 2000 milliseconds, an incorrect response was recorded and the next stimulus item is presented.Prior to the voiced performance trial of each cognitive task, participants completed4practice trials of each cognitive task. Practice trials consisted of 13 stimulus items each, with the exception of the first of such trials, which provideddetailed instruction and corrective feedback on 4 stimulus item presentations. Generalized corrective feedback (i.e., "correct," "incorrect," or "too slow") was provided on all other trials, including voiced trials.

Medium-load cognitive task. The medium-load condition consisted of a dual-choice continuous performance task, similar to the task used by Melinder and Barch(2003), in that participants were required to continually monitor presented stimuli in order to respond to items based on whether they matched or did not match a predetermined target held in memory. Participants were instructed to press the "a" button on the computer keyboard if the presented stimulus object was an "*," and to press the "l" key in response to any other presented stimulus.

High-load cognitive task. The high-load condition consisted of a one-back test, based on a commonlyused test of attention and working memory(Cohen, et al., 2011).

Participants were instructed to press the “a” button on the computer keyboard if the presented stimulus was the same as the object presented just prior to that object.Approximately 25% of the symbols presented constituted targets pursuant to this criterion. Participants were instructed to press the “l” key if the presented stimulus was different from the object presented just prior.

Affective reactivity speech task

For the affective reactivity speech task, participants were instructed to recount memories falling into the following four broad topic domains, as characterized by affective tone and arousal level: pleasant high-arousal, pleasant low-arousal, unpleasant high-arousal, and unpleasant low-arousal. General and condition-specific instructions are set forth in Appendix C.Ninety-second speech samples wereobtained for each topic domain. Order of condition presentation was randomized.

This format of obtaining affectively-valenced open-ended autobiographical speech samples has been shown to reveal more meaningful prosody changes among healthy adults in moving across affective conditions than standardized visual photographic stimuli (Cohen, et al., 2010). Furthermore, malingerers have been noted often to call attention to positive symptoms and “overact their part” (Resnick, 1993; Resnick & Knoll, 2008). Allowing such presentation style to manifest in a free speech context may thus increase the magnitude of difference between groups on speech performance.

Post-test Assessment

Following administration of the speech tasks, participants in the feigning group were asked to complete a brief questionnaire about their approach to the speech tasks. For example, the questionnaire instructed participants to indicate their existing familiarity with mental illness, the particular symptoms they attempted to feign during the tasks, and to rate on a

Likert scale ranging from 1 (not at all confident) to 5 (extremely confident) how confident they were that they had performed the speech tasks in a manner that would successfully convince an evaluator that they did, in fact, have schizophrenia, as suggested by Rogers(2008d). A copy of the questionnaire is included herein as Appendix D.

Dependent Variables

Speech variables

CDI. Speech provided in the affective and cognitive load speech tasks were transcribed and rated according to the CDI protocol set forth in greater detail by Docherty, Hawkins, et al. (1996). The referential errors measured by the CDI fall into the following 6 categories:

1. Vague references—i.e., words or phrases that are unclear because they are overinclusive, and their lack of specificity significantly diminishes the meaning of the communication (e.g., "It seems so, you know, this, that, or the other.").
2. Confused references—i.e., references, often pronouns, that are unclear because they could refer to one of at least two alternative referents (e.g., "He stabbed the dude and I kicked him. I thought he punched him. I thought he was on the ground just acting like he was hurt.").
3. Missing information references—i.e., references that assume the listener has prior information that he or she does not (e.g., "I like to work all right. Some of those shops were filthy. I liked the bakeries, some of the shops are clean," (with no prior mention of any shops or bakeries)).
4. Ambiguous word meanings—i.e., words or phrases used in such a way that its intended meaning is unclear, not because the wrong word has been chosen, but

because the word used could have a number of meanings in the current context and the correct meaning is not obvious (e.g., “He was a man that was pow in a minute.”).

5. Wrong word references—i.e., a seemingly incorrect choice of word or phrase (e.g., “We’ve had our qualms about me bowling, but I’ve always won out,” (Does she mean “quarrels”?)).
6. Structural unclarities—i.e., instances in which meaning is unclear due to a breakdown or inadequacy of grammatical structure (e.g., “We went to Arizona. We stopped off lots of towns between Chicago,” (spoken by a person living in Connecticut)).

Total CDI scores were calculated by summing the total number of communication failures per 100 words (to control for differences in the amount of speech generated). CDI ratings were made by the author after training to achieve adequate inter-rater reliability (ICC = .75) using consensus-rated samples from an archival data set maintained in the research lab of Alex Cohen, Ph.D., Louisiana State University. The author was blind to participant group. The author was also blind to speech task category, although content of samples from the affective reactivity task frequently suggested the relevant category. In a single case, a participant who simply verbalized the name of the key pressed he made during the medium cognitive load condition,instead of speaking about the topic provided in the task instructions, was excluded from the CDI analyses so as not to falsely depress the relevant group’s mean CDI scores, as the CDI score would have otherwise misleadingly been scored as “0” (i.e., indicating no instances of referential speech error). It was considered that speech behavior of this nature would be more appropriately captured by the acoustic alogia variables set forth below.

CANS. The Computerized assessment of Affect from Natural Speech protocol was used to assess the behavioral manifestation of negative symptoms via the measurement of

Alogiavariables, which reflect reduction in the quantity of speech*;* Blunt Affectvariables, which reflect diminished expression of emotion characterized by reduced vocal inflection and amplitude variability; and Formant variables, which reflect diminished vocal expression associated with blunted facial expressivity (Cohen, et al., 2008, 2010, 2013, manuscript in preparation, see also Covington et al., 2012).

For the present analyses, speech provided in the affective and cognitive load speech tasks was processed for analysis as follows (Cohen, et al., manuscript in preparation). Speech samples were digitally recorded at 16 bits per second at a sampling frequency of 44,100 hertz. The digitized recordings were then analyzed using PRAAT (Boersma, 2006), a program used extensively in speech pathology and linguistic studies. The PRAAT system was used to organize sound files into "frames" for analysis, which were set at a rate of 100 per second. MATLAB and Excel Macro functions were employed to compute the variables of interest from the PRAAT output. Volume and frequency was measured every 10 milliseconds. Next, each Pause (defined as consecutive assessments with no speech > 10 milliseconds) and Utterance (defined as consecutive speech > 150 milliseconds) was identified. For each Utterance, means and standard deviations were measured for volume and frequency. Using these measurements for each frame, the following variables were calculated:

"Alogia" was examined using the following variables: (i) Total Number of Pauses, (ii) Mean Pause Length, (iii) Total Number of Utterances, and (iv) Mean Utterance Length.

"Blunted Affect" was examined using the following variables: (i) Local Emphasis (i.e., mean standard deviation of volume values); (ii) Global Emphasis (i.e., the standard deviation of standard deviations of volume values); (iii) Local F0 Inflection (i.e., mean standard deviations of fundamental frequency (F0) values); and (iv) Global F0 Inflection (i.e., the standard deviation of standard deviations of F0 values). For inclusion in these variable calculations, F0 values were log transformed to account for nonlinear distribution. In order to control for the fact that increased Utterance length provides greater opportunity to express variability in speech volume and frequency, each of these Blunted Affect variables was divided by (log-transformed) Mean Utterance Length (as matched by task condition), then multiplied by a constant (100) to increase ease of interpretability, given the small size of some resultant variables.

"Formant Variables," i.e., aspects of diminished verbal prosody that are associated with blunted range of oral movement, particularly with regard to vowel expression, were examined using the following variables: (i) Local F1 Inflection (i.e., mean of standard deviation of frequency related to vertical tongue movement (F1)); (ii) Global F1 Inflection (i.e., the standard deviation of standard deviations of F1 values); (iii) Local F2 Inflection (i.e., mean of standard deviation of frequency related to horizontal and back/forward tongue movement (F2)); and (iv) Global F2 Inflection (i.e., the standard deviation of standard deviations of F2 values). Standard deviations in F1 and F2 Inflection have been found to be associated with clinician-rated severity of negative symptoms (Covington, et al., 2012). For inclusion in these variable calculations, F1 and F2 values were log transformed to account for nonlinear distribution. In order to control for the fact that increased Utterance length provides greater opportunity to express variability in speech frequency, each of these Formant variables was divided by (log-transformed) Mean Utterance Length (as matched by task condition), then multiplied by a constant (100) to increase ease of interpretability, given the small size of resultant variables.

Cognitive task performance

Following the procedure set forth by Cohen, et al. (2011), hit rate and false alarms were calculated for the medium- and high-load cognitive tasks.Sensitivity was operationalized using *d*', which takesinto account both correct hits and false alarms. Increasing scoresreflect better performance (i.e., higher hit rate, lower false alarmrate). Response bias was operationalized using the natural log of theβ ratio statistic ("*ln(β)*"; used in lieu of β to account for skewed distribution of β) withincreasing scores indicating a more conservative bias (fewer correctand incorrect responses) and lower scores indicating a moreliberal bias (greater number of both correct and incorrect responses).

Analyses

Data distribution

First, continuous demographic and dependent variables were examined for normality of distribution. Variables were then transformed to correct for skew and outlying data points where necessary, as indicated.

Demographic variables

Next, the three groups were compared on demographic variables obtained during the diagnostic screening interview (e.g., age, ethnicity, gender, education, and parents' education level as an approximation of socioeconomic status unrelated to schizophrenia-specific educational or occupational functioning deficits). Age, ethnicity, and gender were also examined as potential confounding variables to statistically control for in the primary analyses. All tests were two-tailed.

Participant and parental educational variables were not examined for inclusion as covariates in the primary analyses, as cognitive resources (or effortful attempt to feign deficits in such resources) are theoretically related to performance during the speech tasks (including verbal performance (Cohen et al., 2011; Melinder & Barch, 2003)), andboth patient and parental educational attainment are related to psychiatric status (e.g., Byrne, Agerbo, Eaton, & Mortensen, 2004; Chong, et al. 2009). Therefore, participant and parental educational variables might draw meaningful variance from the analyses if included therein.

Primary analyses

Each hypothesis was then tested by a series of mixed model ANOVAs (group (3) *X* cognitive (3) or affective load (4) condition)—looking primarily for (a) main effect of group, and (b) the group by condition interaction (i.e., differences in group patterns in the dependent variables across low and high cognitive or affective load). The Greenhouse-Geisser correction was used where lack of sphericity was indicated. Where multiple ANOVAs were run within a single family of variables, Bonferroni-corrected α-levels of .0125 (i.e., acoustic analysis sets for the Alogia, Blunt Affect, and Formant variables)or .025 (for cognitive task performance variables) were applied for main effects. Significant main effects were examined via Tukey tests where no covariates were included in the model, and via Bonferroni-corrected post-hoc tests for models including covariates. Significant interactions were examined using post-hoc simple-effects analysis, utilizing a series of one-way repeated-measures ANOVAs (or dependent-measures *t*-test for cognitive performance variables) for each group, across conditions (applying a Bonferroni-corrected α level of .017 to account for multiple group analyses). All tests were two-tailed.

Feigning group post-task questionnaire

Feigning group participants' self-reported task strategies and confidence in feigning ability were also explored via post-hoc analysis. All tests were two-tailed.

Power Analysis

Power analyses for the primary analyses were conducted using G*Power software 3.1.2 (Buchner, 2009). Because neither effect sizes nor correlation of dependent variables among within-group conditions have yet been established by existing literature for the groups to be examined herein, ranges of required sample sizes necessary to achieve statistical significance were calculated for each ANOVA using $\alpha = .05$, power = .80, a range of both small ($f = .25$) and large ($f = .40$) effect sizes, and a range of both small ($r = .10$) and large ($r = .75$) correlations among repeated measures. For the mixed model ANOVAs to be performed comparing the groups on the dependent variables in the affective load task (groups = 3, number of measurements = 4), power analysis indicated necessary minimum sample sizes ranging from 24 (using $f = .40$; $r = .10$) to 129 (using $f = .25$; $r = .75$) total participants to detect differences in between-subject factors, and minimum sample sizes ranging from 9 (using $f = .40$; $r = .75$) to 54 (using $f = .25$; $r = .10$) total participants to detect a group by condition interaction. For the mixed model ANOVAs to be performed comparing the groups on the dependent variables in the cognitive load task (groups = 3, number of measurements = 3), power analysis indicated necessary minimum sample sizes ranging from 30 (using $f = .40$; $r = .10$) to 132 (using $f = .25$; $r = .75$) total participants to detect differences in between-subject factors, and minimum sample sizes ranging from 9 (using $f = .40$; $r = .75$) to 54 (using $f = .25$; $r = .10$) total participants to detect an interaction. Note that power analysis for main effects of condition was not computed, as it was anticipated that main effects of condition would be masked and/or rendered irrelevant by the more important group by condition interaction for each ANOVA. Furthermore, main effects of condition, alone, were not relevant to the purpose of the study, i.e., detection of feigning behavior.

This study achieved an actual total samples size of 121 (schizophrenia group n = 52, control group n = 31, feigning group n = 40), falling on the higher side of the various ranges of suggested sample size. All 121 participants were used in the cognitive task performance analyses. However, due to quality issues with a small percentage of audio recordings, total samples sizes ranged from 102 – 105 for CDI analyses, and from 103 – 108 for CANS analyses.

RESULTS

Data Distribution

Continuous demographic and dependent variables were examined for normality of distribution. All continuous demographic variables (age, education, father's education, and mother's education) were normally distributed (skew values < .34, kurtosis values < 1.43). F0, F1, and F2 values were log-transformed to account for nonlinear distribution. CDI, Mean Pause Length, and Mean Utterance Length were also log-transformed to correct for positive skew (skew values > 2.00). Following transformations, scores of 13 participants (6 from the schizophrenia group, 6 from the feigning group, and 1 control) across 20 individual data points (out of 95 individualdependent variables) remained as significant outliers (data points with z-scores > 3.29, as defined by Field (2005)). These outliers were replaced with scores equal to z-score values of 3.29 (Field, 2005). Following this procedure, all transformed dependent variables were normally distributed (skew values < 1.42, kurtosis values < 1.55).

Demographic Variables

Group demographic differences, examined using Pearson's Chi-square analysis for categorical dependent variables and one-way ANOVAs for continuous dependent variables, are set forth in Table 1. Significant main effects of group were further exploredby either examining the standardized residuals' significance across cells (for Chi-square analysis) or byusing post-hoc Tukey tests (for ANOVAs). The schizophrenia group contained significantly more male participants than both the control and feigning groups($ps < .05$); the gender distribution of the control and feigning groups did not significantly differ. Overall differences in ethnicity distribution across groups were significant, but post-hoc group comparison did not reveal significant differences. Participants in the feigning group were significantly younger than

Table 1: Group Demographic Differences

	Control	Feigning	Schizophrenia	Test Statistic[a]
N	30	36	41	
Gender (%)				14.07***
% Male[b]	45%	31%	67%	
% Female	55%	69%	27%	
Ethnicity (%)[c]				7.42*
% Caucasian	48%	79%	60%	
% African American	48%	21%	40%	
% Hispanic/Latino	4%	0%	0%	
Age (M ± SD)[d]	40.68 ± 12.61	29.23 ± 10.71	41.63 ± 11.56	14.43***
Education Level (M ± SD)[e]	14.25 ± 2.34	15.13 ± 2.22	11.96 ± 1.96	27.59***
Father's Education (M ± SD)[f]	12.29 ± 3.70	15.27 ± 3.06	13.24 ± 4.32	5.42**
Mother's Education (M ± SD)[g]	13.79 ± 2.67	15.08 ± 2.59	12.42 ± 2.96	7.14**

*** $p < .001$, ** $p < .01$, * $p < .05$

[a]Pearson's Chi-square analysis used to examine gender and ethnicity (χ^2values provided); ANOVA used to examine age and education variables (*F* values provided).

[b]Schizophrenia > control = feigning

[c] Due to lack of sufficient variability across the ethnicity variable, the African American and Hispanic/Latino categories were combined to form a single category, and an Chi-square analysis was performed using a dichotomous outcome variable (Caucasian v. non-Caucasian).

[d] Feigning < schizophrenia = control

[e] Schizophrenia < control = feigning

[f] Feigning > control

[g] Feigning > schizophrenia

both the control and schizophrenia participants (*p*s < .001); but age of control and schizophrenia participants did not significantly differ (*p* = .93). The schizophrenia group reported lower educational attainment than both the control and feigning groups (*p*s < .001), who did not significantly differ from one another in educational attainment (*p* = .39). Participants in the feigning group reported significantly higher paternal educational attainment than the control group, and significantly higher maternal educational attainment than the schizophrenia group (*p*s < .01); no other group differences in parental education were significant (*p*s > .10).

