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# The role of atypical semantic activation in schizotypy: implications for odd speech and creativity

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THE ROLE OF ATYPICAL SEMANTIC ACTIVATION IN SCHIZOTYPY: IMPLICATIONS  
FOR ODD SPEECH AND CREATIVITY

A Dissertation

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

The Department of Psychology

By

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## Abstract

Individuals with schizophrenia tend to demonstrate patterns of atypical semantic activation, which are characterized by increased activation of weakly associated words within the semantic network. Although atypical semantic activation is associated with formal thought disorder, tangential speech, and poor long-term functioning in schizophrenia, very little is known about this variable in individuals with schizotypy, or the 10% of the population who demonstrate personality traits presumed to reflect genetic liability to schizophrenia. In this project, we employed highly sensitive laboratory procedures to test whether individuals with schizotypy ( $n = 45$ ) display increased atypical semantic activation compared to a non-schizotypy group ( $n = 26$ ). We also examined odd speech across four conditions that varied according to valence (pleasant, unpleasant) and arousal (high, low), investigated creativity, and analyzed the role of atypical semantic activation in odd speech and creativity in schizotypy. In this study, we observed that the schizotypy group demonstrated significantly increased atypical semantic activation, on the order of a large effect size, and performed significantly better on creativity tasks compared to the non-schizotypy group. Odd speech analyses were less conclusive. Overall, the schizotypy group demonstrated a slight increase, on the order of a small effect size, compared to the non-schizotypy group. This increase appeared to be the most robust in high arousal speech conditions. We did not find conclusive evidence for our hypotheses that atypical semantic activation influences odd speech or creativity. Potential implications of this study and future directions for examining atypical semantic activation, odd speech, and creativity across the schizophrenia-spectrum are also discussed.

## Introduction

Atypical semantic activation is characterized by a higher frequency of distantly related concepts becoming activated within semantic memory, which may lead to more loosely connected words or ideas being produced. There is evidence that individuals with schizophrenia who display thought disorder, which is defined by disordered speech (Bleuler, 1911; Kraepelin, 1919) and disruptions in conscious thinking (Kuperberg, Lakshmanan, Caplan, & Holcomb 2006), are more likely to demonstrate atypical semantic activation than patients without thought disorder or healthy controls (Pomarol-Clotet, Oh, Laws, & McKenna, 2008). Although atypical semantic activation has been examined in schizophrenia, very little is known about this variable in individuals with schizotypy, a construct that has been defined as reflecting approximately 10% of the population that demonstrates personality traits presumed to reflect genetic liability to schizophrenia (Meehl, 1962; Lenzenweger, 2006). Whereas atypical semantic activation is thought to lead to symptoms such as tangential speech in schizophrenia (Aloia, Gourovitch, Weinberger, & Goldberg, 1996), the milder patterns of atypical semantic activation that might be present in schizotypy may lead to both advantages and disadvantages. For instance, there is evidence that suggests creativity is enhanced (Folley & Park, 2005; Green & Williams, 1999; Miller & Chapman, 1983) and odd speech is more prevalent (Kerns & Becker, 2008; Minor & Cohen, 2010) in individuals with schizotypy. Atypical semantic activation could potentially explain both of these findings. The primary goals of the proposed project are to: 1) replicate previous findings that individuals with schizotypy display increased odd speech, creativity, and atypical semantic activation compared to a non-schizotypy group, 2) investigate how these variables differ across various manifestations of schizotypy and 3) examine whether atypical semantic activation leads to odd speech or creativity in schizotypy.

To achieve these goals and provide context for the present study, a review of several literatures is required. First, we discuss odd speech and how it affects those with schizophrenia and schizotypy. We also review how an additional factor, stress, may be related to odd speech. Second, we provide an overview of previous creativity studies that utilized schizophrenia and schizotypy samples. Third, we tie these areas together by examining atypical semantic activation. Finally, our rationale is presented and the results of this study are provided. The review of these literatures will begin with a brief discussion of schizophrenia and schizotypy.

## Review of Literature

### Schizophrenia

Schizophrenia is a complex, debilitating disease that affects approximately 0.5-1.0% of the population (Kessler et al., 2005; Sartorius et al., 1986). The disorder accounts for a heavy disease burden, totaling over 60 billion dollars in 2002 in the United States alone (Wu et al., 2005). This burden is especially relevant to young adults, where schizophrenia ranks ahead of heart disease, drug use, and HIV in cost to society (Murray & Lopez, 1996). First episodes of schizophrenia most commonly occur between ages 18-25 in males and ages 25-35 in females (Green, 2001). Although the risk factors that trigger the onset of schizophrenia are unknown and case-specific, there is compelling evidence to suggest that an interaction between environmental stressors and a genetic predisposition plays a critical role in symptom development (Zubin & Spring, 1977).

A wide range of symptoms characterize schizophrenia, including delusions, catatonia, and affective flattening (American Psychological Association, APA, 2000). However, there is no metabolic, genetic, neuroanatomical, neuropsychological deficit or symptom that is present in all, or even most, cases of the disorder (Cohen & Docherty, 2005; Menezes, Arenovich, & Zipursky, 2006). This heterogeneity is a significant hurdle when attempting to predict disease course in recently diagnosed cases (Cohen & Docherty, 2005). One way of reducing heterogeneity is to classify patients according to shared symptomology. Symptoms are often attributed to three clusters of behavior: (1) positive, (2) negative, and (3) disorganized (Bergman, Silverman, Harvey, Smith, & Siever, 2000; Liddle, 1987). This three-factor model is a way of classifying patients who have been diagnosed with schizophrenia. Next, we will provide an overview of how participants who demonstrate subclinical traits of schizophrenia are classified.



## Schizotypy

It has been suggested that the onset of schizophrenia is not the beginning of the disorder, but rather one of the last steps on a long path (Green, 2001). Schizotypy has been discussed since the early days of schizophrenia research, when it was referred to as “latent schizophrenia” by Bleuler (1911). Schizotypal traits resemble diminished forms of schizophrenia symptoms (see Ingraham, 1995) and studying these traits is critical for understanding the disorder as a whole. The genetic vulnerability that predisposes an individual to schizophrenia, which individuals with schizotypy are thought to demonstrate, has been hypothesized to have a prevalence rate of approximately 10% in the population, with 10% of those individuals eventually progressing to onset of schizophrenia (Lenzenweger & Korfine, 1992; Meehl, 1990). In addition to being at an increased risk for schizophrenia, individuals with schizotypy are also at an increased risk for other schizophrenia-spectrum and psychological disorders (Chapman, Chapman, & Kwapil, 1994; Gooding, Tallent, & Matts, 2005; Kwapil, Miller, Zinser, Chapman, & Chapman, 1997; Tyrka et al., 1995). Research using participants with schizotypy also offers some advantages over studies utilizing patients with schizophrenia, as researchers can examine traits without confounding factors such as medication effects (Gooding et al., 2005; Harrow & Marengo, 1986) or compliance issues (Weinstein & Graves, 2001).

One of the most common methods of identifying schizotypy is through the use of psychometric questionnaires, which are effective for screening large populations and identifying participants who would not be recruited using other methodologies (i.e., genetic identification; Gooding et al., 2005). Much like with schizophrenia, heterogeneity is also a hurdle in schizotypy research and schizotypal traits are separated into three factors to address this problem: 1) cognitive-perceptual (positive schizotypy), 2) interpersonal deficits (negative schizotypy), and 3)

disorganization traits (Arndt, Alliger, & Andreasen, 1991; Bilder, Mukherjee, Rieder, & Pandurangi, 1985; Kerns, 2006; Liddle & Barnes, 1990; Reynolds, Raine, Melling, Venables, & Mednick, 2000). In the proposed study, schizotypal traits are examined using this model. As it is unlikely that odd speech, creativity and atypical semantic activation will be evenly distributed across these traits, it is important to keep this three-factor model in mind as these variables are introduced.

### Odd Speech

Speech disorder is a cardinal symptom of schizophrenia (Andreasen, 1979a; 1979b; Docherty, 2005; Docherty, Rhinewine, Nienow, & Cohen, 2001) that remains relatively stable across periods of active psychosis and symptom remission (Andreasen & Grove, 1986; Docherty, Cohen, Nienow, Dinzeo, & Dangelmaier, 2003; Harvey, Docherty, Serper, & Rasmussen, 1990). This symptom has been described since early conceptualizations of the disorder (Bleuler, 1911; Kraepelin, 1919), as Bleuler (1911) stated that patients with schizophrenia displayed a loosening of associations that lead to an interruption in the associative threads that guide thinking. This loosening of associations often results in patients becoming sidetracked and discussing concepts that have no connection with the initial idea (McKenna & Oh, 2005). In extreme cases, patients may go completely off topic without returning to the original subject, a symptom referred to as tangentiality (Andreasen, 1979b; Schneider, 1959).

Although speech disorder is an important symptom of schizophrenia, few psychometric schizotypy studies have used behaviorally based measures to examine odd speech; instead, most studies have relied on self-report instruments. In a study from our laboratory (Minor & Cohen, 2010), we utilized a measure where raters identify specific instances of disorder procured from natural speech samples. We observed that individuals with schizotypy demonstrated significantly

elevated odd speech in comparison to a non-schizotypy group. In addition, we examined how odd speech was related to schizotypal traits, as researchers have proposed that speech disorder is associated with disorganized symptoms of schizophrenia (Andreasen, 1999). A similar pattern was observed in schizotypy, as disorganized schizotypy was associated with increased odd speech, whereas negative schizotypy was inversely associated with odd speech (Minor & Cohen, 2010).

One factor that appears to exacerbate speech disorder in individuals with schizophrenia is stress, as patients demonstrate an increase in this symptom when discussing stressful events (Burbridge, Larsen, & Barch, 2005; Cohen & Docherty, 2004; Docherty & Hebert, 1997; Seghers & Docherty, 2009). Researchers have proposed that increased arousal may impair speech in schizophrenia (Burbridge et al., 2005) and there is some evidence demonstrating this in individuals with schizotypy. Kerns and Becker (2008) examined odd speech across stressful and pleasant topics in 32 individuals with disorganized schizotypy compared to 34 non-schizotypal individuals. They observed that the disorganized schizotypy group demonstrated significantly elevated odd speech in the stressful, but not pleasant, condition. However, in a previous study from our laboratory (Minor & Cohen, 2010), we found that although both non-schizotypy and schizotypy groups demonstrated elevated odd speech in a stressful compared to pleasant condition, there was no significant group by condition interaction. We also examined affective reactivity, which measures the change in odd speech from the pleasant to stressful condition (Docherty, Evans, Sledge, Seibyl, & Krystal, 1994; Docherty & Hebert, 1997). Within the schizotypy group, we observed that negative schizotypy was inversely associated with affective reactivity, whereas positive and disorganized schizotypy were positively associated with affective reactivity at a trend level. Investigating the role of stress further is an important line of

research, as evidence suggests that this factor may play a role in the progression to schizophrenia (Myin-Germeys, van Os, Schwartz, Stone, & Delespaul, 2001; Myin-Germeys, Krabbendam, Jolles, Delespaul, & van Os, 2002; Myin-Germeys, Delespaul, & van Os, 2005; Norman & Malla, 1993; Ventura, Nuechterlein, Lukoff, & Hardesty, 1989). In this study, one aim is to examine which components of stress are related to increased odd speech by separating speech conditions according to both valence (unpleasant, pleasant) and arousal (high, low). Although we expect that both groups will exhibit increased odd speech in unpleasant valence and high arousal conditions, a second aim was to investigate group by condition interactions, with the expectation that the schizotypy group would exhibit significant elevations in the pleasant to unpleasant valence and low to high arousal conditions compared to the non-schizotypy group.

