2010

Emotion recognition in schizotypy

Laura Brown
Louisiana State University and Agricultural and Mechanical College

EMOTION RECOGNITION IN SCHIZOTYPY

A Thesis
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
Master of Arts

In

The Department of Psychology

by
Laura Brown
B.S., Louisiana State University, 2006
May 2010

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Abstract

Deficits in social cognition are repeatedly found in individuals with schizophrenia. Facial emotion recognition is a major aspect of social cognition in which individuals with schizophrenia show consistent deficits. However, many questions about these deficits remain unanswered including whether they occur in individuals with schizotypy—those at high risk for the disorder that do not manifest full pathology. Examining emotion recognition in schizotypy eliminates many of the confounds associated with schizophrenia research such as medication effects, chronic institutionalization, and generalized cognitive deficits, and allows for the examination of whether emotion recognition deficits reflect vulnerability to schizophrenia. Prior research in this population has yielded mixed findings and is subject to a number of limitations including measurement of only a subset of schizotypy symptoms and use of non-validated or less sensitive emotion recognition measures. The current study examined emotion recognition in control and psychometrically-identified schizotypic individuals, employing a well-validated emotion recognition task that allowed for the examination of accuracy and bias scores. Of interest was whether individuals with schizotypy would show deficits when labeling emotional faces, whether they would exhibit biases when rating the emotional valence of faces, and how these variables relate to neurocognitive abilities, symptoms, and quality of life. Results indicate that individuals with schizotypy were significantly less accurate than controls when labeling facial emotions; however, they did not show generalized impairment on neurocognitive measures. Within the schizotypy sample, both disorganization symptoms and lower quality of life were associated with a bias toward perceiving facial expressions as more negative. Results

support prior studies suggesting that poor emotion recognition is associated with vulnerability to psychosis even in the absence of neurocognitive impairment. Results also offer evidence of social cognitive biases in schizotypy, and suggest that these biases may be more related to overall functioning than accuracy labeling emotions.

Introduction

Schizophrenia is a devastating disorder distinguished not only by a variety of bizarre behaviors but also deficits in neurocognition, social cognition, and overall functioning. First, I give a brief overview of schizophrenia symptomology and associated cognitive deficiencies. Next, I consider research on facial emotion recognition, an important domain of social cognition. Facial emotion recognition is generally impaired in individuals with schizophrenia, however it is unclear whether this impairment is better understood as a reflection of generalized neurocognitive deficits or a specific impairment in emotion recognition ability. However, facial emotion is specifically related to social behavior and overall functioning. I then turn to examining these issues in individuals with schizotypy, or those with the purported genetic liability for schizophrenia that do not display the full disorder.

Review of the Literature

Schizophrenia

Schizophrenia is a disorder characterized by impaired reality testing, odd behaviors, and substantial social and occupational dysfunction. It is estimated that about 0.4 percent of the United States population is affected (Wu, Shi, Birnbaum, Hudson, & Kessler, 2006). In 2001, the World Health Organization named schizophrenia among the top ten causes of healthy life lost to disability (World Health Organization, 2001). Schizophrenia has been recognized by physicians and researchers for many years. It was once termed *demence praecoce* or "early dementia" (Morel, 1890) as physicians thought it entailed progressive deterioration. Emil Kraepelin was instrumental in characterizing symptoms and outcome (1919; 1971). The disorder was finally named *schizophrenia* meaning "split mind" by Eugen Bleuler in 1911, focusing on what he termed the splitting of psychic functions (1911; 1950).

Symptoms

Individuals with a diagnosis of schizophrenia may display extremely variable symptoms, sometimes experiencing acute psychosis, sometimes predominant symptoms of amotivation and flat affect, and often severe cognitive and emotional deficits (Andreasen, 1997). Although many different symptoms are manifest in an individual simultaneously, not all patients display the same symptoms. Further complicating the issue, none of the symptoms are specific to schizophrenia (American Psychiatric Association, 2000), and efforts to determine with disorder-specific criteria have been largely unsuccessful (e.g. first rank symptoms, Schneider, 1959; Nordgaard, Arnfred, Handest, & Parnas, 2008). Patients also show a variable course, with some displaying

intermittent psychotic episodes followed by periods of clinical stability and others exhibiting a chronic course characterized by lack of motivation and emotional expression with transient delusions and hallucinations (Gerbaldo, Cassady, & Helisch, 1995).