Gender was examined using independent samples *t*-tests. Gender was significantly associated with CDI scores in the unpleasant/low arousal condition (*t* = -3.11, *p*< .01), with men (*M* = .52, *SD* = .32) having higher CDI scores than women (*M* =.33, *SD* = .30). Gender was also significantly associated with Total Number of Pauses and Mean Pause Length across all task conditions (*t*s > -2.04, *p*s < .05), except for Total Number of Pauses in unpleasant/high arousal affective reactivity task condition, in which gender demonstrated difference at a trend level (*t* = 1.09, *p* = .06). Women (range of means (*M*s) = 157.21 – 198.33, range of standard deviations (*SD*s) = 53.43 – 5.04) made more pauses during the speech tasks than men (*M*s = 131.26 – 175.96, *SD*s = 52.10 – 60.46); while men (*M*s = 2.58 – 2.78, *SD*s = .21– .27) took longer pauses than women (*M* = 2.48 – 2.65, *SD*s = .18 – .21). There were also significant gender differences in F0 Local and Global Inflection across all task conditions (*t*s > 4.23, *p*s < .001), with women (*M* = 1.27 – 1.86, SDs = .40 – .75) using more F0 Local and Global Inflection in their speech than men (*M*s = .88 – 1.28, *SD*s = .41 – .52). Women (*M*s = 1.82 – 1.88, *SD*s = .77 – .92) expressed significantly more F1 Global Inflection than men(*M*s = 2.27 – 2.32, *SD*s = .96 – 1.02) across all conditions in the affective reactivity task (*t*s > 2.31, *p*s < .03), except the pleasant/low arousal condition, in which women used more F1 Global

Inflection than men (*M* = 2.18, *SD* = .89) at a trend level (*t*= -1.93, *p* = .06). There were no other significant gender differences across any remaining dependent variables (*t*s < 1.90, *p*s > .06). In summary, gender was not significantly associated with any of the cognitive performance dependent variables. It was, however, associated with CDI scores in the affective reactivity task. It was also associated with several acoustic analysis variables spanning Alogia, Blunt Affect, and Formant categories—there were gender differences across both cognitive load and affective reactivity tasks for Total Number of Pauses, Mean Pause Length, and Local and Global F0 Inflection; as well as gender differences in F1 Global Inflection in the affective reactivity task.

Ethnicity was also examined using independent samples *t*-tests (using Caucasian v. African American groups, due to lack of adequate distribution of participants among other ethnic groups). Ethnicity was significantly associated with CDI scores in the unpleasant/high arousal affective reactivity tasks condition (*t* = -2.40, *p* = .02), with African-American participants having higher CDI scores (*M* = .57, *SD* = .36) than Caucasians (*M* = .41, *SD* = .30). African Americans (*M* = .46, *SD* = .35) also demonstrated higher CDI scores than Caucasians (*M* = .35, *SD* = .29) in the pleasant/low arousal affective reactivity condition at a trend level (*t* = -1.68, *p* = .10). Ethnicity was significantly associated with Global F0 Inflection in the low cognitive load condition (*t* = 2.30, *p* = .02), with Caucasian participants using more Global F0 Inflection (*M* = 1.16, *SD* = .46) than African Americans (*M* = .95, *SD* = .44). African Americans (*M*s = 2.72 – 2.82, *SD*s = .81 – .97) used more Local F2 Inflection than Caucasians (*M*s = 2.37 – 2.44, *SD*s = .76 – .83) across all conditions of the affective reactivity task (*t*s > -2.04, *p*s < .05), with the exception of the unpleasant/high arousal condition, in which African Americans (*M* = 2.75, *SD* = .81) used more Local F2 Inflection than Caucasians (*M* = 2.47, *SD* = .80) at trend level (*t* = -1.79, *p* = .08). African Americans (*M*s = 2.66 – 2.69, *SD*s = .77 – .91) also used more

Local F2 Inflection than Caucasians (*M*s = 2.39 – 2.40, *SD*s = .68 – .78) in the medium and high cognitive load conditions at a trend level (*t*s > -1.84, *p*s < .09). African Americans (*M* = 1.17, *SD* = .55) used significantly more Global F2 Inflection than Caucasians (*M* = .94, *SD* = .53) in the medium cognitive load condition (*t* = -2.16, *p* = .03), and African Americans (*M*s = 1.13 – 1.16, *SD*s = .56) used more Global F2 Inflection than Caucasians (*M*s = .92 – .95, *SD*s = .56 – .58) in the low cognitive load and unpleasant/low arousal affective reactivity conditions (*t*s >-1.82, *p*s < .08). There were no other significant ethnicity differences across any remaining dependent variables (*t*s < 1.60, *p*s > .12). In summary, ethnicity was not significantly associated with any of the cognitive performance dependent variables. It was, however, associated with CDI scores in the affective reactivity task. It was also associated with several acoustic analysis variables spanning Blunt Affect and Formant categories—there were differences among different ethnic groups in Local and Global F2 Inflection across both cognitive load and affective reactivity tasks; and there were differences among different ethnic groups in Global F0 Inflection in the cognitive load condition.

Age was examined using Pearson's correlations. Age was significantly inversely correlated with Mean Pause Length in the low cognitive load condition (*r* = -.22, *p* = .02), and in the affective reactivity task across the pleasant/low arousal, pleasant/high arousal, and unpleasant/low arousal conditions (*r*s > -.20, *p*s = .05). It was also inversely correlated with Mean Pause Length in the unpleasant/high arousal condition at a trend level (*r* = -.17, *p* = .07). Age was significantly inversely correlated with Global F0 Inflection across all task conditions (*r*s > -.19, *p*s < .05), except the unpleasant/high arousal condition, in which it was inversely correlated with Global F0 Inflection at a trend level (*r* = -.17, *p* = .07). Age was significantly correlated with Global F1 Inflection in the medium cognitive load condition (*r* = .19, *p* = .05) and the pleasant/high arousal affective reactivity condition ($r = .20$, $p = .04$). Age was significantly correlated with Local and Global F2 Inflection across all task conditions (*r*s > .29, *p*s < .01). Age was also significantly correlated with *d'* scores in the medium cognitive load condition ($r = .20$, $p = .03$). Age was not significantly correlated with any other remaining dependent variables (*r*s < .17, *p*s > .08). In summary, age was not significantly correlated with any of the CDI variables. It was, however, associated with *d'* scores in the cognitive load task, and several acoustic variables across Alogia, Blunt Affect, and Formant categories. Age was associated with Mean Pause Length, Global F0 and F1 Inflection, and Local and Global F2 Inflection in both the cognitive load and affective reactivity tasks, and with Local F1 Inflection in the cognitive load task.

Based on the above analyses, (a) gender was entered as a covariate for (i) all analyses examining Total Number of Pauses, Mean Pause Length, Local F0 Inflection, and Global F0 Inflection, and (ii) affective reactivity task analyses examining CDI scores and Global F1 Inflection; (b) ethnicity was entered as a covariate for (i) all analyses examining Local and Global F2 Inflection, (ii) the cognitive load task analysis examining Global F0 Inflection, and (iii) and the affective reactivity task analysis examining CDI scores; and (c) age was entered as a covariate for (i) all analyses examining Mean Pause Length, Global F0 Inflection, Global F1 Inflection, Local F2 Inflection, and Global F2 Inflection, and (ii) the cognitive load task analysis examining*d'*.

Primary Analyses

Affective Reactivity Speech Task

A summary of significant results for the affective reactivity task is set forth in Table 2.

Table 2: Summary of significant affective reactivity task condition results

Affective Reactivity Task			
Dependent variables (by category)	Significant Effects[a]		
	Group	Condition	Interaction
CDI	S > F = C		
Alogia			
Total Number of Pauses	C > S = F		
Mean Pause Length	F = S > C		
Total Number of Utterances			
Mean Utterance Length			
Blunt Affect			
Local Emphasis			
Global Emphasis			
Local F0 Inflection			
Global F0 Inflection			
Formant			
Local F1 Inflection			
Global F1 Inflection	S > F		
Local F2 Inflection	C > S > F		C: P/ha > U/la = U/ha[b]
Global F2 Inflection	C = S > F		

[a] C = control group, S = schizophrenia group, F = feigning group, P/ha = pleasant/high arousal condition, U/ha = unpleasant/high arousal condition, U/la = unpleasant/low arousal condition
[b] This effect was not robust to Bonferroni-correction for family-wise error.

CDI. Affective reactivity speech task means and standard deviations for CDI variables, across groups, are set forth in Table 3. Note, to aid interpretability, non-transformed CDI scores (i.e., number of speech errors made per 100 words generated) are provided.

Table 3: Means (± standard deviations) for CDI variables across groups, for affective reactivity task conditions

CDI	Control	Feigning	Schizophrenia
Pleasant/Low-arousal	1.01 (1.24)	1.69 (2.25)	3.92 (5.01)
Pleasant/High-arousal	1.76 (1.92)	1.28 (1.50)	3.81 (3.97)
Unpleasant/Low-arousal	1.49 (1.30)	2.14 (3.64)	3.93 (4.43)
Unpleasant/High-arousal	2.25 (2.30)	1.80 (1.89)	4.54 (4.29)

Results for the ANOVA examining CDI scores across groups and affective load condition, controlling for gender and ethnicity, are set forth in Table 4. There was a significant main effect for group, but the main effect of affective condition and the group by condition interaction were nonsignificant. Tukey post-hoc tests examining the main effect of group revealed that the schizophrenia group evidenced significantly more speech disorganization than both the control and feigning groups across conditions (*p*s < .001); but the feigning and control groups were not significantly different from one another ($p = 1.00$). See Figure 1.

Table 4: ANOVA comparing groups on CDI scores, across affective reactivity task conditions (controlling for gender and ethnicity)

	df	*F*	$\eta\rho^2$	*p*
Group	2, 100	12.50	.20	< .001[a]
Condition	3, 300	1.52	.02	.21
Group * Condition	6, 300	1.43	.03	.20

[a] Schizophrenia > feigning = control

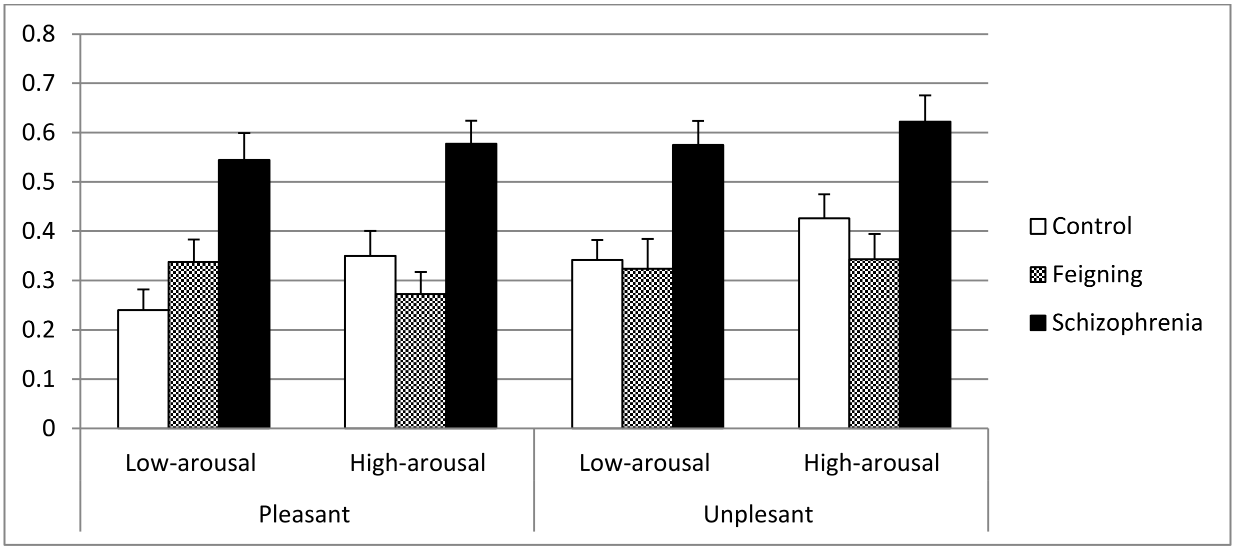

Figure 1: Log transformed CDI scores across affective reactivity conditions

Alogia. Affective reactivity speech task means and standard deviations for Alogia variables, across groups, are set forth in Table 5. Note, to aid interpretability, non-transformed Pause and Utterance scores are provided.

Results for ANOVAs examining Alogia variables across affective reactivity conditions are set forth in Table 6. For Total Number of Pauses (controlling for gender) and Mean Pause Length (controlling for gender and age), there were significant effects for group, but no significant main effects of condition or interactions. Bonferroni-corrected post-hoc pair-wise comparisons revealed that the control group used significantly more pauses, with a shorter mean pause length, than either the schizophrenia ($p < .01$) or feigning groups ($p < .01$), who were not significantly different from one another ($p = 1.00$). There were no significant main effects or interactions for either Total Number of Utterances or Total Utterance Length. See Figure 2.

Table 5: Means (± standard deviations) for Alogia variables across groups, for affective reactivity task conditions

Alogia	Control	Feigning	Schizophrenia
Total Number of Pauses			
Pleasant/Low-arousal	204.74 (44.12)	157.72 (58.48)	157.38 (45.55)
Pleasant/High-arousal	220.32 (51.04)	177.31 (62.47)	165.93 (51.62)
Unpleasant/Low-arousal	214.37 (52.98)	167.25 (59.18)	166.29 (48.47)
Unpleasant/High-arousal	222.35 (48.15)	174.64 (64.86)	169.45 (47.62)
Mean Pause Length			
Pleasant/Low-arousal	302.55 (119.94)	489.69 (250.74)	482.14 (276.91)
Pleasant/High-arousal	273.16 (113.39)	409.47 (223.20)	464.74 (270.81)
Unpleasant/Low-arousal	302.50 (131.88)	459.28 (234.30)	455.71 (257.45)
Unpleasant/High-arousal	278.16 (105.98)	442.96 (294.25)	443.00 (285.45)
Total Number of Utterances			
Pleasant/Low-arousal	72.77 (17.07)	59.56 (15.58)	65.93 (19.94)
Pleasant/High-arousal	66.97 (18.10)	60.22 (18.41)	64.33 (16.98)
Unpleasant/Low-arousal	70.23 (17.28)	62.81 (18.46)	65.38 (17.67)
Unpleasant/High-arousal	68.74 (4.73)	62.58 (20.15)	63.50 (16.40)
Mean Utterance Length			
Pleasant/Low-arousal	1431.48 (364.23)	1758.56 (550.07)	1641.29 (549.75)
Pleasant/High-arousal	1564.58 (415.20)	1767.45 (554.71)	1651.40 (512.38)
Unpleasant/Low-arousal	1481.97 (374.96)	1678.84 (493.30)	1602.67 (441.04)
Unpleasant/High-arousal	1490.00 (313.37)	1715.83 (542.89)	1679.83 (573.64)

Table 6: ANOVAs comparing groups on Alogia variables, across affective reactivity task conditions

Alogia	df	*F*	$\eta\rho^2$	*p*
Total Number of Pauses (controlling for gender)				
Group	2, 103	.82	.16	< .001[a]
Condition	3, 309	1.11	.01	.35
Group * Condition	6, 309	.52	.01	.80
Mean Pause Length (controlling for gender and age)				
Group	2, 102	7.99	.14	.001[b]
Condition	3, 306	.18	.00	.91
Group * Condition	6, 306	1.13	.02	.35
Total Number of Utterances				
Group	2, 105	2.09	.04	.13
Condition	3, 315	1.14	.01	.23
Group * Condition	6, 315	1.13	.02	.35
Mean Utterance Length				
Group	2, 105	2.28	.04	.11
Condition	3, 315	1.37	.01	.25
Group * Condition	6, 315	.64	.01	.53

[a] Control > schizophrenia = feigning
[b] Schizophrenia = feigning > control

In summary, the control group used significantly more pauses, with a shorter mean pause length, than either the schizophrenia or feigning groups. In other words, the feigning group successfully resembled the schizophrenia group in its use of longer (and conversely fewer overall) pauses. Notably, the main effects of group for Total Pause Number ($p < .001$) and Mean Pause Length ($p = .001$) were robust to application of a Bonferroni-correction for family-wise error within the Alogia analysis set.