### Creativity

Much like with odd speech, researchers have been investigating the association between creative abilities and psychopathology for several decades (Burch, Pavelis, Hemsley, & Corr, 2006; Eysenck, 1995; Post, 1994; Prentky, 1980, 1989; Woody & Claridge, 1977). Research into this relationship was spurred on by studies where a higher incidence of mental illness in highly creative people was observed (Andreasen, 1987; Jamison, 1993; Nettle, 2001; Post, 1994; Wills, 2003). In regard to schizophrenia-spectrum disorders, it appears that enhanced creativity is found in individuals who display schizotypal traits (Eysenck & Furnham, 1993; Kline & Cooper, 1986; Merten & Fischer, 1999; O'Reilly, Dunbar, & Bentall, 2001; Weinstein & Graves, 2001; 2002; Woody & Claridge, 1977) as opposed to patients with schizophrenia (see Rybakowski, Klonowska, Patrzala, & Jaracz, 2008 for a review; see also Andreasen & Powers, 1975; Cropley & Sikand, 1973; Shimkunas & Murray, 1974). It has been proposed that creativity and psychosis may have an inverted U-shaped relationship, with creativity first increasing with mild

schizotypy, then decreasing as individuals approach the threshold of psychosis (Akiskal & Akiskal, 1988; Brod, 1997).

In the broad creativity literature, researchers are generally concerned with two types of creativity: 1) Everyday creativity, which is the generation of ideas or products that are both original and relevant to a particular task (Barron, 1969; Richards, Kinney, Benet, & Merzel, 1988; Richards, Kinney, Lunde, Benet, & Merzel, 1988), and 2) Eminent creativity, which focuses on the amount and caliber of an individual's creative achievements (Runco & Richards, 1998, Simonton, 1977). Much of the research into the relationship between creativity and schizotypy has focused on the everyday creativity advantages that individuals with schizotypy tend to display. Everyday creativity is generally assessed using psychometric tests that measure divergent thinking ability. On these tests, participants are instructed to produce multiple solutions for a given problem (Batey & Furnham, 2006; Rybakowski et al., 2008; Silvia, 2008). Several studies have found a link between schizotypy and everyday creativity tasks (Folley & Park, 2005; Green & Williams, 1999; Mohr, Graves, Gianotti, Pizzagalli, & Brugger, 2001; Schuldberg, 2001). Within schizotypy, it appears that positive schizotypy is related to enhanced everyday creativity (Barrantes-Vidal et al., 2002; Dinn, Harris, Aycicegi, Greene, & Andover, 2002; Gough, 1979; Kerns, Berenbaum, Barch, Banich, & Stolar, 1999; McCreery & Claridge, 2002; Nelson & Rawlings, 2010; O'Reilly et al., 2001; Weinstein & Graves, 2002), whereas negative schizotypy is inversely related to everyday creative abilities (Burch et al., 2006; Jaeger, Tatsuoka, Berns, & Varadi, 2006; Nettle, 2006; Schuldberg, 2001; Schuldberg, French, Stone, & Herberle, 1988). Most studies assessing the relationship between schizotypy and creativity have defined schizotypy as a dimensional construct and have utilized a two-factor model of schizotypy, consisting of positive and negative schizotypy. In the proposed study, our goal is to

examine how schizotypy and non-schizotypy groups differ on a measure of everyday creativity using a categorical conceptualization and to determine how specific traits, including disorganization traits, are related to creativity within the schizotypy group.

### Atypical Semantic Activation

A potential explanation for the expected increase in creativity and odd speech involves the patterns of atypical activation found within the semantic networks of individuals with schizotypy (Spitzer, 1997). These atypical patterns may be a result of an inability to suppress indirect associations, which could lead to more distantly related concepts becoming activated in the information-processing stream (Abraham & Windmann, 2008; Anderson & Pirolli, 1984). As a result, it would be more likely that unrelated words and ideas are produced. In patients with schizophrenia, atypical semantic activation appears to be related to clinically-defined thought disorder (see also Kreher, Goff, & Kuperberg, 2009; Kuperberg, Deckersbach, Holt, Goff, & West, 2007), as a recent meta-analysis found that patients with thought disorder showed increased atypical semantic activation compared to patients without thought disorder and healthy controls (Pomarol-Clotet et al., 2008).

In terms of speech production, atypical semantic activation appears to be associated with tangential speech in schizophrenia (Aloia et al., 1996), whereas the milder disturbances in semantic activation found in schizotypy may be manifested through odd speech that is less pronounced compared to patients, yet significantly higher than non-schizotypal individuals. In addition, atypical semantic activation may also be advantageous in schizotypy, as the ability to access atypical associations within the semantic network is associated with more unique solutions on creativity tasks (Mohr et al., 2001; Pizzagalli, Lehman, & Brugger, 2001). Evidence from neurobiological studies suggests that both speech disorder and creativity appear to be

linked with overactivation of specific brain areas. Researchers have observed that odd speech may be associated with atypical semantic activation in brain areas such as the temporal regions (Fletcher, 1998; Kircher et al., 2001), particularly the lateral temporal lobe (Kircher, 2008), and the left inferior frontal gyrus (Sabb, Bilder, Chou, & Bookheimer, 2007; Sabb et al., 2010), whereas creativity appears to be related to overactivation of the frontal cortex (Folley & Park, 2005; Gibson, Folley, & Park, 2007).

One method of investigating atypical semantic activation that has shown promise is by examining responses from category fluency (CF) tests. Sophisticated methods, such as the Typicality Index (TI; Kiang & Kutas, 2006), have been developed to analyze the semantic space between words by calculating how unconventional a participants' set of responses are. The more atypical a person's set of responses are is thought to reflect more atypical semantic activation, predominantly through overactivation or a wider spread of activation. Studies examining responses from CF tests have demonstrated that patients with schizophrenia demonstrate atypical semantic processing (Clare, McKenna, Mortimer, & Baddeley, 1993; Cutting & Murphy, 1988; Harvey, Earle-Boyer, Wiegus & Levinson, 1986; Morice & McNicol, 1986; Tamlyn et al., 1992).

Using TI, there is some evidence that atypical semantic activation exhibited in schizotypy may be similar to schizophrenia (Kiang & Kutas, 2006). However, few studies have examined the relationship between atypical semantic activation and odd speech or creativity in schizotypy. We were unable to find any studies that have examined the relationship between creativity and atypical semantic activation using responses from CF tests, despite the evidence that the ability to access indirect associations within the semantic network is an important component of creativity (Mohr et al., 2001; Pizzagalli et al., 2001). In regard to odd speech, we recently

observed that atypical semantic activation was related to odd speech when stressful events were discussed by individuals with schizotypy, but not when pleasant or neutral topics were discussed (Minor, Cohen, Weber, & Brown, 2011). A potential explanation for this finding is that individuals with schizotypy who exhibit atypical semantic activation patterns may be able to inhibit unique associations when discussing pleasant or neutral topics. However, the resources required for inhibiting atypical semantic processing from affecting speech may be tapped when stressful events are discussed, thus resulting in more odd speech. In line with this explanation, researchers have observed an increase in odd speech in stressful compared to pleasant conditions when individuals with schizophrenia (Docherty et al., 1994; Docherty & Hebert, 1997) and schizotypy (Kerns & Becker, 2008) are compared to non-schizotypal participants. There is also evidence that semantic processing difficulties are linked with negatively valenced words, which would suggest that these problems may be due to difficulties integrating stressful information into the semantic system (Klumpp et al., 2010). Our goal in this study is to further examine the role that atypical semantic activation plays in odd speech (across all conditions) and creativity in individuals with schizotypy.

### Purpose

Although there is some evidence to suggest that both creativity and odd speech are pronounced in individuals with schizotypy, very little is known about the mechanisms that lead to these increases. The lack of research concerning specific mechanisms of these variables represents an important knowledge gap in the schizophrenia literature. As odd speech and creativity have been linked to atypical semantic activation, particularly overactivation within semantic memory, we propose that atypical semantic activation may be a potential mediator for both. Thus, the proposed study has three primary aims: 1) to replicate findings that odd speech,



creativity, and atypical semantic activation are elevated in schizotypy, 2) to evaluate these constructs across positive, negative, and disorganization traits within schizotypy and 3) to examine whether atypical semantic activation mediates odd speech or creativity in a group of individuals with schizotypy.

### Extensions Upon Existing Literature

There are several areas in which this study replicates and extends upon the previous literature. As discussed above, little is known about the mechanisms that lead to increased odd speech and better performance on creativity tasks that are generally exhibited by individuals with schizotypy. To our knowledge, this is the first schizotypy study to examine atypical semantic activation as a potential mechanism for both of these variables. Further, responses from CF tests have been utilized as a method of assessing atypical semantic activation in several schizophrenia studies (Clare et al., 1993; Harvey et al., 1986; Tamlyn et al., 1992). However, this is one of the first studies to utilize this methodology in individuals with schizotypy. Results from two previous studies have been inconclusive (Kiang & Kutas, 2006; Minor et al., 2011); however, both suggest that using responses from CF tests is a promising method of identifying atypical semantic activation in those with schizotypy.

In regard to odd speech, most researchers have compared stressful with pleasant speech conditions to investigate the role of stress, without disentangling the unique contributions of valence and arousal. To our knowledge, this is the first schizotypy study to separate speech conditions according to valence (unpleasant, pleasant) and arousal (high, low) in order to examine how each factor is associated with odd speech. By doing so, we can examine whether the schizotypy group exhibits significant elevations in odd speech compared to the control group on either factor and, if so, observe if one factor plays a more prominent role. In addition, we also

seek to replicate findings that odd speech is generally increased in the schizotypy group by examining rates across all four conditions.

The vast majority of previous creativity studies have conceptualized schizotypy as a dimensional construct. Although our primary goal is to replicate findings that the schizotypy group will perform better on creativity tasks than the non-schizotypy group, this is one of a handful of studies to examine creativity in schizotypy using a categorical conceptualization. In addition, this is also one of the first studies to investigate how creativity is related to disorganization traits, which we expect to be significantly associated with creativity. There have also been few studies examining how disorganization traits are related to odd speech and atypical semantic activation in those with schizotypy.

### Hypotheses

As part of this examination, three sets of hypotheses will be evaluated:

- I. Schizotypy versus non-schizotypy group
  - a. The schizotypy group will perform significantly better on creativity tasks.
  - b. The schizotypy group will exhibit significantly elevated atypical semantic activation.
  - c. The schizotypy group will display a significant increase in odd speech.
    - i. Participants from both groups will demonstrate significant increases in odd speech in unpleasant compared to pleasant valence and high compared to low arousal conditions.
    - ii. There will be two significant group x condition interactions (valence, arousal), with the schizotypy group exhibiting significant elevations in both.