There have been two broad strategies for reducing heterogeneity of symptoms. The first involves the notion that schizophrenia is not a single disorder but a collection of disorders with separate etiologies lumped together under one category (Crow, 1980). Absent evidence of separate etiologies, however, and considering that separate syndromes can occur simultaneously in the same individual, the most parsimonious solution is that schizophrenia represents a single disorder (Crow, 1985). A number of taxonomies have been put forward delineating distinct subtypes of the illness. For example, very early in the history of schizophrenia, distinctions were made between "process" and "reactive" types (Kantor, Wallner, & Winder, 1953). Crow (1985) also noted two types of schizophrenia: Type I and Type II. The DSM-IV-TR attempts to address the issue of heterogeneity by defining particular subtypes including paranoid, disorganized, residual, and undifferentiated (APA, 2000). Some problems with the DSM-IV-TR subtypes are that the subtypes diagnoses are not particularly reliable or stable (Blashfield, 1973; Gruenberg, Kendler, & Tsuang, 1985), and many patients seem to fall into the "undifferentiated" category (Kendler, 1985).

A second strategy for understanding heterogeneity is using a statistical method. Much research suggests that particular symptoms cluster together. The most accepted model distinguishes three symptoms clusters and comes from a factor analysis done by Liddle (1987) that found positive, negative, and disorganization factors. More recent research has supported this factor structure (Malla, Norman, Williamson, & Cortese,

1993; Andreasen, Arndt, Alliger, Miller, & Flaum, 1995). Positive symptoms include delusions and hallucinations and reflect an exaggeration of behaviors present in non-disordered individuals. Negative symptoms reflect the absence of behaviors normally present in non-disordered individuals. They include flat or blunted affect, avolition, anhedonia, and alogia. Disorganization symptoms include disorganized speech, disorganized or bizarre behaviors, and inappropriate affect. Positive symptoms are the least stable (Fenton & McGlashan, 1991), respond best to medications (Tandon et al., 2008), and are not a good indicator of prognosis (Strauss, Carpenter, & Bartko, 1975; Addington & Addington, 1991). Negative symptoms are the most stable and generally do not respond well to treatment (Arndt et al., 1995), with the exception of those secondary negative symptoms that occur in response to positive or other mood symptoms (Carpenter, Heinrichs, & Alphs, 1985; Goldberg, 1985; Arango, Buchanan, Kirkpatrick, & Carpenter, 2004). Less is known about how disorganization symptoms related to functioning and other symptoms. They seem to be correlated with executive functioning, attention (Moritz et al., 2001; Kerns & Berenbaum, 2002), and social information processing deficits (Brune, 2003; Shean, Murphy, & Meyer, 2005).

Neurocognition

Neurocognitive deficits were noted early in the history of schizophrenia and seem to be a hallmark of the disorder. Bleuler (1950) and Kraepelin (1899) wrote about deficits in attention, perception, and cognition, and other researchers have characterized schizophrenia by a generalized deficit in any task requiring a "voluntary response" (Chapman & Chapman, 1978). Particular areas of deficiency in schizophrenia include processing speed, attention/vigilance, working memory, verbal learning and memory,

reasoning and problem solving, and verbal comprehension (Neuchterlein, Barch, Gold, Goldberg, Green, & Heaton, 2004). In 1996, a seminal review article highlighted the importance of basic neurocognitive deficits in schizophrenia (Green, 1996). This review revealed, first, that negative symptoms predict overall functional outcome, but positive symptoms do not. Neurocognitive deficits, however, were the best single predictor or functional outcome in individuals with schizophrenia. Specifically, there may be neurocognitive "rate limiting factors" that prevent patients from acquiring certain necessary skills. The effect size is small (d = .20 to .40) in cross-sectional studies (Green, Kern, Braff, & Mintz, 2000) and much lower in longitudinal studies (Milev, Ho, Arndt, & Andreasen, 2005) but is stable (Addington & Addington, 2000). Further research has shown that the pathway from neurocognitive deficits to overall functioning may be best understood as medicated by social cognition as discussed below.

Social Cognition

Social cognition is defined as the way people think about themselves and others (Penn, Sanna & Roberts, 2008) and includes social perception, interpretation, and processing (Penn, Corrigan, Bentall, Racenstein, & Newman, 1997). One theory emerging from the social psychology literature about the relationship between social and nonsocial cognition is the *building-block* theory (Ostrom, 1984; Penn et al., 1997). Nonsocial and social cognition are related but represent different levels of analysis in that more basic cognitive processes provide the foundation for social cognitive processing. Based on this theory, neurocognitive deficits might be a limiting factor, but social cognition would have a more precise relationship to social functioning and outcome in that how an individual understands social behavior and interprets the world is more

closely related to his or her behavior. This theory contrasts with other social cognition theories that propose that social and nonsocial cognition involve identical processes (Ostrom, 1984).