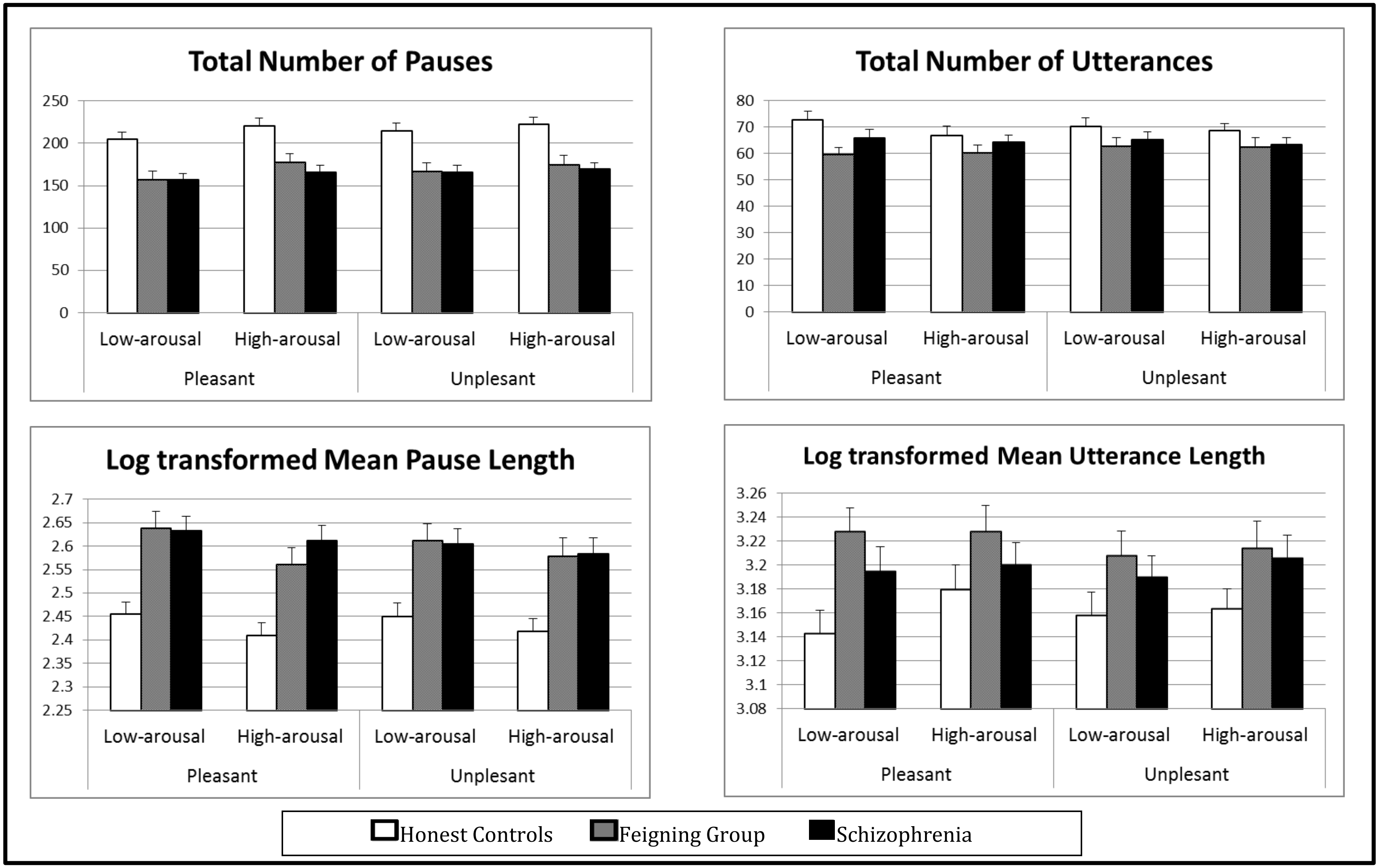

Figure 2: Alogia scores across affective reactivity conditions

Blunt Affect. Affective reactivity speech task means and standard deviations for Blunt Affect variables, across groups, are set forth in Table 7. Emphasis and Inflection scores are provided as log-transformed and corrected for Mean Utterance Length.

Table 7: Means (± standard deviations) for Blunt Affect variables across groups, for affective reactivity task conditions

Blunt Affect	Control	Feigning	Schizophrenia
Local Emphasis			
Pleasant/Low-arousal	252.96 (44.21)	266.99 (72.12)	256.94 (49.21)
Pleasant/High-arousal	261.19 (42.26)	269.06 (75.42)	261.24 (47.06)
Unpleasant/Low-arousal	261.27 (45.26)	263.60 (71.94)	254.45 (55.22)
Unpleasant/High-arousal	257.43 (40.73)	270.01 (68.87)	258.93 (49.52)
Global Emphasis			
Pleasant/Low-arousal	80.86 (18.51)	86.61 (23.49)	87.86 (20.30)
Pleasant/High-arousal	87.06 (19.78)	86.91 (27.76)	87.59 (25.86)
Unpleasant/Low-arousal	84.37 (19.88)	89.64 (27.25)	88.56 (24.52)
Unpleasant/High-arousal	89.56 (17.49)	86.96 (23.94)	85.28 (22.29)
Local F0 Inflection			
Pleasant/Low-arousal	1.61 (.77)	1.62 (.74)	1.30 (.63)
Pleasant/High-arousal	1.64 (.52)	1.59 (.57)	1.38 (.64)
Unpleasant/Low-arousal	1.66 (.79)	1.58 (.61)	1.31 (.56)
Unpleasant/High-arousal	1.67 (.56)	1.68 (.66)	1.44 (.69)
Global F0 Inflection			
Pleasant/Low-arousal	1.19 (.45)	1.22 (.45)	.93 (.51)
Pleasant/High-arousal	1.16 (.50)	1.17 (.44)	.98 (.51)
Unpleasant/Low-arousal	1.17 (.53)	1.21 (.39)	.97 (.51)
Unpleasant/High-arousal	1.19 (.43)	1.18 (.44)	.96 (.50)

Results for ANOVAs examining Blunt Affect variables across affective reactivity conditions are set forth in Table 8. There were no significant main effects or interactions for Local or Global Emphasis, or Local (controlling for gender) or Global F0 (controlling for gender and age) Inflection. See Figure 3.

Table 8: ANOVAs comparing groups on Blunt Affect variables, across affective reactivity task conditions

Blunt Affect	df	*F*	$\eta\rho^2$	*p*
Local Emphasis				
Group	2, 105	.38	.01	.69
Condition	3, 315	1.02	.01	.39
Group * Condition	6, 315	.62	.01	.71
Global Emphasis				
Group	2, 105	.13	.00	.88
Condition	2.74, 287.23	.40	.00	.73
Group * Condition	5.47, 287.23	.76	.01	.59
Local F0 Inflection (controlling for gender)				
Group	2, 103	.96	.02	.39
Condition	3, 309	1.10	.01	.35
Group * Condition	6, 309	.32	.01	.93
Global F0 Inflection (controlling for gender and age)				
Group	2, 102	1.15	.03	.24
Condition	3, 306	.43	.00	.73
Group * Condition	6, 306	.13	.00	.99

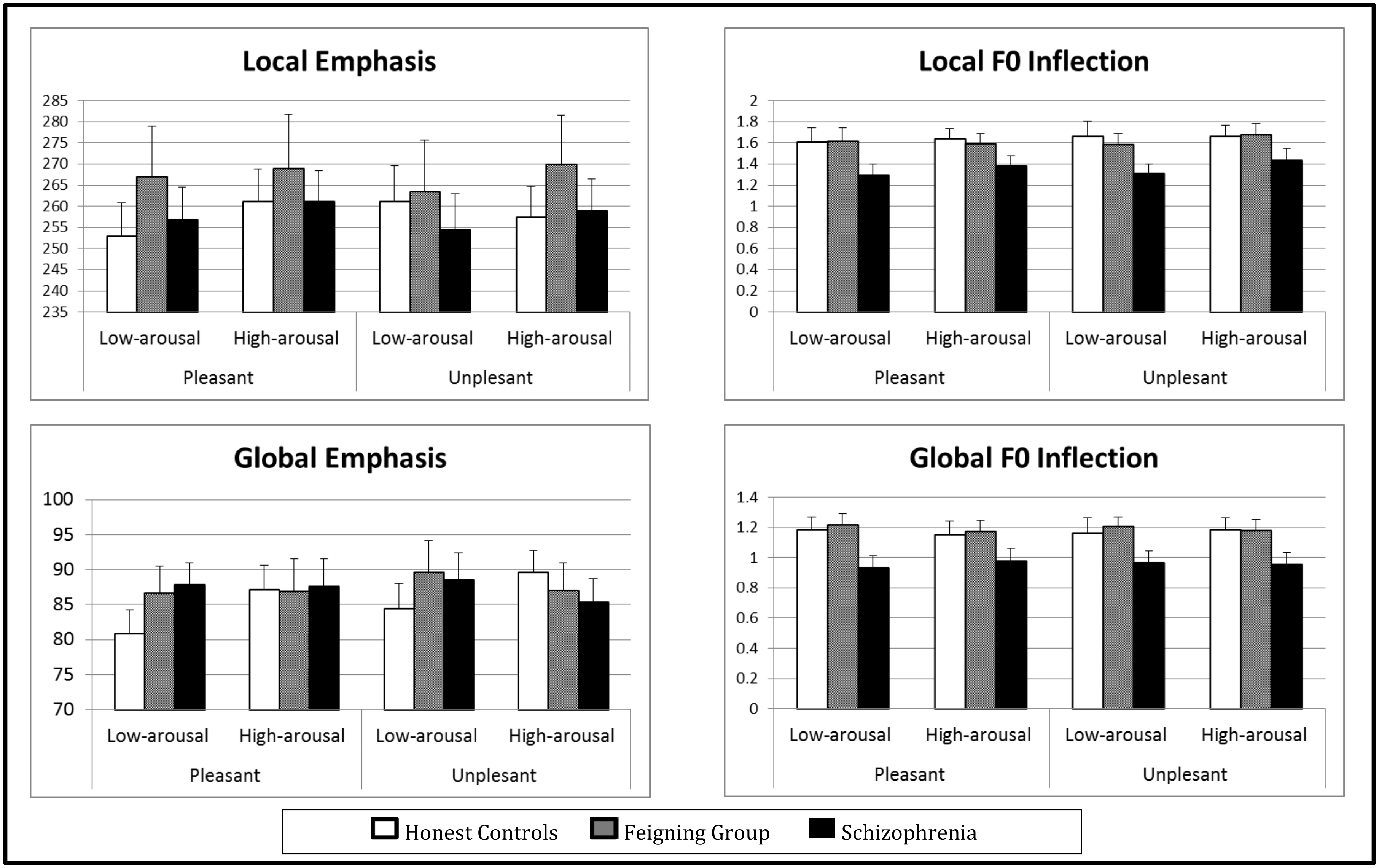

Figure 3: Log transformed and corrected Blunt Affect scores across affective reactivity conditions

Formant variables. Affective reactivity speech task means and standard deviations for Formant variables, across groups, are set forth in Table 9. Inflection scores are provided as log-transformed and corrected for Mean Utterance Length.

Table 9: Means (± standard deviations) for Formant variables across groups, for affective reactivity task conditions

Formant	Control	Feigning	Schizophrenia
Local F1 Inflection			
Pleasant/Low-arousal	4.39 (1.05)	4.23 (2.28)	4.74 (1.56)
Pleasant/High-arousal	4.42 (.86)	4.45 (2.26)	4.74 (1.81)
Unpleasant/Low-arousal	4.39 (1.10)	4.24(2.31)	4.80 (1.65)
Unpleasant/High-arousal	4.40 (1.01)	4.51 (2.26)	4.92 (1.48)
Global F1 Inflection			
Pleasant/Low-arousal	2.02 (.63)	1.67 (1.01)	2.30(.98)
Pleasant/High-arousal	1.99 (.73)	1.79 (1.08)	2.32 (.88)
Unpleasant/Low-arousal	1.99 (.56)	1.79 (1.19)	2.45 (.96)
Unpleasant/High-arousal	2.05 (.78)	1.84 (1.08)	2.29 (.81)
Local F2 Inflection			
Pleasant/Low-arousal	3.08 (.72)	1.92 (.49)	2.68 (.87)
Pleasant/High-arousal	3.26 (.68)	1.95 (.49)	2.63 (.94)
Unpleasant/Low-arousal	3.03 (.62)	1.94 (.55)	2.62 (.83)
Unpleasant/High-arousal	3.02 (.70)	1.95 (.47)	2.79 (.75)
Global F2 Inflection			
Pleasant/Low-arousal	1.40 (.44)	.54 (.42)	1.22 (.57)
Pleasant/High-arousal	1.35 (.40)	.51 (.30)	1.13 (.50)
Unpleasant/Low-arousal	1.31 (.41)	.53 (.41)	1.18 (.53)
Unpleasant/High-arousal	1.36 (.41)	.51 (.38)	1.22 (.50)

Results for ANOVAs examining Formant variables across affective reactivity conditions are set forth in Table 10. There were no significant main effects or interaction for Local F1 Inflection(controlling for gender and age). For Global F1 Inflection there was a significant main effect of group, but no significant main effect of condition or interaction. Post-hoc Tukey tests revealed that the feigning group used significantly less Global F1 Inflection than the schizophrenia group ($p < .01$); but the control group was not significantly different from either other group (*p*s > .17). See Figure 4.

For Local F2 Inflection (controlling for ethnicity and age), there was a significant main effect of group and a significant group by condition interaction. Bonferroni-corrected post-hoc pair-wise comparisons revealed that all three groups were significantly different from one another, with the feigning group using less Local F2 Inflection than both the schizophrenia and control groups (*p*s < .001), and the schizophrenia group using less Local F2 Inflection than the control group ($p = .03$). With regard to the interaction effect, post-hoc simple-effects analysis revealed a significant effect of condition within the control group (F (3, 87) = 3.91, $\eta\rho^2 = .12$, $p = .01$), which remained significant after application of Bonferroni correction; with Bonferroni-corrected post-hoc pair-wise comparisons indicating that control participants used more Local F2 Inflection in the pleasant/high arousal condition than both the unpleasant/low arousal ($p = .03$) and unpleasant/high arousal (p = .05) conditions (*p*s for all other pairwise comparisons > .55). The main effect of condition was not significant within the feigning (F (2.43, 84.97) = .22, $\eta\rho^2 = .01$, $p = .84$) or schizophrenia (F (2.02, 82.78) = 1.56, $\eta\rho^2 = .04$, $p = .22$) groups. See Figure 4.

Table 10: ANOVAs comparing groups on Formant variables, across affective reactivity task conditions

Formant variables	df	*F*	$\eta\rho^2$	*p*
Local F1 Inflection (controlling for gender and age)				
Group	2, 102	.54	.01	.59
Condition	2.78, 283.02	1.92	.02	.13
Group * Condition	5.55, 283.02	1.51	.03	.18
Global F1 Inflection				
Group	2, 105	5.25	.09	.01[a]
Condition	3, 315	.34	.00	.80
Group * Condition	6, 315	.68	.01	.67
Local F2 Inflection (controlling for ethnicity and age)				
Group	2, 103	20.23	.28	<.001[b]
Condition	2.62, 269.49	1.14	.01	.33
Group * Condition	5.23, 269.49	2.29	.04	.04[c]
Global F2 Inflection (controlling for ethnicity and age)				
Group	2, 103	28.18	.36	<.001[d]
Condition	2.75, 282.95	1.23	.01	.29
Group * Condition	5.49, 282.95	.71	.01	.63

[a] Schizophrenia > feigning
[b] Control > schizophrenia > feigning
[c] Control group: pleasant/high arousal > unpleasant/low arousal = unpleasant/high arousal (Note: this effect was not robust to family-wise Bonferroni-correction.)
[d] Schizophrenia = control > feigning

For Global F2 Inflection (controlling for ethnicity and age), the main effect of group was significant, but not the main effect of condition or the interaction. Bonferroni-corrected post-hoc pair-wise comparisons revealed that the feigning group used significantly less Global F2 Inflection than the schizophrenia and control groups (*p*s < .001); but schizophrenia and control groups did not significantly differ from one another (p = .36). See Figure 4.