## II. Schizotypal traits (within the schizotypy group)

- a. Creativity will be associated with positive and disorganized schizotypy, whereas it will be inversely associated with negative schizotypy.
- b. Atypical semantic activation will be associated with disorganized and positive schizotypy, whereas negative schizotypy will be inversely related.
- c. Odd speech will be associated with disorganization traits and inversely associated with negative schizotypy across all speech conditions.

## III. Atypical semantic activation as a mediator

- a. The relationship between odd speech and schizotypy group status will be mediated by atypical semantic activation.
  - i. This mediating effect will be the strongest in the Unpleasant valence, High arousal speech condition.
- b. Atypical semantic activation will mediate the association between schizotypy group status and creativity.

### Potential Implications

There are several important implications of the proposed project, in addition to identifying mechanisms for creativity and odd speech. One, it has been suggested that atypical semantic activation may be a potential vulnerability marker for schizophrenia (Sabb et al., 2010) and there have been few studies examining atypical semantic activation in schizotypy. Developing ways to measure risk markers could be tremendously helpful for early identification efforts and the TI method employed here is a simple, cost-effective way of spurring progression toward this goal. Second, language abnormalities are a key diagnostic sign of schizophrenia (Caplan, Guthrie, Tang, Komo, & Asarnow, 2008) and formal thought disorder (Andreasen,

1979b; Andreasen & Grove, 1986; Harvey et al., 1990). As formal thought disorder is associated with poor long term functioning (Racenstein, Penn, Harrow, & Schleser, 1999; Racenstein et al., 2002), it is important to measure odd speech in individuals at risk to examine how they differ from other individuals with schizotypy, as well as non-schizotypal participants. Third, investigating the relationship between everyday creativity and schizotypy is important because, in addition to providing insight into the full spectrum of psychopathology, it also informs our understanding regarding the nature of everyday creativity (Batey & Furnham, 2009). By studying how these constructs are related, it can help explain how some mechanisms give rise to both schizotypy and everyday creativity, and how other mechanisms may differ (Eysenck, 1995; Green & Williams, 1999). Finally, studying different subtypes of schizotypy might increase our understanding of the heterogeneity across the schizophrenia-spectrum. Due to the heterogeneity across patients with schizophrenia, the possible identification of subtypes before diagnosis could have important ramifications in assessing the future disease course of individuals displaying schizotypal traits (Kwapil et al., 1997). This could be especially important in light of our hypotheses. For instance, if our hypotheses are supported, the results would suggest that individuals with predominantly positive and disorganized schizotypy display one set of characteristics compared to non-schizotypal participants (increased odd speech, atypical semantic activation; enhanced creativity), whereas those with predominantly negative schizotypy exhibit a different set of characteristics (attenuated odd speech, atypical semantic activation; less creativity).

## **Method**

### Participants

All participants were college undergraduate students enrolled at Louisiana State University. Undergraduate cohorts are commonly used in schizotypy studies, as they are in the peak age range of schizophrenia onset (Chapman et al., 1994). In total, 1,828 undergraduates completed a schizotypy questionnaire and were separated into schizotypy and non-schizotypy groups based on their responses.

To determine group status, z-scores were computed separately for gender and ethnicity for all participants. For the schizotypy group, participants had to have elevated scores ( $> 1.65$  standard deviation) on at least one of three symptom subscales: positive, negative, or disorganized (Raine et al., 1994). To be selected for the non-schizotypy group, participants had to have scores that were below the mean on all schizotypy scales. Selected participants were contacted via email or phone by research assistants and invited to undergo an “in-person” testing session in our laboratory. All participants involved in the laboratory phase of the study were compensated \$20. In total, 77 participants completed the laboratory phase. Six were excluded, as they did not have completed data for creativity ( $n = 3$ ), atypical semantic activation ( $n = 2$ ), or odd speech measures ( $n = 1$ ). Our final sample consisted of 71 participants (Schizotypy:  $n = 45$ , Non-schizotypy:  $n = 26$ ).

### Measures

#### A. Schizotypal Personality Questionnaire- Brief Revised

The Schizotypal Personality Questionnaire- Brief Revised (SPQ-BR; Cohen, Mathews, Najolia, & Brown, 2010) was used to assess schizotypal traits in the proposed study. It consists

of 32 items across seven domains of schizotypy (Magical Thinking, Unusual Perceptions, Ideas of References/Suspiciousness, Social Anxiety, No Close Friends/Constricted Affect, Eccentric Behavior, Odd Speech). It was developed from the full Schizotypal Personality Questionnaire (SPQ; Raine, 1991), which is one of the most commonly used measures for assessing schizotypy (Stefanis, Smyrnis, Avramopoulos, Ntzoufras, & Stefanis, 2004). We chose to use the SPQ-BR in this study due to its brevity, as the SPQ-BR has been shown to lead to fewer incomplete responses compared to the full SPQ (Cohen et al., 2010). The SPQ-BR has a three factor superordinate structure consisting of positive (Magical Thinking, Unusual Perceptions, Ideas of References/Suspiciousness), negative (Social Anxiety, No Close Friends/Constricted Affect), and disorganized (Eccentric Behavior, Odd Speech) traits. In this study, it was administered to participants using a five-point Likert format for each question.

#### B. Communication Disturbances Index

A behaviorally based measure was utilized to identify specific instances of odd speech for each participant from a set of transcribed speech samples. To procure speech samples, we instructed participant's to complete a narrative task where they spoke into a head-mounted microphone. Their speech was recorded across four randomized free speech conditions: two stressful (low and high arousal), and two pleasant (low and high arousal). Prior to the first speech condition, participants read the following instructions describing the task on their computer screen:

“Next, we will ask you to tell us some stories about yourself. We are 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 us experience things as you did.”

After pressing a key, participants read a set of instructions for the first speech condition. The instructions for the four conditions were similar, with minor alterations tailored to the particular condition. For example, the instructions for one condition (unpleasant valence, high arousal) were:

“Tell us 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 60 seconds.

Some things you could 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  
Press any key when you have some stories to tell.”

Speech samples were later transcribed by trained research assistants and each narrative was analyzed individually for instances of odd speech using the Communication Disturbances Index (CDI; Docherty, 1996). The CDI has been found to be a useful instrument for distinguishing odd speech in controls from patients with schizophrenia (Docherty, 2005; Kerns & Berenbaum, 2003), first degree relatives of patients with schizophrenia (Docherty, Gordinier, Hall, & Cutting, 1999; Docherty & Gottesman, 2000), and individuals with psychometrically defined schizotypy (Minor & Cohen, 2010). It consists of six subscales (vague references, confused references, missing information references, ambiguous word meanings, wrong word references, structural unclarities) and a total CDI score. In order to control for differences in the amount of speech generated, CDI scores were calculated as frequency of failures for every 100 words spoken.

Processing this data began in Fall 2009 as part of a larger project on emotional expression in schizotypy. Once the speech narratives were transcribed, the first author and two undergraduate students began rating transcripts for instances of odd speech using the CDI. Prior

to rating the transcripts, raters spent several weeks scoring sample transcripts and resolving points of contention in the rating system. To establish interrater reliability, the first author rated thirty transcripts previously rated by two undergraduate students, blind to the initial ratings. Overall, total CDI ratings had high interrater reliability between the first author and both undergraduate raters (.84, .88).

### C. Alternative Uses Test

Divergent thinking (DT) is one of the most commonly measured domains used to assess everyday creativity (Batey & Furnham, 2009) and it corresponds highly with creative achievements (Plucker, 1999; Torrance, 1974). In this study, we used the Alternative Uses Test (AUT; Christensen, Guilford, Merrifield, & Wilson, 1960) to measure DT ability. On the AUT, participants were instructed to describe as many different uses as they could for a common household object over a two-minute period. Three AUT trials were used in this study and the objects utilized in these trials were: 1) brick, 2) paperclip, and 3) pencil.

On the AUT, four scores reflecting unique aspects of everyday creativity are generated (Guilford, 1956). These scores include: 1) Fluency, defined as the number of uses given by a participant; 2) Originality, which is the number of uses given by a participant that were rarely given by others; 3) Flexibility, or the number of different categories that a participant's uses describe; and 4) Elaboration, which reflects the amount of description provided for all responses. To calculate the Originality score, one point was given for each use that was named by 1-5% of the sample and two points were given for each use named by less than 1% of the sample. Then, total originality was divided by fluency to control for the number of responses. The three trials were summed to calculate total AUT scores for each of the four areas.



#### D. Category Fluency Test

To assess atypical semantic activation, responses from a category fluency test (CF) were analyzed. Researchers have found that CF tests reflect the strength of semantic memory (Aloia et al., 1996; Sumiyoshi et al., 2001). The CF test included in this study was the Animal Naming Test (ANIMALS; Read, 1987), where participants were instructed to name as many animals as they could in one minute. The ANIMALS test has been used previously in studies where the goal is to examine semantic memory structure (Gruenewald & Lockhead, 1980; Wixted & Rohrer, 1994), as well as in studies that compare how semantic memory differs in patients with schizophrenia from healthy controls (Prescott et al., 2006). In this study, fluency scores consisted of the number of different animals named during the one-minute time frame.

#### E. Typicality Index

The Typicality Index (TI; Kiang & Kutas, 2006) is the quantitative measure used to assess atypical semantic activation from responses on the ANIMALS CF test. Results using TI from CF tests show promise for differentiating between individuals with schizotypy and healthy, non-schizotypal participants (Kiang & Kutas, 2006). To calculate TI, each participant's set of responses was compared to the ANIMALS normative data to form their TI score. This was done, using the following equation (Kiang & Kutas, 2006):

$$TI = \frac{\sum_{i=1}^n [f_i / i]}{n}$$

with  $n$  = total number of responses on ANIMALS,  $i$  = ordinal position of a given response, and  $f$  = ordinal position of that response in norms. Higher TI reflects more atypical semantic activation (i.e., 'satsuma' is rated as a less typical response for fruit than 'apple'; therefore it has a higher

TI score). The order of each response from participants served as the value  $I$  (i.e., the fruit or vegetable said first was given an  $i$  value of 1, the second response an  $i$  value of 2, etc.). Where each given response is ranked in the norms served as the value  $f$ . For example, if ‘apple’ was the first response given, it has an  $i$  value of ‘1’ and an  $f$  value of ‘1’, as it is the most likely first response according to our normative data. In contrast, if ‘satsuma’ is the tenth response given, it has an  $i$  value of ‘10’ and an  $f$  value of ‘43’, as it had the 43<sup>rd</sup> highest odds ratio according to normative data from our laboratory (for full protocol, see Kiang & Kutas, 2006).

### Analyses

The analyses for this study were conducted in four parts. First, we investigated whether schizotypy or non-schizotypy groups differed on demographic categories, including age, gender, ethnicity, grade point average, hours worked, hours enrolled in college, or handedness. Independent  $t$ -tests were used to examine age, grade point average, hours worked, and hours enrolled in college and chi-square correlations were utilized to compare gender, ethnicity, and handedness.

Second, a multivariate analysis of variance (MANOVA) was conducted to test the hypotheses that individuals with schizotypal traits have increased atypical semantic activation and creativity compared to non-schizotypal participants. In this analysis, group (schizotypy, non-schizotypy) served as the independent variable (IV), with atypical semantic activation and creativity as the dependent variables (DV). To examine odd speech, a repeated-measures analysis of variance (ANOVA) was conducted with group (schizotypy, non-schizotypy) as a between-subject IV, condition (stressful, pleasant, neutral), and arousal (high, low) as within-subjects IVs, and odd speech as the DV.