Green & Nuechterlein (1999) proposed a model of the relationship between neurocognition and functional outcome in which social cognition was a mediator. Further research supports this model in that 1) social cognition and neurocognition are related but separate factors (Sergi et al., 2007), and 2) social cognition contributes variance to functioning above and beyond the contribution of neurocognition (Brekke, Kay, Lee, & Green, 2005; Sergi, Rassovsky, Nuechterlein, & Green, 2006). Therefore, neurocognitive abilities may affect the quality of patients' social abilities and interactions, and this, in turn, is something that influences general functioning and life quality.

Emotion Recognition

Emotion recognition is a widely researched domain of social cognition referring to the ability to decode emotions from facial expressions. The ability to recognize facial expressions of emotion is an important aspect of human social interactions. The ability develops very early in life, around one year of age (Sorce, Emde, Campos, & Klinnert, 1985), and facial processing in general is neurally distinct from processing of other, non-social objects (Aldolphs, 2002). Further, some facial expressions of emotion are invariant across cultures; happiness, sadness, anger, fear, disgust, and surprise (Ekman & Friesen, 1971; Ekman, 1973; Izard, 1994).

A plethora of research studies have been conducted to examine emotion recognition in schizophrenia patients. Some reliable findings include that patients are more impaired in facial emotion recognition than controls (Dougherty, Bartlett, & Izard,

1974); this is related overall functional impairment (Mueser et al., 1996; Kee, Green, Mintz, & Brekke, 2003). Emotion recognition deficits may reflect a trait-like vulnerability marker for schizophrenia rather than a state-like deficit that can be attributed to symptoms. Support for this idea comes from studies that have found no improvement with symptom remission (Addington & Addington, 1998), no improvement with antipsychotic treatment (Herbener, Hill, Marvin, Sweeney, 2005), and deficits that remain stable over time (Addington, Saeedi, & Addington, 2006).

Researchers have investigated different mechanisms possibly underlying emotion recognition deficits in schizophrenia. These include neurocognitive deficits, social cognitive biases, and symptom heterogeneity. Neurocognitive explanations have been most widely offered by researchers. Chapman and Chapman (1973) observed that individuals with schizophrenia exhibit a "generalized deficit" in cognitive tasks, meaning that their performance is worse than typical persons on most cognitive tasks, and suggested that this be taken into account when looking for more *specific* areas cognitive deficits. This generalized deficit makes it very likely that individuals with schizophrenia will show below average performance, whether or not they actually have a specific deficit in the domain being investigated. Researchers have addressed this problem in a number of ways, the most stringent control for the generalized deficit being the use of control tasks matched on every aspect other than the domain being tested. These tests should be psychometrically validated on individuals with schizophrenia. This allows for the control of general processing, responding, or encoding deficits present in schizophrenia. Researchers using this "differential deficit design" have disagreed on whether there is a specific emotion recognition deficit in schizophrenia. While many studies show that

patients are differentially impaired when processing emotions in facial expressions (Heimberg et al., 1992; Hall et al., 2004; Kucharska-Pietura et al., 2005; Schneider et al., 2006), there is also compelling research to suggest patients have a generalized facial processing deficit (e.g. Kline, Smith & Ellis, 1992; Kerr & Neale, 1993; Salem, Kring & Kerr, 1996; Mueser et al., 1996; Addington & Addington, 1998; Kohler, Bilker, Hagendoorn, Gur, & Gur, 2000). It seems that neurocognition plays an important role in emotion recognition. However, given the inconsistent findings, neurocognition probably does not account for all of the difficulties, and it may do so in only some patients.

Another mechanism potentially underlying poor emotion recognition in schizophrenia is a social cognitive bias. Biases occur when individuals have a tendency to perceive stimuli in a particular way, such as a bias toward perceiving the faces as more negative, more positive, or more threatening.This idea is supported by research showing that individuals with schizophrenia make more errors than would be explained by neurocognitive limitations differential deficit), or that they may be consistently making certain types of errors. Several studies have investigated potential biases in emotion recognition and these issues have been examined in a number of different ways.
First, many have considered whether patients are impaired when recognizing only particular emotions. This research has yielded many different findings with some supporting a deficit in recognizing positive emotions (Sachs, Steger-Wuchse, Kryspin-Exner, Gur, & Katschnig, 2004), negative emotions (Kucharska-Pietura, David, Masiak, & Phillips, 2005), or threatening emotions such as anger or fear (Premkumar et al., 2008). Other researchers have examined the types of errors patients make. Some studies indicate that patients are more likely to perceive emotion in neutral faces (Heimberg et al., 1992;