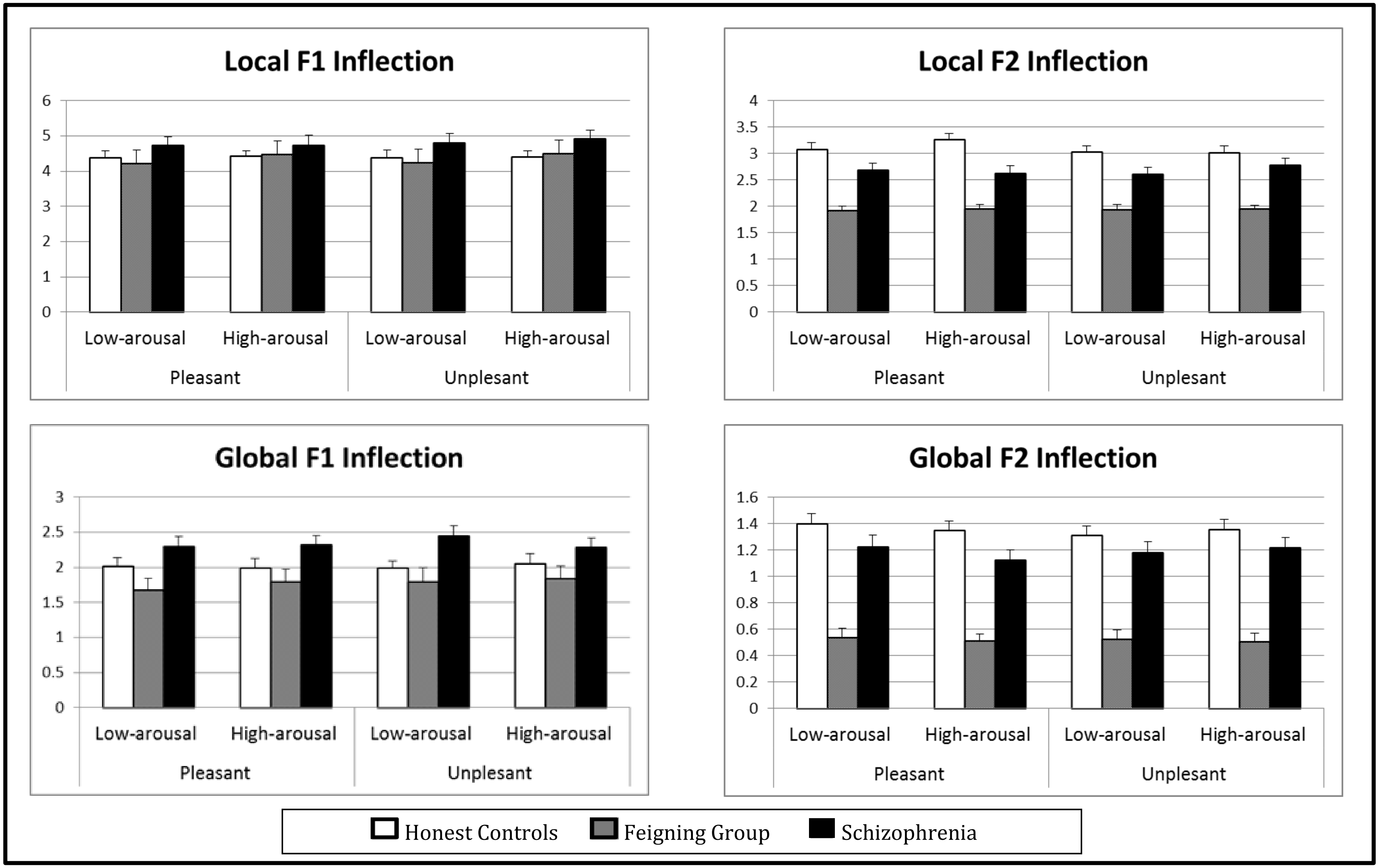

Figure 4: Corrected and log-transformed Formant variable scores across affective reactivity conditions

In summary, the feigning group used less F1 Global, F2 Local, and F2 Global Inflection than the schizophrenia group. In other words, the feigning group tended to use poor formant inflection (less tongue movement-based articulation) in attempt to mimic schizophrenia symptoms. Notably, all three of these main group effects were robust to application of Bonferroni correction to account for potential family-wise error within the Formant variable set(F1 Global Inflection group effect $p = .007$, F2 Local and Global Inflection group effect *p*s < .001). The feigning group's strategy distinguished it from the control group for F2 Local and Global Inflection, in a direction matching that distinguishing the schizophrenia group from the control group with regard to Local F2 Inflection (i.e., the schizophrenia group also used less Local F2 Inflection than controls). However, the feigning group over-exaggerated this effect, using significantly less F1 Global, F2 Local, and F2 Global Inflection than even the schizophrenia group. Furthermore, even though the control group demonstrated slight affective reactivity for Local F2 Inflection in the pleasant/high arousal condition, the feigning group appeared to remain steady across affective conditions. However, this interaction effect ($p = .04$) was not robust to Bonferroni-correction for family-wise error.

Cognitive load speech task

A summary of significant results for the cognitive load task is set forth in Table 11.

CDI. Cognitive load speech task means and standard deviations for CDI variables, across groups, are set forth in Table 12. Note, to aid interpretability, non-transformed CDI scores (i.e., number of speech errors made per 100 words generated) are provided.

Table 11: Summary of significant cognitive load task condition results

Dependent variables (by category)	Significant Effects[a]		
	Group	Condition	Interactions
CDI		l > h	
Alogia			
Total Number of Pauses	C > S = F	l > m > h[b]	C: l = m> h F: l > m = h S: l > m = h
Mean Pause Length	F = S > C		
Total Number of Utterances	C > S	l>h	S: l > m = h
Mean Utterance Length	S>C	h>l	S: h > l[b]
Blunt Affect			
Local Emphasis			
Global Emphasis			
Local F0 Inflection			
Global F0 Inflection	C > S[b]		
Formant			
Local F1 Inflection			
Global F1 Inflection			
Local F2 Inflection	C > S > F		
Global F2 Inflection	C > S > F		
Cognitive Performance			
d'	C > S > F	m > h	S: l > h C: l > h
ln(β)	C = S > F	m > h[b]	

[a] C = control group, S = schizophrenia group, F = feigning group, l = low cognitive load condition, m = medium cognitive load condition, h = high cognitive load condition
[b] This effect was not robust to Bonferroni-correction for family-wise error.

Table 12: Means (± standard deviations) for CDI variables across groups, for cognitive load task conditions

	Control	Feigning	Schizophrenia
CDI			
Low Load	1.02 (1.73)	1.88 (3.23)	3.13 (3.60)
Medium Load	.85 (1.02)	1.58 (3.12)	3.50 (13.11)
High Load	1.04 (1.20)	1.48 (3.20)	1.37 (1.89)

Results for the ANOVA examining CDI scores across groups and cognitive load conditions are set forth in Table 13. There was no significant main effect of group, but there was a significant main effect for cognitive load condition. The group by cognitive load condition interaction was not significant. Bonferroni-corrected post-hoc pair-wise comparisons examining the main effect of cognitive load condition revealed significantly more speech disorganization in the low cognitive load condition than the high load condition ($p = .01$). The medium load condition was not significantly different from the high load condition ($p = 1.0$), but differed from the low load condition at a trend level ($p = .10$). See Figure 5.

Table 13: ANOVA comparing groups on CDI scores, across cognitive load task conditions

	df	*F*	$\eta\rho^2$	*P*
Group	2, 99	1.67	.03	.19
Condition	1.80, 11.91	4.04	.04	.02[a]
Group * Condition	3.77, 186.65	1.91	.04	.11

[a] low > high load condition

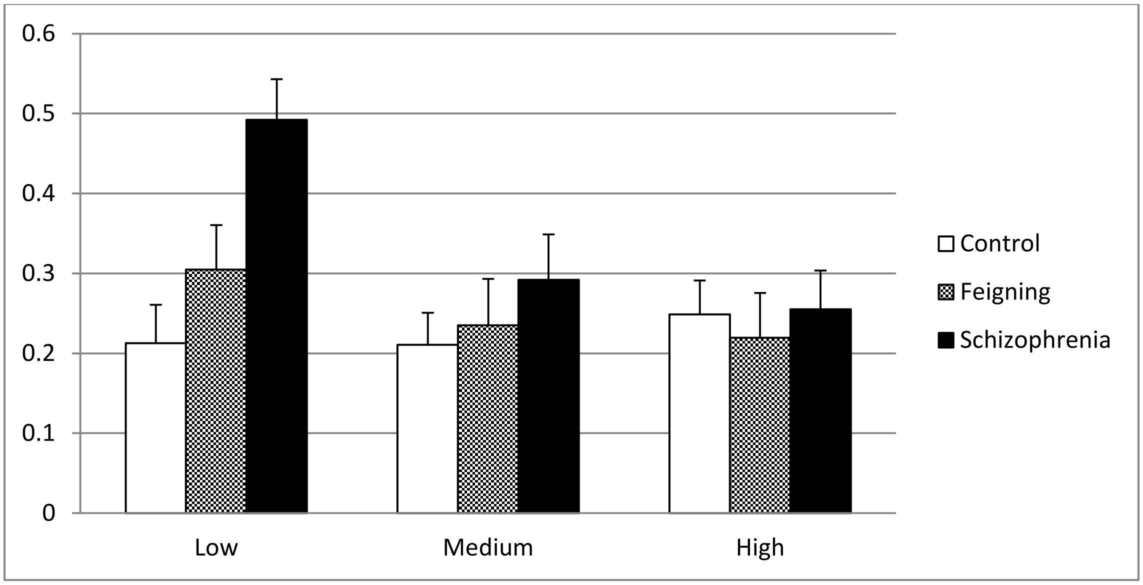

Figure 5: Log-transformed CDI scores across cognitive load conditions

Alogia. Cognitive load speech task means and standard deviations for Alogia variables, across groups, are set forth in Table 14. Note, to aid interpretability, non-transformed pause and utterance scores are provided.

Results for ANOVAs examining Alogia variables across cognitive load conditions are set forth in Table 15. For Total Pause Number (controlling for gender), there were significant main effects for group and condition, as well as a significant group by condition interaction. Bonferroni-corrected post-hoc pair-wise comparisons revealed that the control group used significantly more pauses than either the feigning ($p < .01$) or schizophrenia ($p < .001$) groups; but the feigning and schizophrenia groups were not significantly different from one another ($p = 1.00$). In addition, participants used significantly more pauses in the low cognitive load condition than either other condition (ps < .001), and more pauses in the medium cognitive load condition than the low cognitive load condition ($p < .001$). With regard to the interaction effect, post-hoc simple-effects analysis revealed a significant effect of condition within the

Table 14: Means (± standard deviations) for Alogia variables across groups, for cognitive load task conditions

Alogia	Control	Feigning	Schizophrenia
Total Number of Pauses			
Low Load	209.20 (54.51)	170.28 (63.04)	158.95 (51.35)
Medium Load	198.17 (48.43)	144.77 (50.71)	134.14 (52.71)
High Load	167.77 (48.05)	153.63 (61.39)	116.88 (45.14)
Mean Pause Length			
Low Load	316.33 (128.05)	454.03 (272.32)	504.19 (382.26)
Medium Load	346.66 (139.49)	575.81 (313.85)	755.62 (749.33)
High Load	459.97 (209.05)	548.69 (292.48)	790.40 (556.23)
Total Number of Utterances			
Low Load	71.03 (18.60)	63.94 (19.20)	62.74 (18.93)
Medium Load	71.38 (16.71)	59.40 (17.86)	58.79 (20.15)
High Load	67.13 (18.60)	62.86 (21.90)	51.29 (19.09)
Mean Utterance Length			
Low Load	1483.73 (408.23)	1703.95 (652.71)	1751.02 (694.51)
Medium Load	1452.83 (352.25)	1808.97 (655.21)	1910.81 (865.72)
High Load	1580.80 (487.89)	1735.97 (579.79)	2235.02 (1106.64)

control group (F (2, 56) = 33.41, $\eta\rho^2$ = .54, p< .001), which remained robust to application of the Bonferroni correction; with Bonferroni-corrected post-hoc pairwise-comparisons revealing that the control group used significantly fewer pauses in the high cognitive load condition than both the low and medium load conditions (*p*s < .001), but the low and medium load conditions were not significantly different from one another (p = .08). Within the feigning group, there was a significant effect of condition (F (1.60, 52.71) = 5.39, $\eta\rho^2$ = .14, p = .01),which remained robust to application of Bonferroni correction; with Bonferroni-corrected post-hoc pairwise-comparisons revealing that the feigning group used significantly more pauses in the low cognitive load condition than both the medium (p = .01) and high (p = .03) cognitive load conditions, but the medium and high cognitive load conditions were not significantly different from one another (p = 1.00). Within the schizophrenia group, there was a significant main effect of condition (F (2, 82) = 16.24, $\eta\rho^2$ = .28, p< .001), which remained robust to application Bonferroni correction, with Bonferroni-corrected post-hoc pairwise-comparisons revealing that the schizophrenia group used significantly more pauses in the low cognitive load condition than both the medium (p = .01) and high (p< .001) cognitive load conditions, but the medium and high cognitive load conditions were not significantly different from one another (p = .06). See Figure 6.

For Mean Pause Length (controlling for gender and age), there was a significant main effect of group, but no significant main effect of condition or interaction. Bonferroni-corrected post-hoc pair-wise comparisons revealed that the mean length of pauses for the control group was shorter than that of either the schizophrenia (p< .001) or feigning (p = .04) groups, but the schizophrenia and feigning groups did not differ from one another (p = .92). See Figure 6.

For Total Number of Utterances, there were significant main effects of group and condition, as well as a significant interaction. Post-hoc Tukey tests revealed that the schizophrenia group made significantly fewer utterances than the control group (p = .01), but the feigning group did not significantly differ from either other group (ps > .15). Bonferroni-corrected post-hoc pair-wise comparisons revealed that there were more utterances made during the low than the high cognitive load conditions (p < .001), but the medium load condition was not significantly different from either other condition (ps > .12). With regard to the interaction effect, post-hoc simple-effects analysis revealed a significant effect of condition within the

Table 15: ANOVAs comparing groups on Alogia variables, across cognitive load task conditions

Alogia	df	*F*	$\eta\rho^2$	*p*
Total Pause Number (controlling for gender)				
Group	2, 100	9.90	.17	<.001[a]
Condition	2, 200	4.10	.04	.02[b]
Group * Condition	4, 200	3.79	.07	.01[c]
Mean Pause Length (controlling for gender and age)				
Group	2, 99	8.17	.14	.001[d]
Condition	1.82, 180.08	.19	.00	.81
Group * Condition	3.64, 180.08	1.79	.04	.14
Total Utterance Number				
Group	2, 102	4.62	.08	.01[e]
Condition	2, 204	7.06	.07	.001[f]
Group * Condition	4, 204	3.74	.07	.01[g]
Mean Utterance Length				
Group	2, 102	4.46	.10	.01[h]
Condition	1.77, 180.54	6.27	.06	< .01[i]
Group * Condition	3.54, 180.54	3.63	.06	.01[j]

[a] Control > schizophrenia = feigning
[b] low load > medium > high (Note: this effect was not robust to family-wise Bonferroni-correction.)
[c] Controls: low = medium >high; feigning and schizophrenia: low > medium = high
[d]Schizophrenia = feigning> control
[e] Control > schizophrenia
[f]low load>high
[g] Schizophrenia: low > medium > high
[h] Schizophrenia > control
[i]high load >low
[j] Schizophrenia: high>low(Note: this interaction effect was not robust to family-wise Bonferroni-correction.)

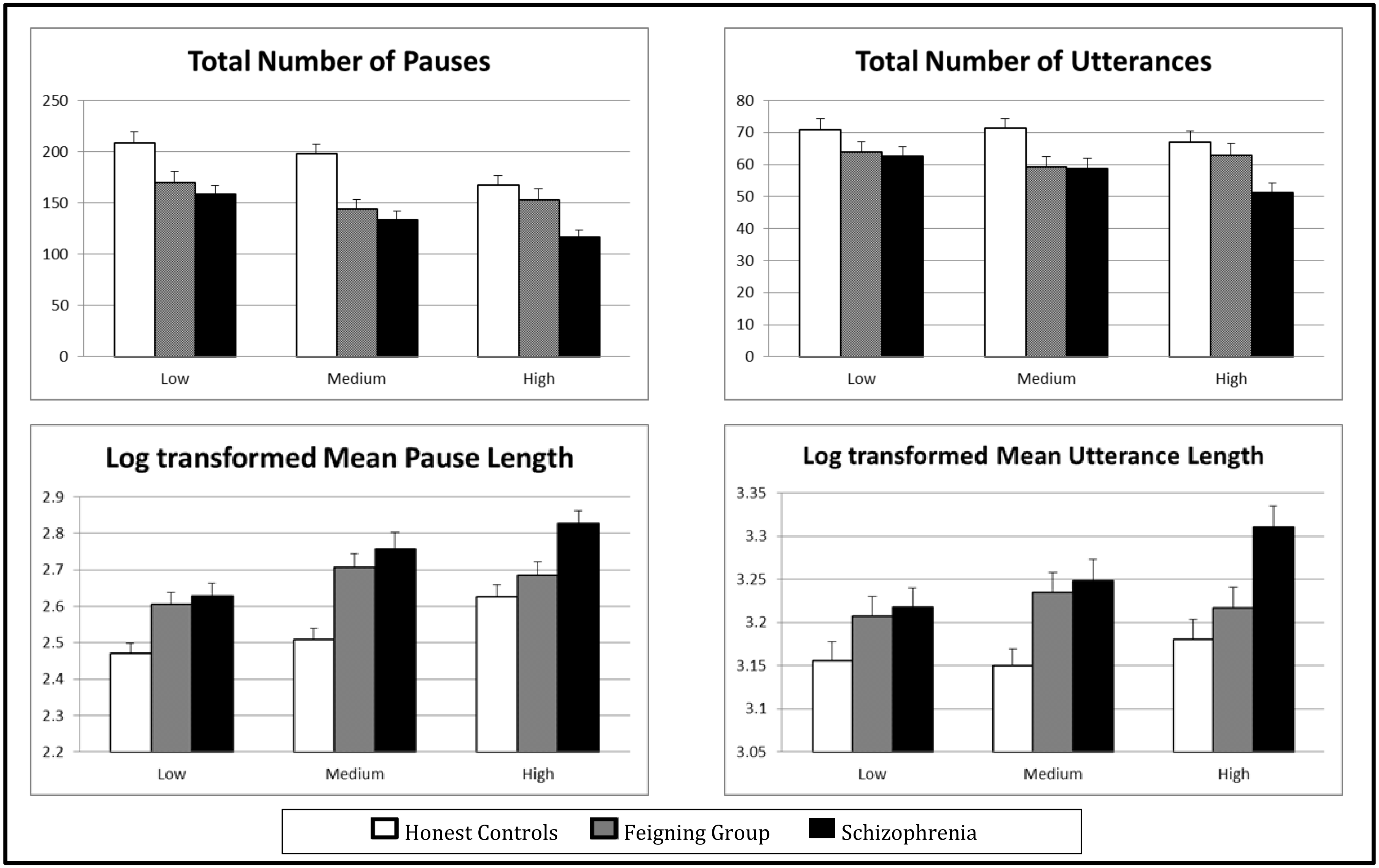

Figure 6: Alogia scores across cognitive load conditions

schizophrenia group (F (2, 82) = 9.14, $\eta\rho^2 = .18$, $p < .001$), which was robust to Bonferroni correction; with Bonferroni-corrected post-hoc pairwise-comparisons revealing that the schizophrenia group used significantly shorter utterances in the high cognitive load condition, as compared to both the low ($p < .001$) and medium ($p = .04$) load conditions, which were not significantly different from one another ($p = .49$). There were no significant main effects of condition within either the control (F (2, 56) = 2.20, $\eta\rho^2 = .07$, $p = .12$) or feigning (F (1.64, 54.0) = 2.48, $\eta\rho^2 = .07$, $p = .10$) group. See Figure 6.