Third, correlation analyses were conducted to determine whether individual schizotypy dimensions (positive, negative, disorganized) are associated with atypical semantic activation, odd speech and/or creativity. Traits will be based on z-scores from the SPQ that were computed for each individual in the schizotypy group. The relationship of each schizotypy trait dimension was correlated with odd speech, creativity, and atypical semantic activation variables while the other two dimensions were controlled for (i.e., positive schizotypy analyses were conducted while controlling negative and disorganized traits).

Finally, two separate mediation analyses were conducted to examine whether atypical semantic activation mediates odd speech or creativity. Full or partial mediation was determined using the steps outlined by Baron and Kenny (1986). In step one, we examined the correlation between the IV (group status [schizotypy, non-schizotypy]) and the DV (Analysis 1: odd speech, Analysis 2: creativity). In step two, we examined the correlation between the IV (group status) and the mediator (atypical semantic activation). In step three, hierarchical multiple regression was conducted to assess how the mediator (atypical semantic activation) affects the DV (Analysis 1: odd speech, Analysis 2: creativity), while the IV (group status) was controlled for. In step four, the relationship between the IV (group status) and the DV (Analysis 1: odd speech, Analysis 2: creativity) was tested while the mediator (atypical semantic activation) was controlled for. In step four, Sobel's test (1982) was utilized to determine whether atypical semantic activation mediates this effect and, if so, whether it is a full or partial mediator.

For mediation analyses, atypical semantic activation and odd speech values were converted to z-score format to reduce multicollinearity and aid with interpretation. In all analyses, outliers ( $> 3$  SDs) were identified and transformed to the minimum/maximum score that is within 3 SDs of the mean. An alpha level of .05 was used for all analyses in this study.

## Power Analyses

Power analyses were conducted for each of the primary hypotheses using G\*Power software 3.1.2 (G\*Power, 2010). We are adequately powered for hypothesis 1, as it was determined that a moderate effect size can be observed with 21 participants in each group (MANOVA: special effects and interaction design,  $f(V)= 0.3$ ,  $\alpha= 0.05$ ,  $\beta= 0.80$ , groups= 2). We are also adequately powered to examine the group by condition odd speech interaction, as we need 52 participants (ANOVA: repeated-measures, main effects and interactions design,  $f(V)= 0.20$ ,  $\alpha= 0.05$ ,  $\beta= 0.80$ , groups= 2).

For hypothesis 2, G\*Power indicated that 67 participants are needed to observe a moderate correlation with adequate power (Correlation: Bivariate normal model,  $r = 0.30$ ,  $\alpha = 0.05$ ,  $\beta = 0.80$ , one-tail). As we only have 45 participants in the schizotypy group, we are underpowered for these analyses. To be adequately powered for the schizotypy group in this study ( $n = 45$ ), we would have to observe correlations of  $r = .37$  or higher.

Hypothesis 3 concerns the mediation analyses and power analyses for each step are presented. We are adequately powered for steps 1 and 2, as the 71 participants in our study is greater than the recommended number of 64 (Correlation: Point biserial model,  $\alpha= 0.05$ ,  $\beta= 0.80$ , one-tail). For Steps 3 and 4, we used the criteria outlined by Green (1991), which suggests that  $50 + 8k$  participants are needed for multiple regression, with  $k$  representing the number of predictors. We have 2 predictors and would need at least 66 participants to be adequately powered, a number that is below the total number of participants in this study ( $n = 71$ ). This suggests that we have an adequate number of participants for all steps of the mediation analyses.

## Results

### Group Comparisons

To begin, we conducted group comparisons to determine if the schizotypy and non-schizotypy groups differed in age, gender, ethnicity, grade point average, hours worked, current enrolled hours in college, or handedness. These variables were analyzed to determine whether the groups were well-matched, as each could serve as a potential confound in later analyses. Complete demographic data, along with SPQ scores is contained in Table 1. No significant differences were observed between the non-schizotypy and schizotypy groups on any demographic variables. As expected, the schizotypy group demonstrated significantly higher SPQ scores overall and on all three trait dimensions.

**Table 1.**

Demographic data and SPQ-BR scores for schizotypy and non-schizotypy groups.

	Schizotypy		Non-schizotypy		Chi-square
% Female	68.89%		73.08%		0.14
% Caucasian	84.45%		84.62%		0.00
% Right-handed	82.22%		88.46%		0.49
	Mean	SD	Mean	SD	<i>t</i>
Age	19.23	1.90	18.64	0.76	1.47
Grade Point Average	2.91	0.84	3.10	0.71	-0.96
Hours Worked	11.82	12.32	7.96	9.26	1.39
Hours Enrolled in College	15.31	1.98	15.62	1.60	-0.67
SPQ-BR (z-scores)					
Positive	1.24	1.04	-1.15	0.70	11.51***

(Table 1 continued)

Negative	1.04	1.19	-0.90	0.50	9.59***
Disorganized	1.22	0.81	-1.09	0.66	13.18***
Total	1.42	0.69	-1.34	0.67	16.38***

\*\*\*  $p < .001$

SD- Standard deviation

SPQ-BR- Schizotypal Personality Questionnaire-Brief Revised

### Hypotheses Ia, 1b: Schizotypy Versus Non-schizotypy Group

Box's M test was conducted as the first step of the MANOVA analysis, as the two groups in this study have different samples sizes. We observed that Box's  $M = 95.62$ ,  $p > .001$ . Thus, the two groups did not significantly differ and the assumption of homoscedasticity is upheld.

The Wilks Lambda test of overall differences was significant,  $F(10, 60) = 2.26$ ,  $p = .03$ , indicating that the linear combination of the DVs significantly changed as a function of group status. Next, we examined the univariate between-subjects tests to further investigate which DVs significantly differed based on group. These results are provided in Table 2. The schizotypy group demonstrated significant increases in atypical semantic activation on the order of a large effect size. They also scored significantly higher on all four creativity variables compared to the non-schizotypy group. Originality was on the cusp of a large effect size, whereas the other three creativity variables were in the medium effect size range.

**Table 2.**

Multivariate analysis of variance of atypical semantic activation and creativity.

Univariate Tests	Schizotypy		Non-schizotypy		<i>F</i>	Cohen's <i>d</i>
	Mean	SD	Mean	SD		
Atypical Semantic Activation	6.21	3.92	3.85	1.36	8.76**	0.80
Creativity						

(Table 2 continued)

Originality	0.27	0.15	0.16	0.13	9.42**	0.78
Fluency	23.89	9.54	19.27	6.57	4.78*	0.56
Flexibility	20.64	7.99	16.54	5.98	5.58*	0.58
Elaboration	1.53	2.01	0.62	1.30	4.37*	0.54

\*  $p < .05$

\*\*  $p < .01$

SD = Standard Deviation

#### Hypotheses 1c: Schizotypy Versus Non-schizotypy Group (Odd Speech)

The results of the repeated-measures ANOVA indicated significant main effects for both arousal,  $F(1, 69) = 3.69, p = .03$ , and valence,  $F(1, 69) = 12.39, p < .001$ , conditions. We did not observe a significant main effect for group,  $F(1, 69) = 1.26, p = .24$ . In addition, there was a trend level group X arousal interaction,  $F(1, 69) = 2.03, p = .08$ . The group X valence interaction,  $F(1, 69) = 0.50, p = .48$ , and the valence X arousal interaction,  $F(1, 69) = 1.63, p = .10$ , did not reach the level of significance. Likewise, the three-way group X valence X arousal interaction also failed to reach the level of significance,  $F(1, 69) = 0.01, p = .94$ . In line with our hypotheses, this suggests that all participants produced higher rates of odd speech in high arousal compared to low arousal conditions and unpleasant compared to pleasant valence conditions. Additional expectations were not supported.

Our hypothesis that the schizotypy group would produce higher rates of odd speech was only partially supported. The schizotypy group exhibited significantly elevated odd speech in the Pleasant valence, High arousal condition, but not in the other three conditions. The schizotypy group did demonstrate elevated odd speech in the moderate effect size range for the Pleasant valence, High arousal condition, as well as increases in the small effect size range for Composite

score, which measured odd speech across all conditions, and in the Unpleasant valence, High arousal condition (see Table 3).

**Table 3.**  
Repeated-measures analysis of variance of odd speech

Odd Speech Conditions <b>Valence, Arousal</b>	Schizotypy		Non-schizotypy		Cohen's <i>d</i>
	Mean	SD	Mean	SD	
Composite	1.41	0.70	1.23	0.58	0.28
Unpleasant, High	1.87	1.29	1.60	1.41	0.20
Pleasant, High	1.37	0.92	0.92	0.88	0.50*
Unpleasant, Low	1.30	0.91	1.37	1.13	-0.07
Pleasant, Low	1.10	1.17	1.01	0.87	0.09

\*  $p < .05$   
SD = standard deviation

#### Hypothesis II: Positive, Negative, and Disorganized Schizotypy Traits

To examine whether specific schizotypal traits were associated with atypical semantic activation, odd speech, or creativity variables we created a correlation matrix (Table 4). Each set of correlations were conducted within the schizotypy group and controlled for the other two types of traits (i.e., positive schizotypy correlations controlled for negative and disorganized traits). There were few significant correlations. Contrary to expectations, positive schizotypy was inversely related to atypical semantic activation and odd speech in the Pleasant valence, High arousal condition and disorganized schizotypy was inversely associated with odd speech in the Unpleasant valence, High arousal condition. In line with our hypothesis, negative schizotypy was inversely correlated with one of the creativity variables, flexibility. In general, however, our hypotheses were not supported here.



**Table 4.**

Correlations between schizotypal traits and odd speech, creativity, and atypical semantic activation.

Odd Speech	Schizotypal Traits		
	Positive	Negative	Disorganized
Unpleasant, High	-0.21+	0.16	-0.35*
Pleasant, High	-0.43**	0.20	0.05
Unpleasant, Low	-0.11	-0.12	-0.05
Pleasant, Low	-0.20	0.06	-0.10
Creativity			
Originality	-0.18	0.02	0.25+
Fluency	-0.04	-0.19	-0.10
Flexibility	-0.06	-0.26*	-0.10
Elaboration	0.05	0.14	0.09
Atypical Semantic Activation	-0.29*	0.02	-0.01

\*  $p < .05$

\*\*  $p < .01$

### Hypothesis III: Atypical Semantic Activation as a Mediator

Two separate mediation analyses were conducted to examine whether atypical semantic activation mediates odd speech or creativity. Odd speech was examined in the first. To begin, we calculated a composite score of odd speech across all four conditions. To test for mediation, the first two steps were to examine whether the IV is related to both the DV and the mediator. We observed that schizotypy was significantly associated with atypical semantic activation,  $r = 0.23$ ,  $p = .03$ . However, schizotypy and odd speech,  $r = 0.10$ ,  $p = 0.21$ , were not significantly associated (Table 5). As it is possible that this relationship may be significant once other

variables are controlled for, we proceeded with steps three and four. The hierarchical multiple regression was conducted with schizotypy entered in Block 1 and atypical semantic activation entered in Block 2 (Table 6). However, schizotypy did not significantly account for variance in odd speech,  $R^2 = 0.01$ ,  $F = 0.64$  and the coefficient was not significant,  $\beta = 0.10$ ,  $p = .43$ . Likewise, atypical semantic activation did not significantly account for additional variance in odd speech,  $R^2$  change = 0.02,  $F = 0.86$ . The coefficient for the mediator in Block 2 was also not significant,  $\beta = 0.13$ ,  $p = .30$ . Sobel's test confirmed that our hypothesis was not supported.