Leppánen, Niehaus, Koen, Du Toit, Schoeman, & Emsley, 2006), especially negative emotion (Kohler et al., 2003). Still others have considered whether patients systematically perceive faces as being more negative or positive than they are considered by controls. In some studies, patients show a bias toward viewing expressions as more positive (Dougherty et al., 1974; Schneider, Gur, Gur, & Shtasel, 1995). More recent studies using more lifelike emotion recognition tasks with a range of emotional intensities have revealed a negative bias (Kohler, Turner, Bilker, & Brensinger, 2003; Tsoi et al., 2008). Prior research examining cognitive biases does not lead to any strong conclusions. However, this is not unexpected given the many correlates of patient status (i.e. heavy medication, social isolation, broad neurocognitive deficits) which could impact emotion recognition ability as well as the range of methodologies employed (discussed below).

Few studies have examined emotion recognition in different subtypes of schizophrenia in a systematic way that examines the full range of symptoms. However, many studies that attempt to examine different subtypes or symptom dimensions suggest that heterogeneity may be an important issue when studying emotion recognition deficits. It may be that only some patients have trouble recognizing facial emotions or different types of symptoms may be associated with different biases. For example, individuals with paranoid symptoms tend to be more accurate when recognizing facial emotions than nonparanoid individuals (Kline et al., 1992; Phillips et al., 1999). Mandal, Jain, Haque-Nizamie, Weiss, & Schneider (1999) found that patients with positive but not negative symptoms exhibited a positive bias when identifying facial emotions. Schneider and colleagues (1995) also found that emotion recognition performance was negatively correlated with severity of negative symptoms and bizarre behavior. This suggests that

patients with different symptom presentations may approach emotion recognition tasks very differently. Further support for this is found in an article written by Cohen, Nienow, Dinzeo, and Docherty. (2009) in which, although error profiles in patients as a group and controls were similar, within patients, severity of positive symptoms was associated with fear misperceptions and severity of disorganization and negative symptoms was associated with anger misperceptions. Although the extant literature on subgroups of patients does not offer definitive conclusions, it highlights the importance of considering heterogeneity.

The emotion recognition literature has many limitations. While the effect of the generalized deficit may be replicable across studies, findings concerning differential deficit, biases, and subtypes are not. One reason for this may be that methods are not consistent across studies (see Edwards (2002) for a review). Many researchers have created their own emotion recognition tasks with different stimuli, response formats, and emotion categories. To address this issue, Kerr and Neale (1993) developed a standardized measure of emotion recognition, the Facial Emotion Identification Test (FEIT), which has been used in a number of studies since. While this offered some consistency of methods and represented an improvement over developing a new task for each study, the FEIT still has limitations. There are a limited number of stimuli, faces are restricted in ethnicity and age, stimuli contain actors depicting only posed expressions of emotion, and tasks do not control for emotion intensity of facial expressions.

In sum, there are many inconsistencies in the literature concerning emotion recognition abilities in patients with schizophrenia. The research is rife with methodological problems, including the use of nonstandardized tasks, emotional stimuli

limited in ethnicity and age, and inattention to the considerable heterogeneity of schizophrenia symptoms. Although there is substantial support for a deficit in emotion recognition performance in individuals with schizophrenia, it is questionable how meaningful this deficit is given general cognitive deficits. Moreover, the potential role of social cognitive biases has not been clarified. Finally, the question still remains whether emotion recognition deficits reflect general cognitive abilities in schizophrenic patients, or whether they are a vulnerability marker present even in individuals who have the genetic liability but do not show symptoms. These questions may be addressed by considering individuals at risk for schizophrenia.

Schizotypy

It has been proposed that schizophrenic symptoms are multidimensional and are present at subclinical levels in individuals who possess the underlying genetic vulnerability. Sandor Rado (1956; Rado & Daniels, 1956) first used the term "schizotype" to refer to an individual who had the schizophrenic phenotype. Rado viewed schizophrenia symptoms as continuous and present to a lesser degree in some individuals. Meehl (1962) refined this theory, focusing on what he called the "schizogene," a gene that affected brain development which all individuals with schizotypy possess. Having this gene resulted in an integrative neural deficit and produced a central nervous system anomaly, which Meehl termed "schizotaxia." The effect of schizotaxia in interaction with social learning and other environmental influences produces a schizotypal personality organization. Three phenotypic outcomes are possible for the schizotype: 1) schizotypy, 2) schizophrenia spectrum disorder, or 3) schizophrenia. According Meehl's model, about 10 percent of the general population has the genetic vulnerability, but only 5