For Mean Utterance Length, there were significant main effects of group and condition, as well as a significant interaction. Post-hoc Tukey tests revealed that the schizophrenia group had significantly longer utterances than the control group ($p < .01$), but the feigning group did not significantly differ from either other group (ps > .14). Bonferroni-corrected post-hoc pair-wise comparisons revealed that participants made shorter utterances in the low than the high cognitive load condition ($p < .001$), but the medium cognitive load condition did not significantly differ from either other condition (ps > .29). With regard to the interaction effect, post-hoc simple-effects analysis revealed a significant effect of condition within the schizophrenia group (F (1.76, 72.01) = 7.96, $\eta\rho^2 = .16$, $p = .001$), which was robust to application of Bonferroni correction; with Bonferroni-corrected post-hoc pairwise-comparisons revealing that the schizophrenia group used significantly longer utterances in the high cognitive load condition as compared to the low cognitive load condition ($p < .001$),but the medium load condition was not significantly different from either the low or high load conditions (ps > .08). There were no significant main effects of condition for either the control (F (2, 56) = 2.27, $\eta\rho^2 = .08$, $p = .11$) or feigning (F (1.67, 55.18) = 1.45, $\eta\rho^2 = .04$, $p = .24$) group. See Figure 6.

In summary, similar to performance on the affective reactivity task, on the cognitive load task the control group used significantly more pauses, with a shorter mean pause length, than either the schizophrenia or feigning groups. In other words, the feigning group was able to successfully resemble the schizophrenia group in its use of longer (and conversely fewer overall) pauses. The control group also used more and longer utterances than the schizophrenia group. Notably, these main effects of group (*p*s $\leq$ .012) were robust to Bonferroni-correction for family-wise error within the Alogia analysis set. For Total Pause Number, all three groups used fewer pauses as cognitive load increased; however, while this effect appeared to emerge when comparing the medium to high cognitive load condition for the control group, for the schizophrenia and feigning groups it emerged when comparing the low to medium load condition.

With regard to both Total Utterance Number and Mean Utterance Length, only the schizophrenia group participants demonstrated significant change across the conditions, using fewer utterances as they moved from the low to medium condition, and longer utterances as they moved from the low to high condition. These interaction effects were not robust to Bonferroni-correction for family-wise error for Mean Utterance Length (p = .014), but they were robust to such correction for Total Pause Number (p = .005) and Total Utterance Number (p = .006). See Figure 6.

Blunt Affect. Cognitive load speech task means and standard deviations for Blunt Affect variables, across groups, are set forth in Table 16. Emphasis and Inflection scores are provided as log-transformed and corrected for Mean Utterance Length.

Table 16: Means (± standard deviations) for Blunt Affect variables across groups, for cognitive load task conditions

Blunt Affect	Control	Feigning	Schizophrenia
Local Emphasis			
Low Load	256.99 (47.47)	274.32 (79.16)	268.06 (58.65)
Medium Load	258.72 (56.41)	273.71 (71.96)	262.84 (62.01)
High Load	267.29 (48.66)	265.19 (72.10)	259.05 (65.45)
Global Emphasis			
Low Load	85.29 (20.84)	86.78 (28.06)	89.29 (23.55)
Medium Load	80.92 (17.61)	90.23 (29.87)	84.23 (22.89)
High Load	87.90 (19.89)	85.57 (28.09)	88.81(21.53)
Local F0 Inflection			
Low Load	1.60 (.67)	1.62 (.63)	1.24 (.53)
Medium Load	1.69 (.66)	1.59 (.70)	1.27 (.51)
High Load	1.56 (.53)	1.55 (.62)	1.22 (.48)
Global F0 Inflection			
Low Load	1.22 (.46)	1.21 (.43)	.90 (.48)
Medium Load	1.22 (.47)	1.24 (.47)	.90 (.46)
High Load	1.29 (.42)	1.29 (.46)	.89 (.42)

Results for ANOVAs examining Blunt Affect variables across cognitive load conditions are set forth in Table 17. For Local Emphasis, there were no significant main effects. There was a trend-level interaction, but post-hoc simple effects analysis did not reveal any significant main effects of condition within any groups (Fs < 1.93, ps > .15). There were no significant main effects or interactions for Global Emphasis. See Figure 7.

There were no significant main effects or interactions for Local F0 Inflection (controlling for gender). For Global F0 Inflection (controlling for gender, age, and ethnicity), there was a significant main effect of group, but no significant main effect of condition or

Table 17: ANOVAs comparing groups on Blunt Affect variables, across cognitive load task conditions

Blunt Affect	df	*F*	$\eta\rho^2$	*p*
Local Emphasis				
Group	2, 102	.22	.00	.80
Condition	1.86, 189.48	.22	.00	.79
Group * Condition	3.72, 189.48	2.36	.04	.06
Global Emphasis				
Group	2, 102	.28	.01	.76
Condition	2, 204	.43	.00	.64
Group * Condition	4, 204	1.20	.02	.31
Local F0 Inflection (controlling for gender)				
Group	2, 100	1.90	.04	.16
Condition	2, 200	1.49	.02	.23
Group * Condition	4, 200	.41	.01	.80
Global F0 Inflection (controlling for gender, age, ethnicity)				
Group	2, 98	4.16	.08	.02[a]
Condition	2, 16	.02	.00	.99
Group * Condition	4, 196	.25	.01	.91

[a] Control > schizophrenia (Note: this effect was not robust to family-wise Bonferroni-correction.)

interaction. Bonferroni-corrected post-hoc pair-wise comparisons revealed that the schizophrenia group used significantly less F0 Global Inflection than the control group (p = .02), but the feigning group was not significantly different from either other group (*p*s > .28). However, this main effect of group (p = .019) was not robust to application of a Bonferroni correction for family-wise error within Blunt Affect analysis set. See Figure 7.

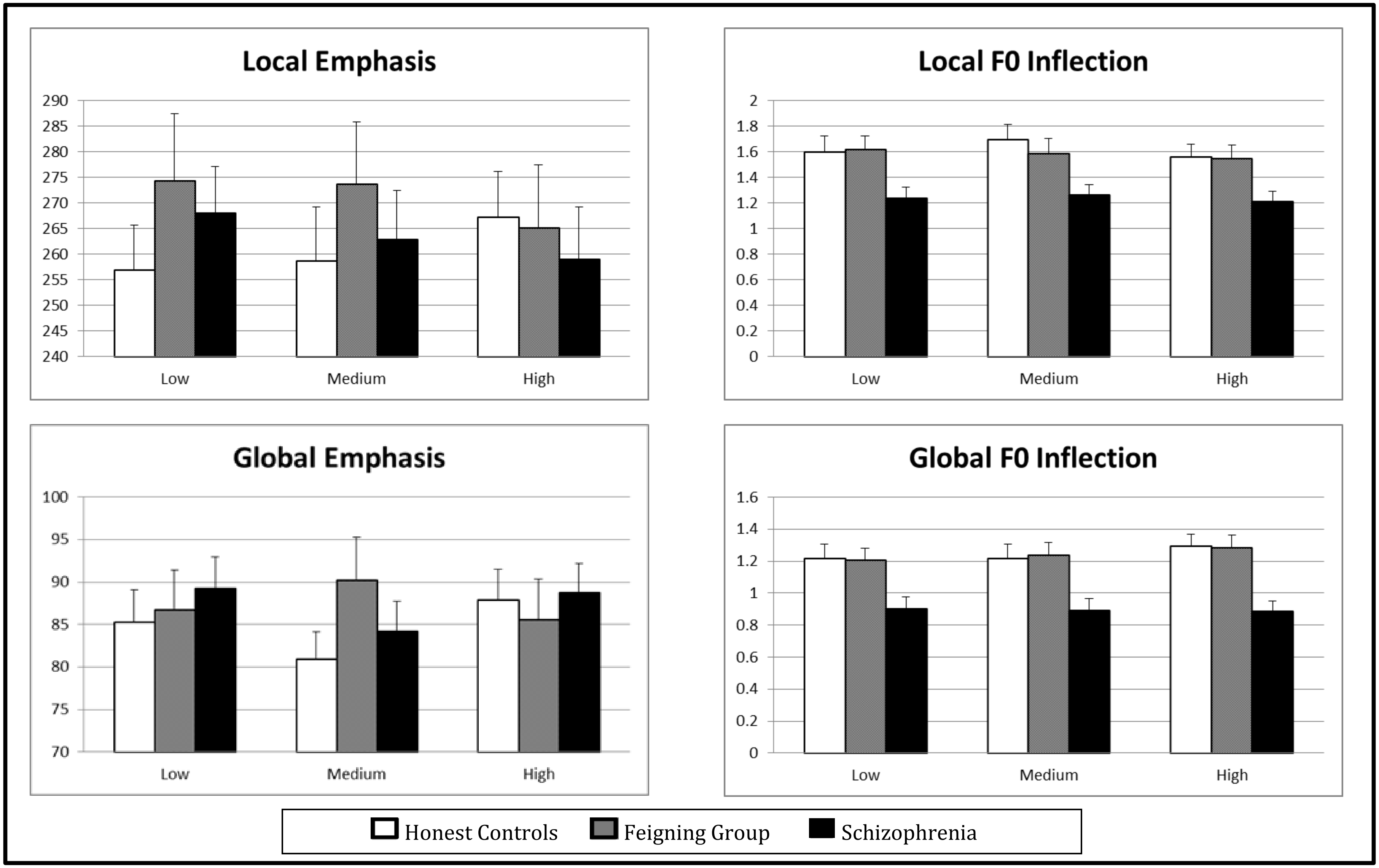

Figure 7: Corrected and log transformed Blunt Affect scores across cognitive load conditions

Formant variables. Cognitive load speech task means and standard deviations for Formant variables, across groups, are set forth in Table 18. Inflection scores are provided as log-transformed and corrected for Mean Utterance Length.

Table 18: Means (± standard deviations) for Formant variables across groups, for cognitive load task conditions

Formant variables	Control	Feigning	Schizophrenia
Local F1 Inflection			
Low Load	4.44 (1.00)	4.85 (2.62)	5.02 (1.61)
Medium Load	4.50 (1.39)	4.63 (2.33)	4.82 (1.66)
High Load	4.42 (1.06)	4.66 (2.37)	5.28 (1.89)
Global F1 Inflection			
Low Load	2.14 (.69)	2.06 (1.23)	2.39 (.90)
Medium Load	2.25 (.81)	2.09 (1.18)	2.42 (.88)
High Load	2.45 (.86)	2.25 (1.52)	2.66 (.98)
Local F2 Inflection			
Low Load	3.05 (.63)	2.02 (.51)	2.67 (.85)
Medium Load	3.00 (.92)	1.94 (.45)	2.60 (.77)
High Load	2.98 (.61)	1.95 (.44)	2.60 (.70)
Global F2 Inflection			
Low Load	1.38 (.41)	.53 (.35)	1.21 (.55)
Medium Load	1.37 (.53)	.59 (.36)	1.14 (.45)
High Load	1.52 (.44)	.56 (.36)	1.15 (.46)

Results for ANOVAs examining Formant variables across cognitive load conditions are set forth in Table 19. There were no significant main effects or interactions for Local F1 Inflection or Global F1 Inflection (controlling for age). For Local F2 Inflection (controlling for ethnicity and age) there was a significant main effect of group, but no significant main effect of condition or group by condition interaction. Bonferroni-corrected post-hoc pair-wise comparisons revealed that the control group used significantly more Local F2 Inflection than both the schizophrenia (p = .03) and feigning (p< .001) groups, and the schizophrenia used significantly more Local F2 Inflection than the feigning group (p< .01). See Figure 8.

For Global F2 Inflection (correcting for ethnicity and age), there was a significant main effect of group, a trend-level main effect of condition, and a significant interaction. Bonferroni-corrected post-hoc tests revealed that the control group used significantly more Global F2 Inflection than both the schizophrenia (p = .03) and feigning (p< .001) groups, and the schizophrenia used significantly more Global F2 Inflection than the feigning group (p< .001); but there were no significant differences among conditions (ps > .12). With regard to the interaction effect, however, post-hoc simple-effects analysisdid not reveal any significant effects of condition within any group, upon application of Bonferroni correction (Fs < 4.84, ps > .02). See Figure 8.

In summary, similar to performance on the affective reactivity task, in the cognitive load task the feigning group used less F2 Local and Global Inflection than the schizophrenia and control groups. In other words, the feigning group tended to use poor formant inflection (i.e., less tongue movement-based articulation) in attempt to mimic schizophrenia symptoms. Notably, both main effects of group for these variables (ps < .001) were robust to application of Bonferroni correction to account for family-wise error within the Formant variable analysis set. The feigning group's strategy did distinguish it from the control group for F2 Local and Global Inflection, in a direction matching that distinguishing the schizophrenia group from the control group (i.e., the schizophrenia group also used less Local and Global F2 Inflection than the control group). However, the feigning group over-exaggerated this effect, such that it also used significantly less F2 Local and Global Inflection than the schizophrenia group.

Table 19: ANOVAs comparing groups on Formant variables, across cognitive load task conditions

Formant variables	df	*F*	$\eta\rho^2$	*p*
Local F1 Inflection				
Group	1, 100	1.24	.02	.29
Condition	2, 200	1.32	.01	.27
Group * Condition	4, 200	1.11	.02	.35
Global F1 Inflection (controlling for age)				
Group	2, 99	.60	.01	.55
Condition	1.86, 184.30	1.41	.01	.32
Group * Condition	3.72, 184.30	1.11	.00	.98
Local F2 Inflection (controlling for ethnicity and age)				
Group	2, 98	14.72	.23	<.001[a]
Condition	1.85, 181.57	.66	.01	.51
Group * Condition	3.71	.04	.00	1.00
Global F2 Inflection (controlling for ethnicity and age)				
Group	2, 98	24.97	.34	<.001[a]
Condition	2, 196	2.89	.03	.06
Group * Condition	4, 196	4.51	.08	<.01[b]

[a] Control > schizophrenia > feigning.
[b] Post-hoc analysis did not reveal any significant differences across conditions for any group.

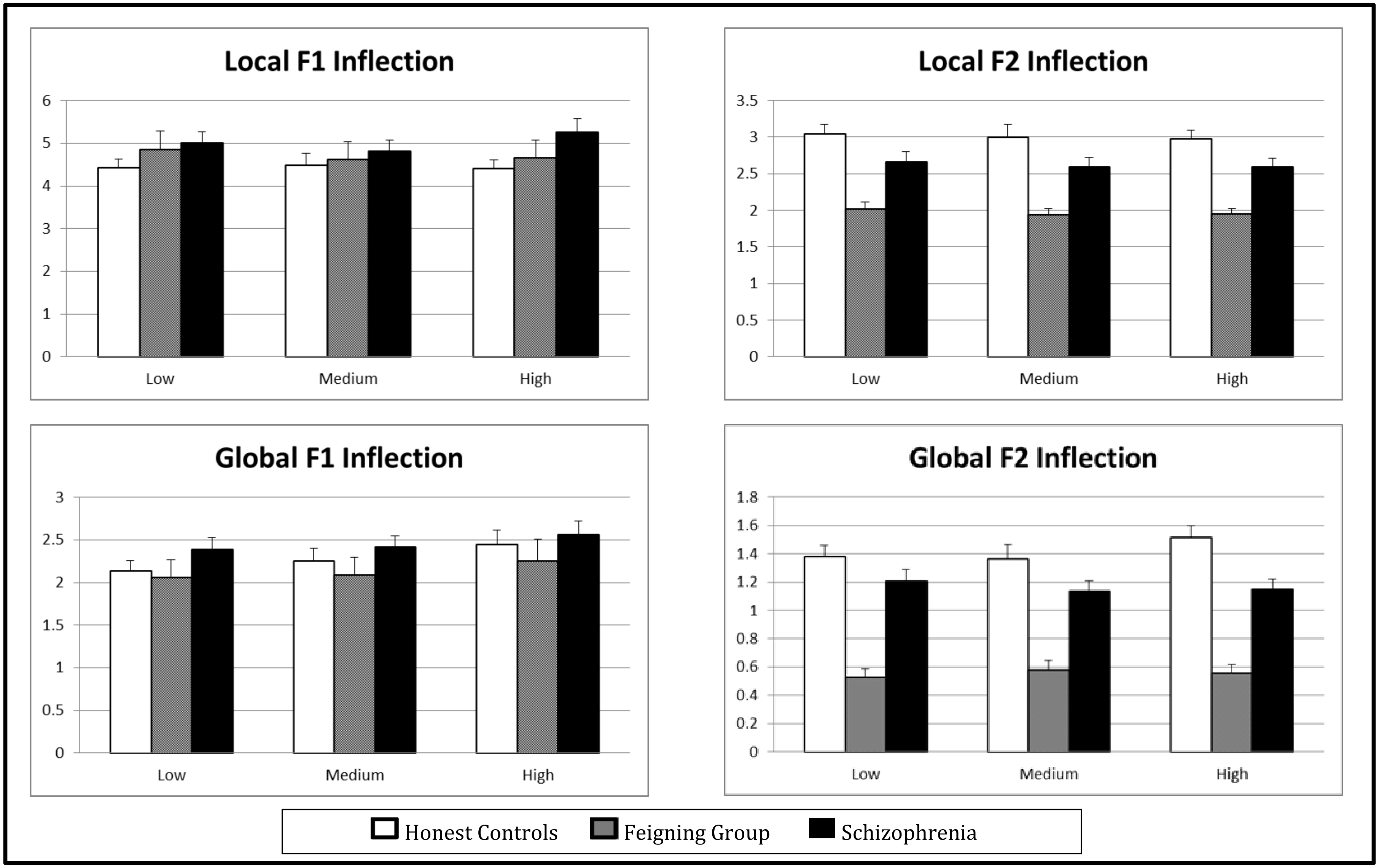

Figure 8: Corrected and log transformed Formant variable scores across cognitive load conditions

Cognitive task performance. Cognitive load speech task means and standard deviations for cognitive task performance variables, across groups, are set forth in Table 20.