For analysis two, we used the originality score as our creativity variable. First, we investigated whether schizotypy was related to atypical semantic activation and creativity (Table 5). There was a significant correlation in both cases. In step three, we observed that schizotypy accounted for significant variance in creativity,  $R^2 = 0.09$ ,  $F = 6.59$  and the coefficient was significant,  $\beta = 0.29$ ,  $p = .01$ . However, atypical semantic activation did not significantly account for additional variance in creativity,  $R^2$  change = 0.04,  $F = 4.92$ . The coefficient for the mediator did not reach the level of significance,  $\beta = 0.20$ ,  $p = .09$ . Sobel's test confirmed that the inclusion of atypical semantic activation as our mediator variable did not significantly alter the relationship between schizotypy and creativity (Table 6).

**Table 5.**  
Zero-order correlations for mediation analyses.

<b>Step One: Correlation between IV and DV</b>		
<b>Analysis One</b>	Schizotypy	Atypical Semantic Activation
Odd Speech	0.10	0.14
<b>Analysis Two</b>		
Creativity	0.29**	0.26*

(Table 5 continued)

**Step Two: Correlation between IV and Mediator**

Analyses One and Two	Schizotypy
Atypical Semantic Activation	0.23*

\*  $p < .05$   
 \*\*  $p < .01$   
 IV = independent variable  
 DV = dependent variable

**Table 6.**  
 Steps Three and Four of Mediation Analyses

Analysis One: Odd Speech					
Block 1	b	SE b	Beta	R <sup>2</sup>	R <sup>2</sup> change
Constant	-.026	.123			
Schizotypy	.064	.080	.096	0.01	0.01
Block 2					
Constant	-.018	.124			
Schizotypy	.044	.082	.066		
ASA	.128	.123	.128	0.03	0.02
Analysis Two: Creativity					
Block 1					
Constant	-.081	.118			
Schizotypy	.197	.077	.295	0.09	0.09*
Block 2					
Constant	-.068	.117			
Schizotypy	.165	.078	.248		

(Table 6 continued)

ASA	.204	.117	.204	0.13	0.04+
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**Sobel's Test**

	Sobel's	Standard Error
Odd Speech	0.21	0.02
Creativity	0.64	0.03

\*  $p < .05$

ASA = atypical semantic activation

## Discussion

Our primary goals in this study were to investigate whether the schizotypy group demonstrated significantly increased atypical semantic activation, odd speech, and creativity compared to the non-schizotypy group and examine whether atypical semantic activation leads to odd speech and creativity in those with schizotypy. Several interesting findings emerged. First, we observed that the schizotypy group demonstrated significant increases in atypical semantic activation, on the order of a large effect size, compared to the non-schizotypy group. Second, there was a trend level group by condition interaction for arousal, but not valence. We also found that odd speech significantly increased for all participants in the unpleasant compared to the pleasant and low compared to high arousal speech conditions. Third, the schizotypy group scored significantly higher than the non-schizotypy group in all four areas of creativity. Fourth, we did not find evidence to support our hypotheses that atypical semantic activation mediates odd speech or creativity in individuals with schizotypy. Fifth, in contrast with previous literature (Kerns et al., 1999; McCreery & Claridge, 2002; Minor & Cohen, 2010; Nelson & Rawlings, 2010), our hypotheses concerning the relationship between schizotypal traits with atypical semantic activation, odd speech, and creativity were generally not supported. Each of these findings will be discussed in depth in the following paragraphs.

This is one of the first studies where significant differences between schizotypy and non-schizotypy groups in atypical semantic activation using responses from CF tests have been observed. Atypical semantic activation has been previously suggested as a potential vulnerability marker of schizophrenia (Sabb et al., 2010). The results here indicate that heightened atypical semantic activation occurs across the schizophrenia-spectrum and appears to be a meaningful endophenotype of schizophrenia, as group differences in the large effect size range were found.

The TI method used in this study is a fast, cost-effective instrument that could play a critical role in early identification efforts, particularly for individuals at risk for formal thought disorder, as atypical semantic activation appears to be related to clinically-defined thought disorder in patients with schizophrenia (Kreher et al., 2009; Kuperberg et al., 2007). The results here are also consistent with the spreading activation model (Spitzer, 1997), which postulates that individuals with schizophrenia-spectrum disorders have increased activation of weakly associated items within their semantic networks, leading to more distantly related concepts becoming activated in the information-processing stream (Abraham & Windmann, 2008). This bolsters a previous proposal that atypical semantic activation exhibited in schizotypy may be similar to schizophrenia, albeit in a milder form (Kiang & Kutas, 2006).

The current study is one of a handful to examine odd speech in psychometrically-defined schizotypy using a behaviorally-based measure. Thus far, the general consensus appears to be that individuals with schizotypy demonstrate elevations in odd speech in the small to moderate effect size range compared to non-schizotypy groups (Kerns & Becker, 2008; Minor & Cohen, 2010). Although the elevations observed here were in the lower range, our investigation examining valence and arousal yielded several interesting findings. In line with expectations, odd speech significantly increased for all participants in unpleasant compared to pleasant valence and high compared to low arousal speech conditions. Thus, it appears that discussing unpleasant experiences and highly arousing content tends to elevate odd speech, regardless of schizotypy status. This increase is thought to be partially attributable to heightened physiological arousal, as Burbridge and colleagues (2005) have observed that healthy adults tend to have higher heart rates and increased galvanic skin conductance when discussing stressful compared to pleasant or neutral content.

We were particularly interested in examining how odd speech changes as a function of both valence and arousal in individuals with schizotypy compared to those without schizotypy. We found no indication of a significant group effect for valence, as odd speech increased at a similar rate for both groups as they moved from pleasant to unpleasant topics. However, a trend level interaction was observed for arousal. Although the results did not reach the level of significance, the findings here suggest that it may be arousal, and not valence, that plays the most important role in odd speech elevations exhibited by those with schizotypy. However, the effect of arousal on odd speech in schizotypy appears mild when compared to individuals with schizophrenia, where highly arousing situations tend to severely affect speech (Docherty et al., 1994; Docherty & Hebert, 1997).

The small to medium effect size differences that are exhibited by individuals with schizotypy may be partially accounted for by cognitive deficits, particularly in working memory, as speech disorder is thought to reflect a failure in neurocognitive processing (Docherty, DeRosa, & Andreasen, 1996). However, individuals with schizotypy demonstrate vastly different levels of cognitive impairment compared to schizophrenia and non-schizotypy groups. For example, individuals with schizotypy exhibit impairment in the small to negligent effect size range compared to those without schizotypy (Gates, Minor, & Cohen, In Preparation), whereas patients exhibit severe deficits across a broad range of cognitive domains in comparison to controls (Heinrichs & Zaksannis, 1998). A meta-analysis from our laboratory found that working memory deficits are among the most prominent differences in cognitive abilities between schizotypy and non-schizotypy groups, yet remain at a small effect size level (Gates et al., In Preparation). In line with this finding, Kerns and Becker (2008) observed that individuals with schizotypy demonstrated both working memory deficits and increases in odd speech in a stressful speech

condition when compared to a non-schizotypy group. They also observed that group differences in odd speech in this stressful condition were no longer significant when working memory deficits were controlled for. Thus, it may be the case that working memory deficits partly account for the differences in odd speech between schizotypy and non-schizotypy groups.

In line with the existing literature, the schizotypy group performed significantly better in all areas of creativity compared to the non-schizotypy group. As this is one of a few studies to use a categorical conceptualization of schizotypy, these findings provide further evidence for the inverted U-shaped relationship between creativity and psychosis (Akiskal & Akiskal, 1988; Brod, 1997). As we examined individuals scoring at or above the 95<sup>th</sup> percentile, this shows that schizotypal traits are still having a beneficial effect for these individuals. Researchers have suggested that creativity begins to decrease once someone enters into active psychosis (Brod, 1997); future studies should examine at what point these traits become disadvantageous and begin to block creative abilities. It would be interesting to compare the performance of individuals in the prodromal phase of schizophrenia on creativity tasks with psychometrically-identified schizotypy and non-schizotypy groups in order to view when the creative advantages of schizotypy begin to wane.

The hypotheses that atypical semantic activation mediates odd speech and creativity in individuals with schizotypy were not supported. In terms of odd speech, there was no evidence of atypical semantic activation as a mediator in any of the four speech conditions. Further, odd speech and atypical semantic activation were not significantly correlated within the schizotypy group. In a recent study from our laboratory (Minor et al., 2011), we found that atypical semantic activation was associated with odd speech in individuals with schizotypy in a stressful speech condition, but not in pleasant or neutral conditions. Although support for this finding was not



observed here, this could be due to key differences between the speech tasks in the two studies. Whereas participants recalled past experiences from memory here, they were asked to view a series of emotionally valenced photographs in the previous study and discuss what each picture meant to them, what it reminded them of, and how it made them feel. There is likely an increased strain on working memory resources on the latter task, as participants have to constantly attend to novel stimuli as opposed to being able to control what they discuss. Thus, it may not be stressful emotional content that is solely responsible for depleting the resources necessary to prevent atypical semantic activation from affecting speech, as we proposed in the previous study. Rather, it may be a combination of highly arousing content with an accompanying cognitive load that leads to the association between atypical semantic activation and odd speech in those with schizotypy.

Likewise, atypical semantic activation was not supported as a mediator for creativity in individuals with schizotypy, despite ample evidence that the ability to access indirect associations within the semantic network is an important aspect of creativity (Mohr et al., 2001; Pizzagalli et al., 2001). A potential problem in this study might be the similarity between our measures of creativity and atypical semantic activation. Although both are designed to assess two distinct constructs and their correlation ( $r = 0.29$ ) is slightly below the recommended cutoff for moving forward with a mediation analysis ( $r = 0.30$ ; Tabachnick & Fidell, 2007), the shared variance between these two instruments may help explain why partial mediation was not observed. Overinclusive thinking has been proposed to be a key aspect of both constructs (Eysenck, 1995) and it may be possible to demonstrate atypical semantic activation as a mediator for creativity in those with schizotypy by utilizing measures with less overlapping variance.

A strength of this study is that we included disorganization traits, as most researchers have focused on only positive and negative traits when examining atypical semantic activation, odd speech, and creativity. Based on past studies (Kerns et al., 1999; McCreery & Claridge, 2002; Minor & Cohen, 2010; Nelson & Rawlings, 2010), we expected two primary groups to emerge: 1) those with heightened positive and disorganized schizotypy, who demonstrated increased atypical semantic activation, odd speech and creativity, and 2) those with elevated negative schizotypy, who displayed significant decreases in all three areas. We were surprised to find that only a few of our expected hypotheses were supported. Generally, these traits were not significantly correlated with our variables of interest. It could be the case that there is not one overriding factor that tends to be associated with odd speech, atypical semantic activation, and creativity. Perhaps, these associations are not apparent in individuals with schizotypal traits while they are functioning at a relatively high level, but may become noticeable once an individual progresses on the schizophrenia-spectrum, such as at disease onset or during the prodromal phase. Previous studies have observed conflicting results (Kerns et al., 1999; McCreery & Claridge, 2002; Minor & Cohen, 2010; Nelson & Rawlings, 2010), however, and a general consensus is needed in this area.