percent of them will develop full-blown schizophrenia (Meehl, 1962; Lenzenweger & Korfine, 1992). Therefore, these individuals are at substantially increased risk for developing schizophrenia compared to the general population with a prevalence of 0.4 percent). It is notable, also, that later conceptualizations of this model include polygenetic influences rather than a single gene (Lenzenweger, 2006). Probably the most important part of Meehl's model is that those who do not decompensate will show the liability as subtle aberrations in psychological and neurocognitive processes. This theory has led to a myriad of studies examining risk markers, or endophenotypes, for schizophrenia (Gottesman & Gould, 2003). Meehl's risk signs included cognitive slippage, interpersonal aversiveness, anhedonia, and ambivalence. These signs result from the central nervous system anomaly and are present in all who possess the schizogene, regardless of whether symptoms are manifest. Further research in schizotypy has supported Meehl's model. Schizotypes can be reliably identified (Raine, 1991), taxometric studies indicate that a subset of the population exhibits schizotypal personality organization (Horan, Blanchard, Gangestad, & Kwapil, 2004), and this population is at an increased risk for schizophrenia and related disorders (Chapman, Chapman, Kwapil, Eckblad, & Zinser, 1994; Gooding, Tallent & Matts, 2005).

Symptoms

Schizotypy research has also revealed symptom dimensions similar to that of schizophrenia (Wuthrich & Bates, 2006; Rossi & Daneluzzo, 2002). Kerns (2006) found that a three factor model of schizotypy including positive, negative, and disorganization symptoms exhibited a good fit. This study included extensive schizotypy measures, assessing the full range of symptoms. Schizotypy symptom dimensions closely resemble

those of schizophrenia, only not severe enough to meet clinical threshold (Raine, Reynolds, Lencz, Scerbo, Triphon, & Kim, 1994). Positive schizotypy symptoms include ideas of reference, magical thinking, and paranoid ideation. Negative schizotypy includes having no close friends and constricted affect. Disorganized schizotypy is characterized by oddities of speech and behavior such as speech that uses vague or unclear references. Just as in schizophrenia, individuals may exhibit different degrees of each symptom dimension with different levels of functional impairment, including some that show little to no impairment.

Measurement of Schizotypy

Current research methods usually identify schizotypes in one of four ways: biological relatives of schizophrenia patients, individuals in the prodromal phase, individuals with schizotypal personality disorder, and individuals with psychometrically-identified schizotypy. Studies using biological relatives identify patients with schizophrenia and assume biological relatives possess the genetic vulnerability (twins, siblings, parents). This method finds support in studies that have found that relatives are at increased risk for schizophrenia and display subclinical symptoms (Baron et al., 1985; Erlenmeyer-Kimling & Conblatt, 1987; Thaker, Adami, Moran, Lahti & Cassidy, 1993). Another method is the ultra-high-risk method which seeks to identify individuals who are on the verge of decompensation into schizophrenia (Simon et al., 2006). These individuals are already experiencing psychotic symptoms and some functional impairment but have not yet deteriorated to the point of meeting diagnostic criteria. This includes individuals with intermittent psychosis of a shorter duration, symptoms not intense enough to meet criteria, and individuals with combinations of trait and state

factors that put them at particular risk (Yung et al., 2003). Some research also uses diagnostic criteria for schizotypal personality disorder in which there is a clear diagnostic threshold, with symptoms either being present or not. Particular problems with these methods are first that they are not very efficient, and they capture only those individuals on one end of the schizotypy spectrum, largely ignoring those who never decompensate. According to Meehl's model, the majority never decompensate. Finally, researchers also use a psychometric risk paradigm. The idea is to identify individuals with schizotypy based on behavioral or self-report measures of some of Meehl's signs of schizotypy. This method has been used in many studies and has proven to efficiently capture a sample of individuals who are at a greater risk for developing schizophrenia and schizophrenia- spectrum disorders (Chapman et al., 1994; Kwapil, Miller, Zinser, Chapman, & Chapman, 1997; Gooding, Tallent, & Matts, 2007).

One of the most widely used psychometric measures is the Schizotypal Personality Questionnaire (SPQ). Raine (1991) designed this questionnaire to mirror DSM-III symptoms of schizotypal personality disorder. While previous scales measured a limited number of symptoms (positive symptoms, speech disturbances, etc.), the SPQ assesses a range of symptoms, including all nine features of schizotypal personality disorder: ideas of reference, excessive social anxiety, odd beliefs/magical thinking, unusual perceptual experiences, odd/eccentric behavior, no close friends, odd speech, constricted affect, and suspiciousness. Although SPQ items mirror schizotypal personality disorder symptoms, it assesses a broad range of subclinical pathology rather than just clinically significant symptoms. The SPQ has demonstrated good internal reliability ($\alpha = .91$) and test-retest reliability ($r = .82$). Further, it demonstrates criterion

related validity in that high scorers are much more likely to qualify for a diagnosis of schizotypal personality disorder, and all of those identified with schizotypal personality disorder obtained high scores (Raine, 1991). Raine (1991) also examined correlations between other schizotypy scales and scales related to schizotypy but not measuring DSM-III schizotypal personality symptoms and found evidence for convergent and discriminant validity. The SPQ has also been factor analyzed, revealing three separate dimensions similar to those found in schizophrenia (Reynolds, Raine, Mellingen, Venables, & Mednick, 2000; Wuthrich & Bates, 2006).