Table 20: Means (± standard deviations) for cognitive task performance variables across groups, for cognitive load task conditions

Cognitive Task Performance	Control	Feigning	Schizophrenia
d'			
Medium Load	3.38(.30)	.64(1.31)	2.36(1.49)
High Load	1.06(1.58)	.78(1.35)	-.01(1.70)
ln(β)			
Medium Load	.39(.45)	.08(.46)	.27(.50)
High Load	.28(.73)	-.08(.45)	.11(.64)

Results for ANOVAs examining cognitive task performance variables are set forth in Table 21. For *d'* performance values across groups and medium to high cognitive load conditions (controlling for age), there were significant main effects of group and condition, and a significant group by condition interaction. Bonferroni-corrected post-hoc pair-wise comparisons revealed that the control group performed significantly better than both the schizophrenia (p = .001) and feigning groups (p< .001), and the schizophrenia group performed better than the feigning group at a trend level (p = .06); and participants performed better under medium than high cognitive load (p < .001). Post-hoc simple-effects analysis of the interaction effect revealed that both the control (t = 8.28, p< .001), and schizophrenia (t = 10.56, p< .001) groups performed significantly worse in the high load condition, as compared to the medium load condition; but the feigning group's performance was not significantly different across conditions (t = -.51, p = .62). See Figure 9.

Table 21: ANOVAs comparing groups on cognitive task performance variables, across medium and high cognitive load task conditions

	df	*F*	$\eta\rho^2$	*p*
d' (controlling for age)				
Group	2, 117	16.32	.22	< .001[a]
Condition	1, 117	6.20	.05	.01[b]
Group * Condition	2, 117	23.27	.29	< .001[c]
ln(β)				
Group	2, 118	7.06	.11	.001[d]
Condition	1, 118	4.11	.03	.05[e]
Group * Condition	2, 118	.05	.00	.95

[a] Control > schizophrenia > feigning
[b] Medium load > high load
[c] Schizophrenia and control: low > high
[d] Control = schizophrenia > feigning
[e] Medium load > high load (Note: this effect was not robust to family-wise Bonferroni-correction.)

For *ln(β)* performance values across groups and medium to high cognitive load conditions, there were significant main effects of group and condition, but no significant group by condition interaction. Post-hoc Tukey tests revealed that the feigning group's *ln(β)* values were significantly lower than those of the control ($p = .001$) and schizophrenia ($p = .05$) groups, indicating that the feigning group demonstrated a relatively moreliberal bias (i.e., greater number of both correct and incorrect responses); but the schizophrenia and control groups were not significantly different from one another ($p = .23$). Bonferroni-corrected post-hoc pair-wise comparisons revealed that participants tended to have a more conservative bias (i.e., smaller number of both correct and incorrect responses) in the medium cognitive load condition as compared to the high cognitive load condition, where they tended to show a more liberal bias ($p = .05$). See Figure 9.

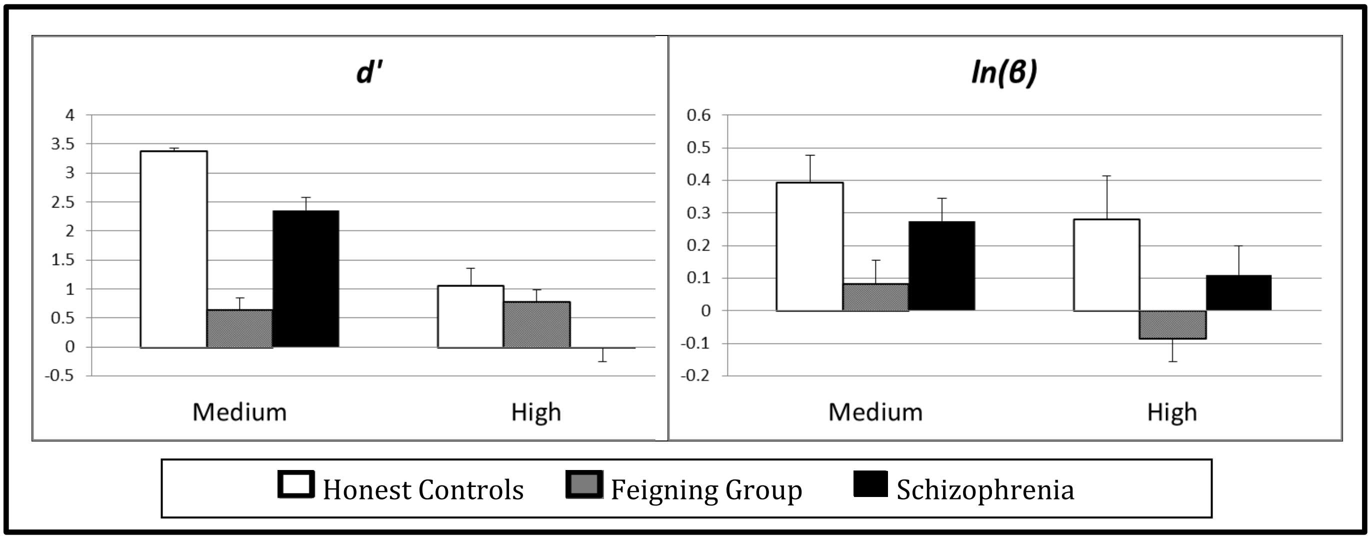

Figure 9:Cognitive performance variables across medium and high cognitive load conditions

In summary, the feigning group performed worse than both the schizophrenia and control groups on the cognitive task, and failed to demonstrate the pattern of impairment demonstrated by both the schizophrenia and control groups (i.e., lowered accuracy in the high as compared to medium cognitive load condition). The feigning group also demonstrated a more liberal bias (i.e., more correct and incorrect responses) than the schizophrenia or control groups. Notably, the main effects of group for both *d'* and *ln(β)*,the main effect of condition (p = .014) and the group by condition interaction for *d'*, were robust to Bonferroni correction (although the main effect of condition was not for *ln(β)*).

Feigning group post-task questionnaire

Table 22 sets forth feigning group participants' responses to a post-task questionnaire about their performance on the speech tasks.

Table 22: Summary of feigning group participants' responses to the post-task questionnaire (indicating % endorsing each response choice)

1. How confident are your performance on these tasks would have successfully convinced an examiner that you have schizophrenia?

Not at all	Slightly	Fairly	Quite	Very
30%	32%	23%	15%	0%

2. Which symptoms of schizophrenia did you focus on simulating in your attempt to convince the examiner that you have schizophrenia (indicate all that apply)?

Hallucinations	Delusions	Thought Disorder	Negative Symptoms	Cognitive Symptoms
53%	50%	65%	48%	53%

3. In addition to the information provided by the examiner, did you rely on any other additional sources of information about schizophrenia in creating your strategy for attempting to convince the examiner that you have schizophrenia (indicate all that apply)?

Know/work with someone with serious mental illness	Movies or television	News	Educational materials (e.g., psychology class)	Relied only on information provided	Other
33%	48%	28%	43%	15%	10%

Overall, participants were not highly confident in their ability to feign schizophrenia symptoms. Though 65% of feigning participants reported that they attempted to portray thought disorder (the symptom category with the highest endorsement with regard to feigning strategy), as a whole the feigning group was not successfully able to feign cognitive disorganization as measured by the CDI. Furthermore, there were no significant differences between individuals who reported that they attempted to simulate thought disorder and those who did not on CDI scores across any of the speech task conditions ($ts < .92$, $ps > .36$). There were also no significant differences between those who endorsed attempted simulation of cognitive symptoms (53%) and those who did not on any cognitive performance variables ($ts < 1.43$, $ps > .16$).

There were a few (mostly trend-level) differences between those who endorsed attempted simulation of negative symptoms (48%) and those who did not on verbal expressivity variables. Interestingly, those who endorsed simulation of negative symptoms used significantly more Local F2 Inflection in the unpleasant/high-arousal affective reactivity condition (*M* = 2.09, *SD* = .53) than those who did not (*M* = 1.78, *SD* = .35; *p* = .05). They also used more Local F2 Inflection in the high cognitive load condition (endorsing: *M* = 2.08, *SD* = .50; not endorsing: *M* = 1.82, *SD* = .33; *p*= .07), pleasant/high arousal condition (endorsing: *M* = 2.09, *SD* = .46; not endorsing: *M* = 1.80, *SD* = .49; *p* = .08), and unpleasant/low-arousal condition (endorsing: *M* = 2.04, *SD* = .49; not endorsing: *M* = 1.79, *SD* = .47; *p* = .06) at a trend level. It is thus unclear what those who thought they were portraying negative symptoms were attempting to behaviorally display. In any event, it should be recalled that as a group the feigners were not successful in using low levels of F2 Inflection to accurately feign negative symptoms, as they significantly under-articulated their speech so as to be distinguishable from the schizophrenia group. There were no other significant differences between those who endorsed attempted simulation of negative symptoms and those who did not on any other verbal expressivity variables (*t*s < 1.67, *p*s > .10).

Confidence in feigning ability was significantly correlated (using nonparametric Spearman correlations) with CDI scores in the pleasant/low-arousal condition (*r* = .42, *p* = .01), Global F1 Inflection in the unpleasant/high arousal condition (*r* = .39, *p* = .02), and Global F2 Inflection in the pleasant/high arousal condition (*r* = .33, *p* = .05). It was also correlated with Global Intensity in the pleasant/low-arousal condition (*r* = .31, *p* = .07), Global F1 Inflection in the pleasant/low arousal (*r* = .29, *p* = .09) and unpleasant/low-arousal (*r* = .29, *p* = .08) conditions, and Global F2 Inflection in the unpleasant/low-arousal condition (*r* = .31, *p* = .06) at trend levels.Again, though, it should be recalled that high levels of Formant Inflection were associated with identifiable feigning, as those in the feigning group demonstrated higher levels of expressivity deficits than individuals in the schizophrenia group. There were no significant correlations between feigning group confidence level and any other dependent variables (rs < .28, ps > .10).

DISCUSSION

This study sought to examine whether certain characteristics of speech disorganization and verbal flattening would discriminate between individuals with schizophrenia and healthy adults instructed to feign symptoms of schizophrenia. The hypotheses of this study generally predicted that the schizophrenia group would demonstrate more referential failures and expressivity deficits than either the controls or feigning group, who would not differ significantly from one another on these variables; and that the schizophrenia group would show a pattern of exacerbation of these disorganization and negative symptoms that was larger in magnitude than either the control or feigning group as cognitive and affective load increased by task condition. In addition, this study predicted that the feigning group would perform worse than either the schizophrenia or control groups on a series of cognitive performance tasks (although the schizophrenia group would also be expected to perform worse than the control group); and that the schizophrenia and control groups would demonstrate a pattern of lowered accuracy in the high, as compared to the medium, cognitive load condition (reflecting true effort spread across conditions of variable difficulty), but the feigning group would not, possibly even performing worse in the lower load condition, due to intentionally poor performance that was not sensitive to item difficulty level. These hypotheses were partially supported.

The first hypothesis predicted that in the affective reactivity speech task there would be (i) significant main effects for participant group, such that the schizophrenia group would demonstrate significantly more overall referential failures and expressivity deficits than both the honest control group and feigners, who would not differ from one another; and (ii) significant condition by group interactions, such that the magnitude of increase in referential failures and expressivity deficits for the schizophrenia group in comparing the pleasant condition to the unpleasant condition and/or the low-arousal to high-arousal condition would be significantly larger than for controls or feigners.

With regard to main effects of group, this predicted pattern was found only for CDI scores. However, there was no main effect of condition or interaction for CDI scores across affective reactivity conditions. Thus, the prior findings of Docherty et al., that schizophrenia patients may demonstrate an increase in speech disorganization in discussion of affectively unpleasant, as compared to pleasant, topics (1998), and at a larger magnitude than that displayed by controls, first-degree relatives, or depressed patients (2001) were not replicated. This failure to replicate these prior findings may be due to the fact that the Docherty et al. (1998, 2001)studies examined 10-minute speech samples, collected on separate days, which may have been more effective at inducing pleasant and unpleasant affective states than the 90 second speech samples collected, back-to-back, in the present study. In addition, unlike the present study in which the interviewer remained silent during the speech sample recording procedure in order to facilitate acoustic analysis procedures, the interviewers in the Docherty et al. (1998, 2001) studies interacted with the participants were necessary to keep participants focused on the instructed affective topic.

With regard to Formant variables (i.e., vocal expressivity variables related to tongue movements), the feigning group was distinguishable from the schizophrenia group in the affective reactivity task, but through display of a pattern opposite that of the pattern predicted. The feigning group demonstrated less vocal inflection than the schizophrenia group for Global F1 Inflection, and less vocal inflection than both the schizophrenia and control groups for Local and Global F2 Inflection. In other words, these variables did distinguish the feigning group from the schizophrenia group in a pattern that would suggest feigning, but did so because the feigning group over-exaggerated such symptoms. It appears as though, in an attempt to feign negative symptoms, the feigning group generally focused on using poor, mumbling, or slurry articulation; however, this strategy resulted in the feigning group exhibiting significantly greater expressivity deficits than even the schizophrenia group. The only significant interaction (for Local F2 Inflection) for the affective reactivity task was not robust to family-wise Bonferroni-correction, and only indicated differential patterns of expressivity across affective reactivity conditions for the control group (i.e., relative increase in inflection in the pleasant/high arousal condition). Therefore, this interaction was not relevant to the goal of identification of feigned symptoms.

By contrast, for Total Pause Number and Mean Pause Length (both variables in the Alogia category), feigning group participants actually more closely resembled the schizophrenia group in the affective reactivity task; and they were both distinguishable from the control group, which used more frequent and shorter pauses than either the schizophrenia or feigning group. In other words, on these dimensions of Alogia, participants in the feigning group appeared to successfully resemble the schizophrenia group in a manner that distinguished them from healthy controls, by demonstrating Alogia symptoms through use of longer (and conversely less frequent) pauses.

The second hypothesis predicted, similarly, that in the cognitive load speech task there would be (i) significant main effects for participant group, such that the schizophrenia group would demonstrate significantly more overall referential failures and expressivity deficits than the honest control group and feigners, who would not differ from one another; and (ii) significant group by condition interactions, such that the magnitude of increase in referential failures and expressivity deficits for the schizophrenia group as working memory load increased would be significantly larger than for controls or feigners.

Main effects of condition were apparent on several of the dependent variables in the cognitive speech task,in a manner consistent with existing research examining cognitive load theory (Paas, et al., 2010; Sweller, 2010), in healthy adults and schizotypy (Cohen et al., 2011) and schizophrenia patients (e.g., Cohen et al., 2013, manuscript in preparation; Melinder & Barch, 2003). However, there were no significant main effects of group that demonstrated the predicted pattern of performance (i.e., that the feigning group would be distinguishable from the schizophrenia group because feigners would not successfully replicate disorganization or negative speech symptoms, and would therefore more closely resemble controls). Similar to the affective reactivity task, though, there were group differences in Formant variable performance—specifically, Local and Global F2 Inflection—that distinguished the feigning group from the schizophrenia and control groups on the cognitive load task due to the feigning group's over-exaggeration of such symptoms. On Local and Global F2 Inflection, the schizophrenia group demonstrated significantly more verbal flattening than the control group; but the feigning group demonstrated significantly more verbal flattening than even the schizophrenia group. Again, it appears as though participants in the feigning group attempted to use poor, mumbling, or slurry articulation; but they over-shot the goal by exhibiting significantly greater expressivity deficits than even the schizophrenia group.