The lack of power within the schizotypy analyses is one limitation of the current study. Although many schizotypy studies include comparable sample sizes, it is hard to draw conclusions regarding the lack of significant correlations with specific schizotypal traits when these analyses are at risk for Type II errors. A second potential limitation concerns our use of an undergraduate sample. Undergraduate samples are frequently used in psychometrically-defined schizotypy studies (Chapman et al., 1995; Gooding et al., 2005; Kerns, 2007; Kwapil et al, 1997) and contain several advantages, such as including participants who are in the peak age range of

schizophrenia onset (Chapman et al., 1994). One concern with this population, however, is that they may exhibit higher functioning compared to other individuals on the schizophrenia-spectrum. Future studies should include participants recruited from community populations and individuals in the prodromal phase to examine how the findings in this study vary at other points on the schizophrenia-spectrum.

Several suggestions for future research should be mentioned. First, researchers should explore atypical semantic activation further by examining what factors produce increased semantic processing abnormalities in individuals with schizotypy. For example, assessing whether increased cognitive load or inducing unpleasant mood increases atypical responses on CF tasks are two possibilities for furthering understanding of this construct. Atypical semantic activation in individuals with schizotypy should also be compared to that of patients with schizophrenia. Second, recording physiological responses during high arousal speech conditions in order to determine whether odd speech is more affected in individuals who demonstrate a heightened physiological response is another avenue for future research. This would provide behaviorally-based methods of assessing both odd speech and arousal. In addition, inducing cognitive load would be a unique way of investigating odd speech in individuals with schizotypy and would test our explanation that working memory deficits are partially responsible for odd speech in schizotypy. Third, the relationship between creativity and psychosis should be examined across the schizophrenia-spectrum. This would provide a method of determining at what point the benefit of schizotypy is strongest and when these advantages begin to wane. Recruiting patients with schizophrenia, individuals in the prodromal phase of the disorder, and participants with schizotypy from both undergraduate and community samples is one way of reaching this goal. Fourth, it is important to continue exploring the underlying factors of atypical

semantic activation, odd speech, and creativity. Although our hypothesis that atypical semantic activation mediates odd speech and creativity was not supported here, it is critical to continue looking for mechanisms that contribute to these constructs. Investigating the underlying cognitive factors that are associated with increases in atypical semantic activation, odd speech, and creativity in patients with schizophrenia and those at risk for the disorder is one area where researchers could turn their focus. If these increases could be linked to neurocognitive underpinnings, researchers would be one step closer to identifying potential risk factors for schizophrenia. Finally, trying to determine how positive, negative, and disorganization traits are related to these constructs is also important. Heterogeneity is a major concern in schizotypy and schizophrenia and coming to a consensus in this area is one way of alleviating this problem.

## Conclusion

The results of the current study revealed several interesting findings regarding the role of atypical semantic activation, odd speech, and creativity in schizotypy. The schizotypy group demonstrated significantly increased atypical semantic activation, on the order of a large effect size, compared to the non-schizotypy group. This suggests that those with schizotypy exhibit semantic activation that is similar to that of patients with schizophrenia, albeit in a milder form, and provides evidence that atypical semantic activation is a meaningful endophenotype of schizophrenia. In regard to odd speech, we found no significant group difference overall, but observed that the schizotypy group produced increased odd speech in the small to medium effect size range for the high arousal conditions and in the small effect size range across all conditions. We also observed a trend level group by arousal interaction, which we postulated could be partially accounted for by working memory deficits. The schizotypy group performed significantly better than the non-schizotypy group in all four areas of creativity and these differences were in the medium effect size range. Our hypotheses that atypical semantic activation is a mediator for odd speech and creativity in schizotypy were not supported. Likewise, our expectations were generally not supported regarding the relationship between positive, negative, and disorganization traits within the schizotypy group with atypical semantic activation, odd speech, and creativity. Future studies should further explore properties of atypical semantic activation, odd speech, and creativity. Promising avenues include investigating the role of cognitive deficits, particularly working memory load, exploring underlying mechanisms of these variables, and examining how these constructs affect individuals across the full range of the schizophrenia-spectrum.

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## Appendix A: Institutional Review Board Approval Sheet

A copy of the approval sheet from the Institutional Review Board for "Speech characteristics and Schizotypy." This is an ongoing study that was started in January 2009. All participants from this dissertation were recruited as part of this protocol.

### Project Report and Continuation Application

(Complete and return to IRB, 203-B1 David Boyd Hall.  
Direct questions to IRB Chairman Robert Mathews 578-8692.)



Institutional Review Board  
Dr. Robert Mathews, Chair  
203 B-1 David Boyd Hall  
Baton Rouge, LA 70803  
P: 225.578.8692  
F: 225.578.6792  
irb@lsu.edu | lsu.edu/irb

Date Sent: August 11, 2011

IRB#: 3037 Your Current Approval Expires On: 11/17/2011

Review type: Expedited Risk Factor: Minimal

PI: Alex Cohen Dept: Psychology Phone: 578-7017

Student/Co-Investigator:

Project Title: Speech characteristics and Schizotypy

Number of Subjects Authorized: 500

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

I. PROJECT FUNDED BY: LSU proposal #:

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

- 1. Active, subject enrollment continuing; # subjects enrolled: 150
- 2. Active, subject enrollment complete; # subjects enrolled:
- 3. Active, subject enrollment complete; work with subjects continues.
- 4. Active, work with subjects complete; data analysis in progress.
- 5. Project start postponed
- 6. Project complete; end date   /  /
- 7. Project cancelled: no human subjects used.

III. PROTOCOL: (Check one).

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

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

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

V. CONSENT FORM AND RISK/BENEFIT RATIO:

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

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

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

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

Signature of Principal Investigator: [Signature] Date: 10-26

IRB Action:	<input checked="" type="checkbox"/> Continuation approved: Approval Expires: <u>10/25/12</u> <input type="checkbox"/> Disapproved <input type="checkbox"/> File closed
Signed	<u>[Signature]</u> Date <u>10/25/11</u>

Form date: April 16, 2008

## Appendix B: The Schizotypal Personality Questionnaire-Brief Revised

The Schizotypal Personality Questionnaire-Brief Revised was administered to participants as part of an on-line screening to identify individuals with schizotypic features.

Please indicate your level of agreement to the following items/questions using the following scale:

0	1	2	3	4
Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Definitely No	No	Neutral	Yes	Definitely Yes

### Item

- Do you sometimes feel that people are talking about you?  
Do you sometimes feel that other people are watching you?  
When shopping do you get the feeling that other people are taking notice of you?  
I often feel that others have it in for me.  
Do you sometimes get concerned that friends or co-workers are not really loyal or trustworthy?  
Do you often have to keep an eye out to stop people from taking advantage of you?  
Do you feel that you cannot get "close" to people.  
I find it hard to be emotionally close to other people  
Do you feel that there is no one you are really close to outside of your immediate family, or people you can confide in or talk to about personal problems?  
I tend to keep my feelings to myself.  
I rarely laugh and smile.  
I am not good at expressing my true feelings by the way I talk and look.  
Other people see me as slightly eccentric (odd).  
I am an odd, unusual person.  
I have some eccentric (odd) habits.  
People sometimes comment on my unusual mannerisms and habits.  
Do you often feel nervous when you are in a group of unfamiliar people?  
I get anxious when meeting people for the first time.  
I feel very uncomfortable in social situations involving unfamiliar people.  
I sometimes avoid going to places where there will be many people because I will get anxious.  
Do you believe in telepathy (mind-reading)?  
Do you believe in clairvoyance ( psychic forces, fortune telling)?  
Have you had experiences with astrology, seeing the future, UFO's, ESP, or a sixth sense?  
Have you ever felt that you are communicating with another person telepathically (by mind-reading)?  
I sometimes jump quickly from one topic to another when speaking.  
Do you tend to wander off the topic when having a conversation?  
I often ramble on too much when speaking.  
I sometimes forget what I am trying to say.  
I often hear a voice speaking my thoughts aloud.  
When you look at a person or yourself in a mirror, have you ever seen the face change right before your eyes?  
Are your thoughts sometimes so strong that you can almost hear them?  
Do everyday things seem unusually large or small?

## Appendix C: Communication Disturbances Index Modified Manual

A modified manual for coding speech disturbances using the Communication Disturbances Index (CDI). Original manual written by Dr. Nancy Docherty.

### Communication Disturbances Index (CDI) Manual

The Communication Disturbances Index (CDI) attempts to classify instances of speech disturbance and separate them into six categories. In addition to gross disturbances, the CDI is designed to identify many subtle instances of disturbance. To this end, even nonpsychiatric controls should demonstrate low levels of speech disturbance. The goal in our laboratory will be to establish interrater reliability when applying CDI ratings to our transcribed speech samples. CDI ratings should be made using only the transcripts, you do not need to listen to the audio file to apply ratings. To find transcripts, go to Lab Projects > SPRL Projects > High Risk (Spring 07) > Narrative Data > Word Files Processed (High Risk 07) and select a narrative. When you have finished a narrative, please place your initials in accompanying slot in the CDI checklist. The CDI checklist can be found in the ‘Narrative Data’ folder alongside the word files.

#### CDI Ratings- General

Communication disturbances are instances in which the intended meaning of a phrase or a word is unclear and that unclarity obscures the clarity of the larger communication. The key is that there is a loss of larger meaning. In other words, an unclear word or phrase is counted as disturbance when it obscures meaning from the statement where it occurs. Unclear words that are unimportant to the understanding are not counted. For example:

*I went up the mountain to look for some things*

In this sentence, ‘things’ is unclear and it makes the larger meaning of the sentence unclear, so it is counted.

**OK-***He had gone to town to pick something up, so he wasn’t there when the call came.*

In this sentence, ‘something’ is unclear; however, it does not impair the overall meaning of the statement so it is not counted.

Faulty grammar, structure, and word usage are not counted unless they obscure meaning. If they render the meaning unclear or ambiguous, or they give the rater significant pause before he/she ascertains the correct meaning, they are counted as disturbance. Instances of disturbance that are immediately corrected or clarified by the speaker are not counted.

#### EXAMPLES:

*He was doing well in the beginning, but then he sort of abused his study habits.*

“Abused” is the wrong word choice here. You can be negligent or lax with your study habits, but you can’t abuse them.

*We seen Niagra Falls on both the American and Canarican side.*

“Seen” is okay because even though it is grammatically incorrect, it does not hinder meaning. However, “Canarican” should give you significant pause, before realizing that the participant means to say “Canadian”. “Canarican” should be counted.

**OK-***We saw Niagra Falls from both the American and **Canarican**, I mean Canadian, sides.* In this instance, “Canarican” would not be counted as an instance of disturbance because it is immediately corrected by the participant and the correct phrase is used.