Overall, these results suggest that schizotypy is a construct similar in structure to schizophrenia, it reflects a vulnerability to schizophrenia, and can be revealed via relatively brief self-report questionnaires. Research with individuals at risk allows researchers to avoid many confounds associated with chronic patients, including severe cognitive deficits, medication effects, hospitalization, and acute psychosis.

Neurocognition

Schizotypy research has often revealed a wide range of neurocognitive deficits, however, these deficits are not as large as those found in schizophrenia (Siever & Davis, 2004). Particular areas of impaired neurocognition include those found in schizophrenia patients: verbal memory, attention, and executive functioning (Sitskoorn, Aleman, Ebisch, Appels, & Kahn, 2004). This comes from studies that have examined individuals with schizotypal personality disorder (Voglmaier, Siedman, Niznikiewicz, Dickey, Shenton, & McCarley, 2005; Siever, Koenisgerg, Harvey, Mitropoulou, Laruelle, Abi-Dargham et al., 2002, Roitman, Bergman, & Obuchowski, 1997), biological relatives of schizophrenia patients (Sitskoorn et al., 2004; Laurent, Biloa-Tang, Bougerol, Duly,

Anchisi, Bosson et al., 2000), ultra-high-risk samples (Wood, Pantelis, Proffitt, Phillips, Stuart, Buchanan, et al., 2003; Brewer, Francey, Wood, Jackson, Pantelis, Phillips et al., 2005), and some psychometric high risk samples (Barrantes-Vidal, Fananas, Rosa, Caparros, Riba, & Obiols, 2002; Bergida & Lenzneweger, 2006, but see Jahshan & Sergi, 2007: Lenzenweger & Gold, 2000). In summary, although broad neurocognitive deficits have been identified in schizotypy samples and do appear to be associated with risk for schizophrenia, these deficits are not as profound as those found in individuals with schizophrenia.

Social Cognition

Individuals with schizotypy also exhibit some social cognitive deviations. However, social cognition has not been widely investigated in at risk samples. Some studies, which will be discussed later, have offered evidence for abnormalities in emotion recognition, but the bulk of the literature is inconclusive. Research has shown that individuals with schizotypy may have difficulty making social inferences (Irani, Platek, Panyavin, Calkins, Kohler, Siegel, 2006; Marjoram, Miller, McIntosh, Owens, Johnstone, & Lawrie, 2006; Chung, Kang, Shin, Yoo, & Kwon, 2008; Pickup, 2006), interpreting nonverbal cues (Toomey, Seidman, Lyons, Faraone, & Tsuang, 1999), and may make deviant attributions for social/interpersonal events (Levine, Jonas, Serper, 2004). There have been studies contradicting these findings, however (Kelemen, Must, & Benedek, 2004; Fernyhough, Jones, Whittle, Waterhouse & Bentall, 2008; Jahshan & Sergi, 2007).

Most notable is the dearth of research in this area and the lack of consistency between studies. There have been relatively few studies examining the different domains of social cognition, and these studies have used different methods of conceptualizing and

identifying schizotypy as well as different ways of measuring social cognitive constructs. Furthermore, studies have not systematically examined heterogeneity within schizotypy, so we do not know whether particular symptoms are related to social cognition. Studies mentioned above have either used restricted schizotypy samples or have not differentiated between symptom domains.

Emotion Recognition

A few studies examining emotion recognition in individuals with schizotypy have not found a deficit compared to controls (Pinkham et al., 2007; Toomey & Schuldberg, 1995; Shean, Bell, & Cameron, 2007). However Kee, Horan, Mintz, and Green (2004) found that across facial, vocal, and combined emotion recognition tasks individuals at risk for schizophrenia were impaired relative to controls, but not as impaired as individuals with schizophrenia. Individual studies may either not be sensitive enough to detect the effect and issues such as neurocognitive limitations, social cognitive biases, and/or symptom heterogeneity may complicate this line of research.