Main effects of group for Total Utterance Number, Mean Utterance Length (both variables in the Alogia category) and Global F0 Inflection (a variable in the Blunt Affect category) on the cognitive load task only distinguished the schizophrenia and control groups (although group effects for Global F0 Inflection were not robust to family-wise Bonferroni correction). Only the schizophrenia group demonstrated a differential pattern for Total Utterance Number and Mean Utterance Length across cognitive load conditions (although the interaction for Mean Utterance Length was not robust to family-wise Bonferroni correction). The schizophrenia group appeared to use longer and fewer utterances as cognitive task difficulty increased. Qualitative examination of participants' performance in the high cognitive load condition suggests that this may be due to the fact that participants in the schizophrenia group tended not to produce complete narratives in the high cognitive load condition, but instead began simply listing items that fell into the category suggested by the neutral task instructions (e.g., when asked to speak about "food" in the high load condition, participants in the schizophrenia group frequently provided responses such as "I like to eat [slowly listing different foods for the remainder of the speech sample]"). Therefore, speech patterns were simplified in response to the increase cognitive load, but not in a manner measured by the present variables in the anticipated direction (i.e., shorter utterances). Similarly, this response pattern (schizophrenia patients' decreased use of complex narrative as cognitive load increased) may explain the lack of a significant group effect for the CDI variable in the cognitive load task.

By contrast, similar to the affective load condition, for Total Pause Number and Mean Pause Length (both variables in the Alogia category), feigning group participants in the cognitive load task more closely resembled the schizophrenia group; and they were both distinguishable from the control group, which used more frequent and shorter pauses than either the schizophrenia or feigning group. In other words, on these dimensions of Alogia, participants in the feigning group did appear to successfully resemble the schizophrenia group in a manner that distinguished them from healthy controls, by demonstrating Alogia symptoms through use of longer (and conversely less frequent) pauses. There was also a significant group by cognitive load condition interaction for Total Pause Number and Mean Pause Length. All three groups demonstrated a similar pattern of increasing Alogia as cognitive load increased. However, for the control group this effect emerged in moving between the medium and high load conditions, whereas for both the feigning and schizophrenia groups this effect emerged earlier, when comparing the low and medium load conditions. In other words, the control group began to show a significant increase in Alogia (though pause use patterns) only when the cognitive load task increased from an easier to a more difficult level; but the schizophrenia and feigning groups began to show a significant increase in Alogia when the easier cognitive task was first introduced.

The third hypothesis predicted that in the cognitive load speech task there would be (i) significant group effects, such that the feigners would demonstrate poorer overall cognitive performance compared to the schizophrenia group, who would in turn demonstrate poorer overall cognitive performance compared to the honest control group; and (ii) significant interactions, such that the schizophrenia and honest control groups would perform worse during conditions of higher working memory load than the medium cognitive load condition, but feigners would perform worse during the medium load condition than high load condition. This hypothesis was generally supported. The schizophrenia group demonstrated significantly worse accuracy (as measured by *d'*) than the control group on the cognitive performance task; but the feigning group demonstrated significantly worse accuracy than the schizophrenia group. The feigning group also demonstrated a more liberal bias (as measured by *ln(β)*, representing a combination of more item hits and misses, possibly suggestive of either random responding or increased intentional misses) than either the control or schizophrenia groups. Additionally, differential group performance on the cognitive task partially supported the second part of this hypothesis, in that both the schizophrenia and control groups demonstrated the expected pattern of lowered accuracy in the high load condition, as comparedto the medium load condition; but the feigning group did not, suggesting an intentionally poor performance that was not sensitive to item difficulty level. In other words, the feigning group simply performed poorly across both levels of item difficulty, at a magnitude that was unrealistic even for individuals with cognitive impairment symptoms typically found in schizophrenia.

Significant results in this study (i.e., those relating to CDI, Alogia, Formant, and cognitive performance variables) may be considered along two dimensions: (i) the success or failure of the feigning group's attempt to portray symptoms of thought disorganization,negative speech symptoms, and/or cognitive deficits, and (ii) the pattern of group effects or interactions determining the success or failure of the attempt. Thus, the following four patterns may be examined: (1) instances where the attempt to feign a symptom was unsuccessful because the feigning group's performance was distinguishable from that of the schizophrenia group, and instead more closely resembled the control group; (2) instances where the attempt to feign a symptom was unsuccessful because the feigning group's performance was distinguishable from both the schizophrenia and control groups, appearing overly impaired; (3) instances where the attempt to feign a symptom was unsuccessful because the feigning group failed to demonstrate the expected pattern of change across cognitive load conditions as demonstrated by both schizophrenia and control groups, and (4) instances in which the attempt to feign a symptom was successful, with the performance of the feigning group resembling that of the schizophrenia group, and both the feigning group and schizophrenia group being distinguished from controls.

The first type of pattern—i.e., where the attempt to feign a symptom was unsuccessful because the feigning group's performance was distinguishable from that of the schizophrenia group, and instead more closely resembled the control group—was evident in CDI performance in the affective reactivity speech task. In essence, even after being provided with a specific description of disorganization symptoms, and despite the fact that 65% of participants in the feigning group reported that they attempted to feign thought disorder on the speech tasks, participants in the feigning group, on the whole, could not successfully mimic the pattern of referential failures commonly seen in schizophrenia. This is consistent with clinical observations made by Resnick and Knoll (2008). Furthermore, there were no significant differences between individuals in the feigning group who reported that they attempted to feign such symptoms and those who did not on CDI scores across any of the speech task conditions. However, confidence level in overall feigning ability was positively correlated with CDI scores in the pleasant/low arousal affective reactivity condition, at a medium effect size. Thus, within a more confident subset of the feigning group there may have been some ability to feign speech disorganization. Like other methods for detecting feigning of symptoms of psychosis, then, there would be expected to be a certain percentage of false negatives not detected by a measure of symptom feigning focused on inability to replicate referential failures. This fact underscores the crucial nature of a multi-symptom, multi-method approach to malingering detection.

The second type of pattern—i.e., where the attempt to feign a symptom was unsuccessful because the feigning group's performance was distinguishable from both the schizophrenia and control groups,appearing overly impaired—was evident in the feigning group's use of Formant inflection and performance on the cognitive task. This pattern of unsuccessful feigning is more consistent with response styles identified by existing malingering assessment tools, i.e., amplified presentation of symptom intensity (Rogers, 2008b). In examining patterns of Formant inflection (particularly, Local and Global F2 Inflection in the affective reactivity and cognitive load tasks, and Global F1 Inflection in the affective reactivity task), the feigning group appears, overall, to have used poor formant inflection (i.e., less tongue movement-based articulation) in attempt to mimic schizophrenia symptoms. This strategy did distinguish the feigning group from the control group in a direction matching that distinguishing the schizophrenia group from the control group (i.e., less inflection). However, the feigning group over-exaggerated this effect, such that it also used significantly less inflection than the schizophrenia group. Nearly half (48%) of individuals in the feigning group reported attempting to feign negative symptoms, but there was no evidence that individuals who attempted to portray negative symptoms were able to demonstrate decreased Formant inflection. Interestingly, those who reported an attempt to portray negative symptoms used significantly more Local F2 Inflection in the unpleasant/high arousal affective reactivity condition compared to those who did not, and used more Local F2 Inflection in the high cognitive load condition, and the pleasant/high arousal and unpleasant/low arousal affective load conditions, at a trend level. Thus, it is unclear what negative speech symptoms those who endorsed portrayal of such symptoms were attempting to display. In any event, individuals in the feigning group tended, as a whole, to overshoot the mark, thereby indicating intentional under-articulation at a level exceeding even that typically observed among individuals with schizophrenia.

Similarly, the feigning group distinguished itself from both the schizophrenia and control groups by performing poorly across cognitive performance variables (*d'* and $ln(\beta)$) in a manner that indicated significantly lower accuracy than was evident even within the schizophrenia group (see also Kertzman, et al., 2006; Melinder & Barch, 2003), as well as a more liberal response bias.This is consistent with prior research finding that individuals feigning psychosis frequently also attempt to feign cognitive impairment (Resnick & Knoll, 2008). There were no significant differences between individuals in the feigning group who reported attempting to feign cognitive symptoms (53%) and those who did not on these variables. There were also no significant relationships between overall confidence in successful feigning of symptoms and any cognitive performance variables. Thus, feigning participants were neither accurate in their perceptions of whether they actually demonstrated this (unsuccessful) feigning strategy, nor confident in their ability to successfully do so.

The third type of pattern—i.e., where the attempt to feign a symptom was unsuccessful because the feigning group failed to demonstrate the expected pattern of change across cognitive load conditions as demonstrated by both schizophrenia and control groups—was evident in cognitive task performance accuracy (*d'*). The schizophrenia and control groups' *d'* scores decreased as cognitive task difficulty increased. By contrast, the feigning group simply performed poorly across both levels of item difficulty, at a magnitude that was unrealistic even for individuals with symptoms cognitive impairment typically found in schizophrenia. This pattern is consistent with prior findings of Kertzman, et al. (2006). Identification of feigning through this pattern of response style capitalizes on the absence of an anticipated performance curve and floor effect among feigners (Rogers, 2008b). In other words, genuine patients produce predictable patterns of increasing errors with increased item difficulty, while feigners may not recognize that some simple cognitive tasks could be completed by even impaired individuals, and tend to demonstrate less of a distinction between items based on difficulty. As noted above, feigning participants were neither accurate in their perceptions of whether they actually demonstrated this (unsuccessful) feigning strategy, nor confident in their ability to successfully do so.

The fourth type of pattern—i.e., where the attempt to feign a symptom was successful because the performance of the feigning group resembled that of the schizophrenia group, and both the feigning group and schizophrenia group were distinguishable from controls—was evident in the pattern of pause use across both the affective reactivity and cognitive load tasks. In both tasks, the control group used significantly more pauses, with a shorter mean pause length, than either the schizophrenia or feigning groups. In other words, the feigning group was able to successfully resemble the schizophrenia group in its use of longer (and conversely fewer overall) pauses, thereby mimicking the schizophrenia group's Alogia. Furthermore, while the control group demonstrated a significant increase in pause-related Alogia as the cognitive task moved from a lower to a higher level of difficulty, the schizophrenia and feigning groups both demonstrated a significant increase in pause-related Alogia at an earlier stage in the process, when the cognitive task was first introduced (as compared to the neutral free speech condition not accompanied by a cognitive task, i.e., the low cognitive load condition). Pause-based variables, however, were not related to either reported attempt to feign negative symptoms or overall confidence in feigning performance. This lack of association between strategy and result raises the question as to what factors may have contributed to the feigning group's successful use of pauses in the speech tasks, such that it was distinguishable from the control group but not the schizophrenia group. On one hand, it could be that pause-based expressivity deficits are easier than other more complex verbally-based deficits to intentionally and accurately mimic. On the other hand, it could be that the added effort of maintaining false speech compounded the cognitive load of the task for individuals in the feigning group, such that at least with regard to pause use they genuinely resembled the schizophrenia group without doing so purely through intentionally and disingenuously impaired performance (see Vrij, Granhad, and Porter (2010) for a discussion of the technique of imposing cognitive load during interviews as a means to detect deception).This interpretation would be consistent with Rogers and Knoll's (2008) clinical observation that malingerers may repeat questions or answer them slowly to give themselves time to generate a deceptive response. In either case, it would be advisable for clinicians not to consider simple pause patterns in making a clinical judgment as to the presentation of genuine versus feigned negative schizophrenia symptoms.

Overall, then the results suggests a few important factors for clinicians to keep in mind when considering a possibly feigned presentation of psychosis. First, the presence of subtle verbal indications of formal thought disorder (e.g., confused references, lack of grammatical clarity, references that assume the listener has prior information that he or she does not) may be a reliable indicator of the presence of a genuine psychiatric disorder that individuals without such impairment are unlikely to successfully feign, even if attempting to do so. However, in order for this discrepancy to be observed, an individual must be placed in a situation requiring spontaneous generation of free speech. The high cognitive load condition did not provide such an opportunity, possibly due to the limited complexity of speech content under high load conditions, frequently resulting in category-naming style responses. Similarly, overly structured clinical interviews requiring only brief responses may be less effective at capturing the presence or absence of speech disorganization in suspected feigners than open-ended questions that require a more lengthy narrative description. By contrast, the cognitive load condition allowed for observation of excessive impairment by feigners on cognitive performance variables. Formant variables also revealed such a pattern of excessive impairment, which was observed across both speech conditions and may therefore possibly be observed under various interviewing styles. While negative speech symptoms were measured as higher in the schizophrenia group then the controls, specifically with regard to F2 Inflection, the feigning group used even less F2 Inflection than either other group. Therefore, extremely poor articulation, or mumbling speech, might be considered an additional red flag for clinicians confronted with a potential feigner. However, because the significance of this variable is one of magnitude, and not simple presence or absence of a behavioral sign, it must be interpreted with significant caution. Moreover, while F2 Inflection has been shown to be associated with clinician ratings of negative symptoms (Covington et al., 2012), it is yet unknown whether clinicians would be able to distinguish between the level of Formant articulation deficits displayed by a genuine schizophrenia patient versus a feigner based only on aural perception unassisted by technology. Additionally, it is again notable that increased pause length, while a behavioral sign observable in patients with schizophrenia, could also possibly be the result of cognitive resources strained by the demand of generating description of or attempting to behaviorally manifest feigned symptoms. Thus, clinicians with reason to suspect the presence of malingering behavior should be careful not to assume that the presence of lengthy pauses (e.g., increased response latency during interviewing) indicates the presence of genuine cognitive impairment.

This study does have several limitations that should be considered when interpreting the results. First, despite participant recruitment attempts aimed at matching participants on demographic variables across groups (i.e., gender, ethnicity, and age), practical limitations of participant recruitment resulted in composition of groups that were significantly different across demographic variables relevant to outcome variables. Therefore, these demographic variables were controlled for statistically in analyses, where necessary, resulting in a loss of statistical power. Individuals recruited for the feigning group (community members, including some college students) may also simply not be representative of actual malingerers that might be present in a forensic or clinical setting. However, this is a general limitation of a simulation design, and would be expected to be addressed in the next anticipated step in a malingering research line, i.e., a known-groups design. Additionally, the schizophrenia group was not screened for malingering, so in part this study reflects some of the flaws inherent in the differential prevalence design (i.e., there may have actually been some malingerers in the patient group, thus the assumption cannot be made that the patient group was 100% "genuine"). However, participants in the schizophrenia group were recruited from non-forensic settings, most often from environments suggesting chronic symptom presentation (i.e., group living facilities). Furthermore, the simulation group here is composed completely of feigners, thus the magnitude of difference in the likely rates of malingering between the two groups is vastly different than in a differential prevalence design and it can be stated with greater certainty that there were more feigners in the simulation group than in the patient group. Also, if there were any feigners present in the schizophrenia group, any differences identified by the present analyses are likely to be conservative with regard to their power to discriminate between feigners and true schizophrenia patients. In addition, the schizophrenia group was psychiatrically medicated, an effect that could not be statistically controlled. Medication side effects, therefore, could have increased the magnitude of negative symptoms displayed by the schizophrenia group. On the other hand, though, medication should improve performance on at least disorganization symptoms in schizophrenia. Either way, given the direction of the patterns of symptom portrayal by the feigning group, such effects would make the results of the present analyses more conservative when compared to what one might expect when comparing feigners to an un-medicated schizophrenia group.

Another limitation is that the control group (along with the schizophrenia group) was recruited as part of a larger study, and the feigning group was concurrently recruited by a separate procedure that referenced "faking" of symptoms in the recruitment materials. Therefore the assignment of community participants to the honest control and feigning groups was not truly "random," but might reflect differential interest in acting, dishonesty, etc., which could undermine the internal validity of the design as a simulation design. However, such a difference may actually be more reflective of the character of malingerers in actual forensic or clinical settings—i.e., those who find the idea of feigning symptoms to be something they would feel comfortable attempting may actually be more likely to attempt to do so. In addition, data from the feigning group was collected during a subset of the data collection processfor the larger study (i.e., for the schizophrenia and honest control groups), such that the data collection process for the larger study spanned almost two years (April 2010 through July 2012) whereas the data collection process for the feigning group spanned only seven months (November 2011 through May 2012). Consequently, a differential set of historical factors may have influenced the groups' verbal behavior. In addition, it is possible that certain news stories about or fictional portrayals of individuals with mental illness highlighted in national or local public media at the time that data was collected from the feigning group may have specifically influenced the feigning group's perceptions of mental illness, in a manner that could limit the generalizability of findings regarding the feigning group's verbal behavior to other time periods or geographical locations.

Furthermore, there are more general limitations of malingering assessment techniques that must be kept in mind when considering the potential future clinical application of this study's results. First, like all malingering assessment techniques, this method can actually only suggest the presence or absence of feigning—it cannot speak to the motivation for feigning. It ultimately remains the clinician's responsibility to infer whether the motivation is external (e.g., tangible reward or punishment avoidance), i.e., malingering, or internal (e.g., factitious disorder). In addition, it is important for clinicians to consider the specific style of the suspected malingerer and tailor assessment methods accordingly (Rogers, 2008b). For example, examining

CDI differences should be limited to situations where suspected malingerers are attempting to actively feign positive and/or disorganization symptoms, as schizophrenia patients with prominent negative symptoms may not demonstrate affective reactivity in cognitive disorganization (although they do show significantly higher overall baseline cognitive disorganization as compared to controls (Cohen & Docherty, 2004)).