Transcripts are rated by counting each instance of communication disturbance. Total words are calculated; however, since many instances of disturbance are multi-word phrases, they are only counted as one word. Total number of disturbances are then divided by this corrected word score to obtain overall CDI score. For example, let’s say you are rating a transcript that contains 109 words and that transcript has 2 instances of communication disturbance. One instance is a sentence that is structurally unclear and the entire ten word sentence is underlined as a case of communication disturbance. The other instance is one word long and is unclear because an ambiguous term is used. In this case, both the word one disturbance and the ten word disturbance would be counted as one word when determining CDI score. Here, you would divide 2 (the number of disturbances) by 100 (the corrected word score after counting each instance of disturbance as one word) to obtain a Total CDI score of 2.0%.

The basic unit is the unclear word or phrase, with phrases of several words being counted as one instance of disturbance. Disturbances will be classified into one of six categories, described below. An instance of disturbance can not be classified into multiple categories (i.e. only one category is assigned per disturbance). Interrater reliability on total CDI scores is relatively easy to obtain; however, agreeing on how to classify disturbances into categories is more difficult. Instructions for separating disturbances into categories will now be discussed.

### **General Tips:**

If applicable, use the photographs when you're coding- this will probably cut down a little bit on instances of CD, especially in the Missing Information category. The only time you should not use the photographs is in the free recall narratives.

### Six Types of Disturbance.

#### **1. Vague References**

Vague references are words or phrases that are unclear because they are overinclusive. They should be scored only if their lack of specificity is important and significantly diminishes the meaning communicated. These types of disturbance often leave the listener with a questionable impression about the intended meaning rather than a clearly communicated meaning.

The most difficult discrimination to make is between vague references and ambiguous word meanings. The vague reference category is limited to nominal or pronominal words and phrases in which the major source of unclarity is overinclusiveness.

The overwhelming majority (80-90%) that we will find will contain ‘things’ or ‘stuff’. Other examples: ‘There was a lot of stress when people talked about me’, ‘it’s a good show, they talk about anything and everything’, The ohm law is basically a law of powers’

#### EXAMPLES:

*I’m hoping they don’t get caught up in some of the ills of our life, of our society.*

In this example, it is not clear what ‘ills’ the speaker is referring to that are present in ‘our life’ or ‘our society’.

*We had to go to court and other bad things.*

It is unclear what ‘other bad things’ the speaker is referring to- are they talking about paying fines, being arrested, or did they have to do bad things separate from this court appearance like going to work afterward? It is impossible to know from this sentence.

*Special education helped me to obtain various levels of grades.*

This sentence is also structurally unclear; however, the main impediment to understanding is the vagueness of ‘various levels of grades’.

*We have all kinds of tools and stuff at our house.*

It is unclear what ‘and stuff’ means- does it refer to other building equipment or ‘things’ that are completely unrelated to fixing something.

*I like older houses, especially with those borders on the walls.*

‘Those’ does not clearly communicate to the reader what types of borders are on the walls.

**KEYS** to determining Vague References:

- a. Unclear because of overinclusiveness
- b. Lack of specificity diminishes overall meaning
- c. Difference between Ambiguous Word Meanings is that Vague References are limited to nominal and pronominal words (“things”, “stuff”, etc.)

## **2. Confused References**

Confused references are unclear because they can refer to one of at least two alternate referents and the correct choice isn’t obvious. Alternatives have usually been provided by the speaker, but it is not possible to determine which is correct. Confused references are counted if: a) it is impossible to be reasonably sure which referent is correct or b) it is only possible to be sure after some consideration.

The most difficult discrimination is between confused references and ambiguous word meanings. With confused references, there are two or more alternatives and one is most likely the intended meaning. Ambiguous word references are not clearcut or referents have not been previously presented by the speaker. Confused references are usually nominal or pronominal. In most cases, the term ‘we’, if coded, is an Ambiguous Word Meaning. However, ‘we’ may occasionally (10-20% of the time) ‘we’ be a confused reference. For example, if two different groups were mentioned (aunt, uncle, cousins), it is possible that we could be a confused reference. For instance: ‘While they went to work, we went to get food.’ (both would be coded as C).

EXAMPLES:

*My son has two children and my daughter has three. The kids have counted on me for a lot.*

Which kids? His son and daughter, his son’s kids, his daughter’s kids, or all of the grandchildren? The correct answer is most likely one of these three referents provided by the speaker, but it is difficult to determine which of these three they are referring to.

*The cat reminds me of the cat in the Edgar Allen Poe story except it’s not black.*

Which cat isn't black? The cat in the story or the cat that is being referred to.

*Take the clock, for instance. You got ten, twelve on it, you got other numbers on it, you got a volume button on it, it go up and down.*

'It' (the final one) is unclear; it could refer to the clock, the volume button, or another part of the clock.

**KEYS** to determining Confused References:

- a. Unclear because these refer to one of at least two alternate referents.
- b. The alternate referents have been previously provided by the speaker, but it is unclear which the speaker is referring to.
- c. Difference between Ambiguous Word Meanings is that with Confused References there are two or more alternatives, whereas the number of possible referents are unlimited with ambiguous word references.

### **3. Missing Information References**

Missing information references assume that the listener has prior information that he or she does not have and should not be expected to have. With our samples, missing information references will be common since participants often describe a photo without giving background. Unqualified references to persons, places or things not previously presented by the speaker and unknown to the listener are classified here. This category includes comparative references for which the basis of comparison is not implicitly clear and has not been made clear by the speaker.

In some cases the meaning of the utterance is reasonably clear upon consideration, but it lacks the redundancy that normally facilitates comprehension.

Remember to use the photo. If the reference can be derived from the photo, it should NOT be coded. So, if the speaker said "I don't like doing using these types of tools" and there is a picture of a wrench, it would not be coded as Missing. MIR is probably the toughest category to get a handle on and we'll work through whatever problems you may have.

EXAMPLES:

*They let George go home, so why not me? (no previous mention of George)*

*I don't like cats very much. It's pretty gross.*

If what 'it's' refers to is not mentioned, it is impossible to know what this is in reference to.

*I want to move out of New Haven and they won't let me leave.*

If there is not prior mention of "they", it is not possible to figure out who they are.

*In my mind I saw the Blessed Virgin Mary sitting on top of the concrete plaza in the back yard. I fought her off...and I went back to sleep.*

'Back' is counted because the speaker never mentioned having been asleep before. This example is more subtle than the others. The use of 'the concrete plaza' conveys that there was a concrete plaza in the back yard, but the use of 'the' implies that the speaker believes the listener already is aware of the existence of the plaza. Similarly, the use of 'back to sleep' conveys the information

that the speaker was previously asleep, but the implication is that this was already known by the listener

**KEYS** to determining Missing Information References:

- a. When the reader assumes that the listener has previous knowledge that they do not have, nor should they be expected to have.
- b. Unqualified references to subjects not previously mentioned belong in this category.

#### **4. Ambiguous Word Meanings**

These include instances in which a word or phrase has more than one possible meaning and is used in such a way that the intended meaning is uncertain. This does not include instances in which it seems that the wrong word has been chosen (Wrong Word References), but rather the word or phrase used could have a number of different meanings in its current context, and the correct meaning is not obvious. Pronouns with unknown referents are also included in this category unless there are clearcut alternative possible referents, in which case it would be classified as a confused reference.

Most instances of unclarity contain ambiguous words or phrases; therefore, if instances of unclarity do not meet criteria for any of the other categories, they are likely to be classifiable here. Any parts of speech may be rated as ambiguous words.

Back to the ‘we’ disturbances mentioned in the CR category. ‘We’ coded if there is no previous mention of who ‘we’ might be. For example, the phrase ‘My brother and I like football. We watch it a lot’ wouldn’t be coded because ‘we’ refers to the speaker and their brother. Other examples of AWM are clichéd sayings like ‘live life to the fullest’, where a specific meaning can’t be derived. Here are some more examples of AWM: ‘My Grandma died... when she went, I broke down. I had a nervous breakdown, crying all the time.’, ‘You have to deal with yourself, because sometimes I get depressed’, ‘My problems began after my father died. I was hurled into the mental health field by psychologists and counselors.’

EXAMPLES:

*I hope my GPA doesn't inhibit me from being accepted into graduate school.*

Here, ‘inhibit’ is a word that has multiple meanings and the most commonly associated meaning does not work. While an alternative meaning might work here, it is a confusing word choice.

*These people don't belong on Earth. God will get them.*

What is meant by ‘get’ them? Similar to confused reference, except here there are an unlimited number of possible meanings.

*We used to party a lot.*

If speaker does not provide a referent to ‘we’. This is a common ambiguous word meaning. One exception is if the person is married and you determine that they are referring to this dyad. In this case, ‘we’ is not counted.

*I'm all natural and don't hang in crowds.*

‘Natural’ is unclear here and could possibly work, but there is probably a better alternative word that would clarify the sentence.



KEYS to determining Ambiguous Word Meanings:

- a. These include instances in which a word or phrase has more than one possible meaning and is used in such a way that the intended meaning is uncertain.
- b. Most categories have unclarity; therefore, this is a rule out category. Before determining a disturbance is an ambiguous word meaning, rule out Vague References, Confused References, or Wrong Word References.

### 5. Wrong Word References

This refers to when a seemingly incorrect word or phrase is used. Wrong word references go beyond awkwardness of usage. The words are not being used according to any of their possible correct definitional meanings, or else they seem to be used in the place of other identifiable more appropriate words (and often but not always resemble those words phonetically).

These can be confused with ambiguous word meanings. The difference is that with ambiguous word meanings, a word may be confusing because of multiple meanings; in the case of wrong word references, the meaning is incorrect using any definition. These also resemble structural unclarity. If the unclarity can be pinpointed to a single word or phrase and substituting another word in place would correct the disturbance, then it is a wrong word reference. If there are several words or the structure of the sentence causes confusion, it is a structural unclarity. This category will probably have the lowest frequency considering most of our participants are high functioning.

Here is a previous example (in the AWM section) that demonstrates the difference between AWM and WWR. Ex. 'My problems began after my father died. I was hurled into the mental health field by psychologists and counselors.' The difference being that 'hurled' (coded AWM) could possibly work but this isn't the best use of the word, while 'field' (coded WWR) is completely wrong (it implies she became a psychologist or psychiatrist).

EXAMPLES:

*I used to sit in the café, have something to eat, and just glare out into the night.*

In this instance, 'glare' is incorrect. The speaker probably meant to say 'stare'.

*He was doing well in the beginning, but then he sort of abused his study habits.*

Here is an example used earlier. "Abused" is the wrong word choice. You can be negligent or lax with your study habits, but you can't abuse them.

*My mother and father wasn't together... but it didn't hinder my likeness for her.*

Here, the speaker probably meant to say 'like' and not 'likeness'. 'Likeness' makes the sentence unclear.

*In this photo, I can see a somewhat manicured background consisting of a beautiful lake.*

In this sentence, 'manicured' is incorrect. 'Pastoral' might be what the speaker meant.

KEYS to determining Wrong Word References:

- These include instances in which a word is not being used according to any of the possible correct definitional meanings, or else it seems to be used in the place of other more appropriate words
- Wrong Word References often are phonetically similar to the intended words.
- They differ from Ambiguous Word Meanings in that none of their alternative definitions would work correctly. They are all incorrect.
- These differ from Structural Unclarities in that Wrong Word References are single words or phrases that are incorrect, as opposed to a breakdown in the structure of the sentence.