Research with individuals with schizotypy raises the same issues as research with individuals with schizophrenia. This first possibility is that individuals with schizotypy are worse than healthy individuals at recognizing facial emotions due to neurocognitive limitations such as visual processing or attention. Second, individuals may be biases when perceiving emotion in faces, tending to see faces as either threatening or negative. Third, possibly only some subset of individuals with schizotypy are impaired or different subgroups may exhibit different patterns of accuracy or bias. These issues have been examined in part by some researchers.

Although, as mentioned above, many studies have shown neurocognitive impairment in individuals with schizotypy, some have not. Any study examining emotion recognition ideally would include a measure of broader cognitive abilities to control for this. Some studies have done this. Two find on emotion recognition deficits and no neurocognitive impairment (Toomey et al., 1999; Jahshan & Sergi, 2007). However, one study finding that college students with schizotypy were impaired on emotion recognition tasks concluded that this was explained by a general attention deficit (Poreh, Whitman, Weber, & Ross, 1994). This has not been replicated.

Given that individuals with schizotypy are not as impaired across the board as are individuals with schizophrenia, they may employ compensatory strategies when decoding emotions with from facial expressions. Therefore, difficulty recognizing emotions may not be evident from accuracy scores alone. One way to examine this is to consider whether individuals with schizotypy exhibit any underlying social cognitive biases when perceiving facial expressions. Couture, Penn, Addington, Woods, and Perkins (2008) found high-risk participants showed a bias toward rating faces as being more trustworthy than controls did. Leppanen, Niehaus, Koen, Du Toit, and Emsley's (1998) participants exhibited similar patterns as their siblings with schizophrenia when labeling emotions in faces: impaired recognition of negative emotions. Relatively intact neurocognitive abilities may enable some individuals to overcome these types of biases when labeling emotions. To date, little research has been conducted in this area.

Performance deficits and biases may also be obscured by the considerable symptom heterogeneity in schizotypy. Particular symptoms may be associated with impairments. Most studies have not considered the full range of symptoms, but a few

suggest there may be differences. Positive schizotypy is associated with emotion recognition errors in one study (Wout, Aleman, Kessels, Laroi, & Kahn, 2004) and with an attentional bias towards threatening facial expressions in another (Green, Williams, & Davidson, 2001). To date, one study including the full range of symptoms has found evidence for emotion recognition deficits. Williams, Henry, and Green (2007) found that high and low schizotypy groups (defined as those scoring in the upper fifteenth and lower fifteenth percentiles from a sample of 843 college students) did not differ when required to choose from a list which emotion a face was expressing but did differ in a task requiring that they choose one of eight faces that matched the emotion in a target faces (discrimination task). This was found after controlling for facial identity recognition. The authors interpreted this as reflecting a trait deficit, and it was particularly associated with negative symptoms. This study used previously validated emotion recognition stimuli, but it had a relatively small sample size (28 schizotypy and 28 controls), and used a brief version of the SPQ with weaker psychometric properties than the full version (Compton, Chien, & Bollini, 2007). These results need replication in larger samples using more psychometrically sound measures.

It is unclear from the existing literature whether individuals at risk for schizophrenia are impaired at facial emotion recognition. The prior literature is subject to a number of limitations including the use of instruments ill-equipped to measure emotion recognition ability, poor attention to the full range of schizotypal symptoms, and small sample sizes. A handful of studies have found impairments in emotion recognition in this population, suggesting that no single study has enough power to detect this difference, the emotion recognition tasks are not sensitive enough, or combining all individuals with

schizotypy into one group without considering heterogeneity may obscure real deficits in particular subtypes. The current study was designed to address the methodological issues that may have obscured findings in previous studies.

Purpose

The current study examines whether individuals with schizotypy have a facial emotion recognition deficit and how this relates to neurocognition, social cognitive biases, and overall functioning. A relatively large sample of individuals with psychometrically-identified schizotypy and normal controls are included to compare these groups of individuals on a well-validated emotion recognition task allowing for quantification of accuracy and positive and negative bias. In order to determine whether poor emotion recognition can be explained by neurocognitive deficits, I include a measure of broad neurocognitive abilities. Measures of schizotypy symptoms and subjective and objective measures of overall life quality are also employed in order to compare the schizotypy and control groups on these measures and determine, within the schizotypy group, the relationship between emotion recognition, neurocognition, social cognition, symptoms, and life quality. Specific research questions and hypotheses follow.

Research Questions and Hypotheses

1. Are individuals with schizotypy different from healthy controls on emotion recognition or neurocognitive ability?

    Hypothesis 1a: Individuals with schizotypy will perform worse than controls on measures of neurocognitive ability.