Moreover, while this study supports the proposition that quantitative examination of certain speech-based disorganization and negative symptoms could add relevant incremental validity to existing malingering assessment tools, several significant hurdles would need to be overcome if the speech patterns discussed herein were ever to provide a future basis for development of a feigning assessment tool designed for use in actual clinical practice. First, it should be recognized that this is a preliminary examination of vocal patterns of individuals feigning psychosis only. In particular, it is cautioned by Rogers(2008b) that the more complex method of examining spurious patterns of psychopathology (e.g., the group by condition interactions examined in the present study), requires extensive cross-validation. Furthermore, the present study's results can only suggest variables relevant to the presence or absence of feigned schizophrenia. It is as of yet unclear to what extent the present procedure suggests the presence of absence of other serious mental disorders that might also involve the transient experience of hallucinations or delusions, such as major depressive disorder (APA, 2000) or PTSD (Morrison, Frame, & Larkin, 2003). Relatedly, general medical conditions, neurological disorders, and substance-induced psychosis would have to be ruled out before malingering could be inferred from these methods, because positive symptoms may be present in these instances (especially when visual or tactile hallucinations are prominent) without thought disorder, bizarre behavior, or negative symptoms (Resnick & Knoll, 2008). In addition, while the CANS employs time-efficient computer-based scoring methods, the CDI requires the labor-intensive transcription of speech samples, and training and hand-scoring methods that are significantly more time-consuming. Thus, the development of a more practical approach to empirical measurement of instances of communication disturbances in natural speech for clinical application may need to be considered by future researchers.

Nonetheless, despite these limitations, the results of this study suggest a promising avenue of research in the area of clinical detection of malingering of psychosis. Going forward, it may be advisable for researchers to explore collection of speech samples of longer duration (Docherty, 1998, 2001), and under conditions more directly relevant to clinical assessment, such as responses generated during structured or semi-structured interviews aimed at obtaining description of distressing psychiatric symptoms. Future studies could employ a known groups design to examine the pattern of speech variables present among suspected malingerers in a clinical setting. Future research should also examine potential nuances in feigned and genuine schizophrenia speech patterns due to ethnic differences. In addition, these methods should be explored in relation to their specificity in the detection of feigned schizophrenia symptoms, through examination of the performances of known groups with other serious mental illness (e.g., bipolar disorder).

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APPENDIX A
SCHIZOPHRENIA SUMMARY EXCERPTED FROM THE NATIONAL INSTITUTE OF MENTAL HEALTH(2009)

What are the symptoms of schizophrenia?

The symptoms of schizophrenia fall into three broad categories: positive symptoms, negative symptoms, and cognitive symptoms.

Positive symptoms

Positive symptoms are psychotic behaviors not seen in healthy people. People with positive symptoms often "lose touch" with reality. These symptoms can come and go. Sometimes they are severe and at other times hardly noticeable, depending on whether the individual is receiving treatment. They include the following:

Hallucinations are things a person sees, hears, smells, or feels that no one else can see, hear, smell, or feel. "Voices" are the most common type of hallucination in schizophrenia. Many people with the disorder hear voices. The voices may talk to the person about his or her behavior, order the person to do things, or warn the person of danger. Sometimes the voices talk to each other. People with schizophrenia may hear voices for a long time before family and friends notice the problem.

Other types of hallucinations include seeing people or objects that are not there, smelling odors that no one else detects, and feeling things like invisible fingers touching their bodies when no one is near.

Delusions are false beliefs that are not part of the person's culture and do not change. The person believes delusions even after other people prove that the beliefs are not true or logical. People with schizophrenia can have delusions that seem bizarre, such as believing that neighbors can control their behavior with magnetic waves. They may also believe that people on television are directing special messages to them, or that radio stations are broadcasting their thoughts aloud to others. Sometimes they believe they are someone else, such as a famous historical figure. They may have paranoid delusions and believe that others are trying to harm them, such as by cheating, harassing, poisoning, spying on, or plotting against them or the people they care about. These beliefs are called "delusions of persecution."

Thought disorders are unusual or dysfunctional ways of thinking. One form of thought disorder is called "disorganized thinking." This is when a person has trouble organizing his or her thoughts or connecting them logically. They may talk in a garbled way that is hard to understand. Another form is called "thought blocking." This is when a person stops speaking abruptly in the middle of a thought. When asked why he or she stopped talking, the person may say that it felt as if the thought had been taken out of his or her head. Finally, a person with a thought disorder might make up meaningless words, or "neologisms."

Movement disorders may appear as agitated body movements. A person with a movement disorder may repeat certain motions over and over. In the other extreme, a person may become catatonic. Catatonia is a state in which a person does not move and does not respond to others. Catatonia is rare today, but it was more common when treatment for schizophrenia was not available.[2]

"Voices" are the most common type of hallucination in schizophrenia.

Negative symptoms

Negative symptoms are associated with disruptions to normal emotions and behaviors. These symptoms are harder to recognize as part of the disorder and can be mistaken for depression or other conditions. These symptoms include the following:

- "Flat affect" (a person's face does not move or he or she talks in a dull or monotonous voice)
- Lack of pleasure in everyday life
- Lack of ability to begin and sustain planned activities
- Speaking little, even when forced to interact.

People with negative symptoms need help with everyday tasks. They often neglect basic personal hygiene. This may make them seem lazy or unwilling to help themselves, but the problems are symptoms caused by the schizophrenia.

Cognitive symptoms

Cognitive symptoms are subtle. Like negative symptoms, cognitive symptoms may be difficult to recognize as part of the disorder. Often, they are detected only when other tests are performed.

Cognitive symptoms include the following:

- Poor "executive functioning" (the ability to understand information and use it to make decisions)
- Trouble focusing or paying attention
- Problems with "working memory" (the ability to use information immediately after learning it).

Cognitive symptoms often make it hard to lead a normal life and earn a living. They can cause great emotional distress.

APPENDIX B
NEUTRAL SPEECH TASK INSTRUCTIONS

1. Tell me as much as you can about where you live.
   You can talk about what your home is like, who you live with, about your furniture and rooms, and anything else you can think of. Include as many details as you can.

2. Tell me as much as you can about your hobbies.
   You can talk about any hobby that you can think of, such as sports, walking, watching TV or anything else. Include as many details as you can.

3. Tell me as much as you can about food.
   You can talk about anything about food you can think of, such as what you like to eat, what food you dislike, what you like to cook and how you cook, when you eat, where you eat and anything else. Include as many details as you can.

APPENDIX C
INSTRUCTIONS FOR AFFECTIVE LOAD SPEECH TASK

General Instructions:

Next, I want you to tell me some stories about yourself. I am interested in hearing about experiences and people from your life. You choose what you want to talk about, but try to get into the story and help me experience things as you did.

Please talk to me while concentrating on the computer screen. That is, talk to me without looking at me.

You will have 90 seconds to tell your story. Please talk for the full time.

Condition-Specific Instructions:

Pleasant Low-Arousal Condition:

Tell me some stories about when you were feeling really good and calm, NOT energetic/excited. Please get into telling this story as much as you can, and talk for 90 seconds.

Some things to talk about include:

1. Times you enjoyed being outside (e.g., sunset)
2. Times when you were really relaxed
3. Times when you felt at peace

Unpleasant Low-Arousal Condition:

Tell me some stories about when you were feeling really bad but NOT energetic/excited. Please get into telling this story as much as you can, and talk for 90 seconds.

Some things to talk about include:

1. Times you felt sad or down
2. Times when you were feeling low energy
3. Times when you ended relationships or people/pets you know passed away.

Pleasant High-Arousal Condition:

Tell me some stories about when you were feeling really bad but energized. Please get into telling this story as much as you can, and talk for 90 seconds.

Some things to talk about include:

1. Times you were really happy with someone
2. Times when you accomplished something really special
3. Times you were feeling at your best

Unpleasant High-Arousal Condition:

Tell me some stories about when you were feeling really bad but energized. Please get into telling this story as much as you can, and talk for 90 seconds.

Some things to talk about include:

1. Times you were really furious at someone
2. Times you were really scared
3. Times you felt disgusted at someone or something

APPENDIX D
POST-TASK QUESTIONNAIRE FOR THE FEIGNING GROUP

1) How confident are your performance on these tasks would have successfully convinced an examiner that you have schizophrenia (please indicate only one response)?
   a. Not at all confident
   b. Slightly confident
   c. Fairly confident
   d. Quite confident
   e. Very confident

2) Which symptoms of schizophrenia did you focus on simulating in your attempt to convince the examiner that you have schizophrenia (indicate all that apply)?
   __ hallucinations
   __ delusions
   __ thought disorders
   __ negative symptoms
   __ cognitive symptoms
   __ other (please indicate____)

3) In addition to the information provided by the examiner, did you rely on any other additional sources of information about schizophrenia in creating your strategy for attempting to convince the examiner that you have schizophrenia (indicate all that apply)?

   __ I know or have worked with someone with schizophrenia or other serious mental illness
   __ fictional movies or television about schizophrenia or other serious mental illness
   __ news items related to mental illness
   __ educational materials (e.g., psychology class)
   __ other (please indicate____)
   __ I relied only on the information provided by the examiner

4) Please briefly summarize your strategy for attempting to convince the examiner that you have schizophrenia in the space provided below (you may also use the back of the page for additional space if necessary).

APPENDIX E
COPY OF THE LOUISIANA STATE UNIVERSITY INTERNAL REVIEW BOARD'S PROJECT APPROVAL FORM

ACTION ON PROTOCOL APPROVAL REQUEST

LSU
Institutional Review Board
Dr. Robert Mathews, Chair
131 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.6792
irb@lsu.edu | lsu.edu/irb

TO: Alex Cohen
Psychology

FROM: Robert C. Mathews
Chair, Institutional Review Board

DATE: October 24, 2011
RE: **IRB#** 2679
TITLE: "Understanding Negative Symptoms in Schizophrenia Using Novel Technologies"

New Protocol/Modification/Continuation: Modification

Brief Modification Description: Request to collect data from a supplemental subset of healthy controls – recruited from the Baton Rouge community. Participants will be interviewed using the structured clinical interview as currently indicated in the existing protocol, and then instructed to complete two of the speaking tasks contained in the existing protocol. Investigators are interested in how individuals can "fake" mental illness based on speech analysis. Revised forms attached.

Review type: Full ___ Expedited X **Review date:** n/a

Risk Factor: Minimal X Uncertain ______ Greater Than Minimal______

Approved________ **Disapproved** ___________

Approval Date:________ **Approval Expiration Date:** 5/9/2012

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 200

Protocol Matches Scope of Work in Grant proposal: (if applicable) N.A.

By: Robert C. Mathews, Chairman [signature]

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING – Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. SPECIAL NOTE:

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

CONSENT FORM

Project Title: Computerized Measure of Negative Symptoms.

Performance Site:

1. Tyler Community Mental Health Clinic, Lafayette, LA
2. Peaceful Village group home: 811 Martin Luther Kind Drive. Lafayette LA 70501
3. River Oaks group home: 1507 Surrey Street. Lafayette LA 70501
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Investigator: The following investigator is available for questions Monday-Friday, 8:00 a.m.- 4:30 p.m.
Alex S. Cohen, Ph.D.
Psychology Department, LSU
(225) 578-7017

Purpose of the Study: The purpose of this research project is to develop a measure of mental illness symptoms using computerized analysis of speech. We are also interested in how this measure might be related to attention and memory ~~and personality and social support variables~~.

Inclusion Criteria: You are being asked to participate in this study because you are between the ages of 18 and 55, and are either:

1. A patient with a diagnosis of schizophrenia, schizoaffective disorder or depression
2. An individual who is free from mental illness.

Exclusion Criteria: Participation is excluded for individuals who are not judged to be clinically stable, have evidence of mental retardation or have history of significant head trauma or alcohol or drug dependence.

Maximum Number of Subjects: The maximum number of subjects will be 200.

Study Procedures/Description of the Study: I am aware that this study will take place over two sessions.

During the ~~first~~ testing session, I will be asked questions about my history and about my mental illness and substance use. I will also be asked to complete computerized tasks that measure my attention and speech patterns, and a questionnaire about those computerized tasks.
~~I will also be asked to complete several questionnaires and paper and pencil tests that measure my quality of life and attention. One of these questionnaires will measure my living skills – for example, how well I can pay bills, handle money and read a bus schedule. I will be recorded during parts of this study using a microphone. This session will last approximately two hours.~~
For participating in this session, I will be compensated $20 cash.

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~~I give permission for the researchers to access my medical records so that they can determine whether I am appropriate for this study.~~ I ~~also~~ recognize that certain portions of this study will be audio and video taped. This is being done to ensure we are doing things correctly, and for measuring certain symptoms of mental illness.

Benefits: I understand that I will not directly benefit from participating in this study. My participation will help researchers find out more information about schizophrenia, depression and related illnesses.

Risks/Discomforts: ~~I understand that I will be expected to participate in two sessions. T~~Participation in this study may be inconvenient in that it will take ~~a total of four~~one to two hours of my time. I also recognize that I will be asked to talk about my mental health history.

Right to Refuse: Participation in this study is voluntary. I may refuse to answer any questions or discontinue any test I am taking. Further, I can change my mind and withdraw from this study at any time without risking my relationship with either Louisiana State University or any treatment clinic or group home. I also recognize that I can contact the researchers at any point after the study is complete to have my audio and video taped records destroyed.

Privacy: All information obtained in this study will be kept confidential unless release is legally compelled. Limits to confidentiality include situations where an individual is at risk of hurting themselves (e.g., suicide) or hurting someone else (e.g., homicide, child abuse). I understand that the investigators are required by law to report any reasonable suspicions.

All records will be kept in a locked laboratory in a secure facility. Electronic data will be entered without identifying information and will be password protected. To ensure confidentiality, I will be assigned a number. All information collected during this study will be linked to this number and kept separate from any identifying information such as my name. Results of the study may be published, but no names or identifying information will be included for publication.

Financial Information: I will receive $20 cash upon the completion of ~~each session~~this study. I will receive a prorated amount if I am unable to complete the entire session. ~~The total monetary compensation for this project will not exceed $40.~~

Withdrawal: Participation in this study is voluntary. I may withdraw from this study at any time without penalty or loss of any benefit to which I would otherwise be entitled to.

Signatures:

The study has been discussed with me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigators. If I have questions about subjects' rights or other concerns, I can contact Robert C. Mathews, Chairman, LSU Institutional Review Board, (225)578-8692. I agree to participate in the study described above and acknowledge the researchers' obligation to provide me with a copy of this consent form if signed by me.

______________________________ ____________________

Participant Signature Date

**Research Assistant: please complete the statement below to indicate whether the consent form was read to the participant.* (Check One)

_________ I certify that I have read this consent form to the participant and explained that by completing the signature line above, he/she has agreed to participate (*NOTE – Consent form should be read to all patient participants)*.

_________ The participant will be enrolled as a control and is English-literate. The participant refused my offering to read this consent form to them.

______________________________ ____________________

Signature of Research Assistant Date

______________________________ ____________________

Signature of Principal Investigator Date

Study Approved By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Approval Expires: 5-9-2012

CONSENT FORM

Project Title: Computerized Measure of Negative Symptoms.

Performance Site:

1. Tyler Community Mental Health Clinic, Lafayette, LA
2. Peaceful Village group home: 811 Martin Luther Kind Drive. Lafayette LA 70501
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Signature of Principal Investigator Date

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225-578-8692 | www.lsu.edu/irb
Approval Expires: 5-9-2012

Project Report and Continuation Application

(Complete and return to IRB, 131 David Boyd Hall.
Direct questions to IRB Chairman Robert Mathews 578-8692.)

Institutional Review Board
Dr. Robert Mathews, Chair
131 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:** 4/15/2013

Review type: Full **Risk Factor:** Minimal **Date Sent: 3/4/2013**

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: N/A LSU proposal #____

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.
- X 4. **Active, work with subjects complete**; data analysis in progress.
- ___ 5. Project **start postponed**
- ___ 6. **Project complete;** end date __/__/__
- ___ 7. **Project cancelled**: no human subjects used.

III. PROTOCOL: (Check one).

- X 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: 0
- If such events occurred, describe them and how they affect risks in your study.
- Have there been any **previously unreported** events? Y/(N) ___ ?
  (if YES, attach report describing event and any corrective action).

V. CONSENT FORM AND RISK/BENEFIT RATIO:

Do 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. N/A Data Analysis in progress

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

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

Signature of Principal Investigator: [signature] **Date:** 3-7-13

IRB Action: √ Continuation approved; **Approval Expires:** 3/10/14	
___ Disapproved	
___ File closed	
Signed [signature]	Date 3/11/13

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Approval Expires: 5-9-2012

THE VITA

Gina M. Najolia is a current student in the Clinical Psychology graduate program at Louisiana State University, with an interest in the study, assessment, and treatment of severe and persistent mental illness. She anticipates earning her Doctorate of Philosophy in Psychology in 2013. She received her Bachelor of Arts in Psychology from New York University in 1999. She received her Juris Doctorate from Harvard Law School in 2002, and is a member of the California State Bar Association. She received her Master of Arts in Clinical Psychology in 2010. She is currently a predoctoral clinical psychology intern at Western State Hospital in Washington, and will begin a Postdoctoral Fellowship in Forensic Psychology at Patton State Hospital in California in the fall of 2013.