## 6. **Structural Unclarities**

Instances in which meaning is unclear due to a breakdown or inadequacy of language structure. This includes grammatical errors that impair meaning and incomprehensible statements that lack sentence structure. Common disturbances found here are semantically unworkable combinations of words (ex. *I thought I was going to live forever because of the sun, the horizon of the sun.* ) where the sentence is not grammatically incorrect, but it is a semantically unworkable combination of words. This can also be a confusing category; there are quite a few judgment calls about what is or is not unclear.

### EXAMPLES:

*I got a sister in Buffalo, New York. I've been there... must have been about twice since I was up there.*

'Twice since I was up there' does not make sense; what was about 'twice' ?

*Either I do custodial work.*

Again, this a grammatically incorrect sentence that does not make sense. It is basically a word salad.

*It looks wet, like it might have just lost it's eye.*

These are two separate thoughts that should not be placed together or if they do make sense, should be explained more thoroughly.

*I've been in three or four weddings... they've been fun, but I don't know, it's a big deal.*

The speaker is probably trying to convey that weddings are a big deal and they have had fun being in three or four weddings. However, the way this sentence is worded makes it hard to decipher that meaning and gives significant pause.

### KEYS to determining Structural Unclarities:

- Unclear due to a breakdown or inadequacy of language structure.
- Grammatically incoherent sentences fit here.
- Grammatically correct sentences where meaning cannot be determined also belong in this category.

## SAMPLE

Um, this picture makes me happy I guess because I really like, I really enjoy reading um even though I'm not an English major I prefer English reading over anything else. Um, my aunt said I started learning to read at the age of three which like the earliest one in the family I don't know why I just enjoy reading. Um, I read almost, um, I enjoy story books like a mystery books. I read Japanese mystery books, English mystery books, and Chinese. Um, this cabinet. Doesn't make me feel I don't feel anything about the cabinet, it's just it looks kind of like my little cabinet at home. Um, it's about this size too. Um, mine, my small little small cabinet like this at home I use to keep is, I keep it next to my chair that's where I use to keep my little um nap books in there. Or sometimes I fall asleep on my couch and this cabinet is like right next to my couch my little chair so like um. This picture reminds me um I don't like this picture that much but it's not I don't hate it that much either I just don't like the dark. I'm afraid of dark blood anything like that. Um, this picture reminds me kind of like a pub I don't know I've never been to one my parents doesn't like me going out late after nine so I haven't been anywhere dark like that so. Um, especially they don't like me going out like to pubs so this kind of reminds me of a pub. Um, why is there, oh I seen those many times. My dad uses them he um before my dad my brother who's like only six before he had him he always wanted a boy I was the second child in the family he always treat me like a boy so every time when he do something like this, cutting wires or stuff he always calls me and it's really scary because he expects me to know the names of like each thing he use. Um, and right now I still don't know most of the names of the equipment he uses. Um, I feel happy to see a towel because towels make me I guess think of like warm you know. Um, I um, that's my color that's my sister's color she kind of like this color towel, I prefer purple though. Um, now it makes me want to take a bath right now I'm so gross. Um, what else? A towel, let's see.

### SAMPLE 1 Breakdown

*Um, this picture makes me happy I guess because I really like, I really enjoy reading um even though I'm not an English major I prefer English reading over anything else.*  
'Anything else' should be coded as a Vague Reference. This description is overinclusiveness and assumes the reader knows what 'anything else' refers to. Since 'anything' is a nominal phrase it is coded as Vague Reference as opposed to Ambiguous Word Reference.

**OK-Um, my aunt said I started learning to read at the age of three which is like *the earliest one* in the family I don't know why I just enjoy reading.**

Here, 'the earliest one' is poor grammatically; however, it can easily be determined that what is meant is the earliest or youngest 'person' in the family that could read.

**OK-Um, I read almost, um, I enjoy story books like a mystery books.**

This sentence is poor grammatically, but the speaker corrects themselves immediately.

*I read Japanese mystery books, English mystery books, and Chinese.*

This is a tough one. It appears to me that the speaker means 'Chinese mystery books', but they could easily mean that they can read the language. I felt like this sentence gave me significant pause and coded it as a Confused Reference since there are two possible options,

**OK-Um, this cabinet. Doesn't make me feel I don't feel anything about the cabinet, it's just it looks kind of like my little cabinet at home. Um, it's about this size too. Um, mine, my small little small cabinet like this at home I use to keep is, I keep it next to my chair that's where I use to keep my little um nap books in there. Or sometimes I fall asleep on my couch and *this cabinet* is like right next to my couch my little chair so like um.**

'This cabinet' is questionable since two cabinets are mentioned in the passage: the one in the photo and the one the speaker owns. However, since the speaker has been describing their cabinet at home in the previous sentence, I did not feel this caused enough of a pause to constitute coding it as a Confused Reference.

*This picture reminds me um I don't like this picture that much but it's not I don't hate it that much either I just don't like the dark.*

This sentence is a grammatical mess. I feel like the transition from how much the speaker does not like the picture to them disliking the dark comes out of nowhere and gives enough pause to code this as a Structural Unclarity.

***I'm afraid of dark blood anything like that.***

The phrase 'anything like that' is overinclusive and would usually be coded as either Vague or AWM; however, the speaker did not have a chance to explain what this meant due to the photo changing so I chose not to code this.

*Um, this picture reminds me kind of like a pub I don't know I've never been to one my parents doesn't like me going out late after nine so I haven't been anywhere dark like that so.*

While 'my parents doesn't like me going out late' is poor grammar, it does not hinder meaning. However, 'dark like that' could mean to a pub, to the 'pub' depicted in this photo (CANSI.7180), or somewhere dark like in the photo. This should be coded as a Confused Reference.

*Um, especially they don't like me going out like to pubs so this kind of reminds me of a pub. Um, why is there, oh I seen **those** many times.*

There is not enough information provided to understand what 'those' refers to; however, if you use the photo (CANSL.7056), it is obvious that the speaker is talking about the bolt cutters.

*My dad uses **them** he um before my dad my brother **who's like only six before he had him** he always wanted a boy I was the second child in the family he always treat me like a boy*  
'Them' refers to the bolt cutters again. 'who's like six before he had him' is a poorly constructed phrase that I had to read several times to determine that the reader was probably trying to communicate that their father was six and wanted a boy until he had the reader's brother. Due to the difficulty in determining the meaning, I coded this as a Structural Unclarity.

*so every time when he do **something like this**, cutting wires **or stuff** he always calls me and it's really scary because he expects me to know the names of like each **thing** he use.*  
'something like this' is okay because it is corrected to 'cutting wires'. 'or stuff' is filler and does not hinder meaning as it is not the subject of the sentence (if it said 'cutting stuff' it would be Vague). However, 'each thing' is overinclusive. Does it mean 'each tool'? It is impossible to know. This should be coded as a Vague Reference.

*Um, and right now I still don't know most of the names of the equipment he uses. Um, I feel happy to see a towel because towels make me I guess think of like warm you know. Um, I um, that's my color **that's my sister's color** she kind of like this color towel, I prefer purple though.*  
The speaker never provides the information needed to know what this color the towel is but you can easily see it the color if you use the photo (CANSL.7002) . This should not be coded.

**OK-Um, now it makes me want to take a bath right now I'm so gross. Um, what else? A towel, let's see.**

This sentence is fine, as the speaker is cut off at the end.

Corrected words (total words in parentheses)- 418 (433)  
TOTAL CDI Score (frequency in parentheses)- 6 (1.44%)  
Vague References- 2 (0.48%)  
Confused References- 2 (0.48%)  
Missing Information References- 0 (0%)  
Ambiguous Word References- 0 (0%)  
Wrong Word References- 0 (0%)  
Structural Unclarity- 2 (0.48%)

## Appendix D: Category Fluency Test

The scoring sheets and instructions for collecting category fluency data.

### Category Fluency Task

**Say:** *Now I'd like you to tell me the names of all the different kinds of animals you can think of. I'll give you one minute to come up with as many as you can. Ready?*

## Animals

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_
13. \_\_\_\_\_
14. \_\_\_\_\_
15. \_\_\_\_\_
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30. \_\_\_\_\_
31. \_\_\_\_\_
32. \_\_\_\_\_
33. \_\_\_\_\_
34. \_\_\_\_\_
35. \_\_\_\_\_
36. \_\_\_\_\_
37. \_\_\_\_\_
38. \_\_\_\_\_

## Appendix E: Alternative Uses Test

Laboratory protocol and a sample scoring sheet for Alternative Uses Test.

### RUNNING SUBJECTS:

#### **I. Consent forms, answering questions, etc. (Approx. 2 minutes)**

The Subject must sign 2 copies of the consent form prior to beginning the experiment. Give the subject 1 copy to take with them.

##### **Ia. Intro statement:**

*“Thanks for agreeing to participate in this research. You will be asked to perform a few brief exercises and answer some questions on your own as well. This experiment should only take about 10 minutes of your time. Do you have any questions?”*

#### **II. Brief Assessment of Creativity- Alternative Uses Tests (Approx. 8 minutes)**

*“During this study, I’ll be asking you to complete a few exercises. I want you to try to come up with as many different uses as you can for a common household item. For example, if the object was a newspaper... you could use it for reading. You could also use it to swat flies, to line drawers in your cabinets, to make a paper hat, and so on. When you are ready, I will say the item and you say aloud as many possible uses as you can think of. You will have two minutes; try to think of as many possible uses for the item as you can for the full time. Ready?”*

- Present the three items (brick, pencil, paperclip) in the order they are listed in your particular packet. Allow two minutes for each item, then move to the next one by saying:

*“Next, I will say another common household item and, just like before, you will again give me as many different uses as you can think of for the item in two minutes. Ready?”*

- Once these exercises are completed, lead the participant outside to the testing lobby and allow them to complete the questionnaire and demographic sheet.

## Alternative Uses Test

# Brick

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
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14. \_\_\_\_\_
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16. \_\_\_\_\_
17. \_\_\_\_\_
18. \_\_\_\_\_
19. \_\_\_\_\_
20. \_\_\_\_\_



## Vita

Kyle S. Minor was born in Glasgow, Kentucky in 1980. He earned Bachelor of Arts degrees in Psychology and English: literature and writing from Northern Kentucky University in 2004. At Northern Kentucky, Kyle completed an Honors Thesis focusing on methods to prevent reoccurrence of psychotic symptoms in patients with schizophrenia. Upon graduation, he worked with Dr. Hiram C. Polk, Dr. Susan Galandiuk, and Dr. Suhal S. Mahid at the Price Institute of Surgical Research in the Department of Surgery at the University of Louisville School of Medicine. In 2006, Kyle entered the doctoral program in clinical psychology at Louisiana State University, where he worked under the mentorship of Dr. Alex S. Cohen and earned a Master of Arts degree in 2009. Recently, he completed an APA accredited internship in clinical psychology, with a specialization in early psychosis, at the Massachusetts Mental Health Center/ Harvard Medical School Department of Psychiatry at Beth Israel Deaconess Medical Center in June, 2012. Kyle will begin a postdoctoral fellowship at the Center for Early Detection, Assessment, and Response to Risk (CEDAR)/ Harvard Medical School Department of Psychiatry at Beth Israel Deaconess Medical Center in July, 2012. His primary research and clinical interests include examining thought disorder across the schizophrenia spectrum and investigating risk factors that increase the likelihood of conversion to psychosis in individuals with attenuated psychotic symptoms, particularly the role of emotion, stress, and neurocognitive factors.