    Hypothesis 1b: Individuals with schizotypy will be less accurate than healthy controls on measures of emotion recognition accuracy.

    Hypothesis 1c: Individuals with schizotypy will show a negative bias when looking at facial expression of emotion relative to controls.

2. Is emotion recognition related to impaired neurocognitive ability in individuals with schizotypy?

Hypothesis 2: In individuals with schizotypy, emotion recognition accuracy will be positively correlated with neurocognitive ability.

3. Are different types of schizotypy differentially related to emotion recognition, and to what degree does this reflect neurocognitive deficits?

Hypothesis 3a: Emotion recognition will exhibit different relationships to different schizotypy symptoms.

Hypothesis 3b: Biases in emotion recognition will be associated with some symptom dimensions, but not others.

Hypothesis 3c: The relationship of symptoms to emotion recognition bias will remain significant when controlling for neurocognitive abilities.

4. Is emotion recognition related to quality of life in individuals with schizotypy, and to what degree does this reflect neurocognitive deficits?

Hypothesis 4a: Emotion recognition accuracy will be associated with poorer quality of life

Hypothesis 4b: Negative bias will be associated with poorer quality of life

Hypothesis 4c: The relationship between emotion recognition, bias, and quality of life will remain significant when controlling for neurocognitive abilities.

Method

Participants

An online questionnaire was sent via email to 8,993 freshman and sophomore undergraduates at Louisiana State University as part of a larger study. Those who completed the questionnaire were entered into a lottery of ten possible $25 prizes. 1775 students responded resulting in 1395 complete profiles. The questionnaire consisted of a consent form, demographic questions, and the SPQ. Those subjects with positive, negative, or disorganized scores in the 95th percentile (based on gender and ethnicity norms) were invited to participate further in the laboratory phase of the study. Of these individuals, seventeen were recruited based on high positive scores, 32 based on high negative scores, and 26 were recruited based on high disorganization scores. Some individuals were recruited based on high scores on more than one factor including two with both high disorganization and negative scores, eight with high disorganization and positive scores, two with high negative and positive scores, and finally two participants had high scores on all three factors. We also identified individuals with scores below gender and ethnicity means on the SPQ subscales whom we recruited as a control group. There were no other exclusionary criteria. All participants in this phase of the study received 20 dollars cash compensation and the possibility of extra credit toward psychology courses. The final sample included 91 participants in the schizotypy group and 27 participants in the control group. Participants were tested by trained undergraduate research assistants. Participants were assessed with the instruments noted here as well as and a variety of other instruments. Testing sessions lasted approximately two hours. Two participants in the schizotypy group were excluded based on incomplete

profiles, resulting in a final sample of 89 participants in the schizotypy group. In addition, one participant in the control group did not complete two of the measures mentioned below, resulting in some analyses being conducted with 26 controls. This study was approved by the Louisiana State University Human Subject Review Board and all subjects offered informed consent prior to completing the surveys.

Measures

Schizotypal Personality Questionnaire (SPQ)

In order to select participants and measure symptomology, the SPQ was used. The SPQ, as described above, is a 74-item, self report questionnaire that assesses the full range of schizotypal personality disorder symptomotology (DSM IV-TR; Raine, 1991) (see Appendix A for individual items and scoring). It has demonstrated good psychometric properties as well as convergent and discriminant validity. The SPQ is easy to administer to large groups and yields a large amount of data. It has been used in a large number of studies and is preferred over other similar instruments because it has superior psychometric properties (Raine, 1991), assesses a large range of symptoms that are closely related to DSM IV-TR symptoms, and is relatively brief.

Participants responded using a five-point Likert scale ranging from "strongly disagree" to "strongly agree." Likert scale versions have been shown to highly correlated with the traditional format (r =.88-.94), and show superior internal reliability (Wuthrich & Bates, 2005). Likert versions may be better able to detect individuals less inclined to disclose symptoms as well as identifying "false alarms" (Wuthrich & Bates, 2005). Given research that has consistently shown that SPQ measured schizotypy is composed of three factors (Raine et al., 1994; Chen, Hsiao & Lin, 1997; Reynolds et al., 2000), we

employed dimensional scores reflecting positive, negative, and disorganized schizotypy for each participant.

Lehman's Quality of Life Brief Interview (QoL-I)

Quality of life was assessed with the QoL-I, a self-report questionnaire that includes items that assess an individual's subjective perception of his/her quality of life as well as objective items assessing activities and social supports (Lehman, 1995). This measure has previously been used in research involving psychiatric populations (Wasserman, Sorensen, Delucchi, Masson, & Hall, 2006; Heider et al. 2007; Anderson, McNeil, & Reddon, 2002) and has demonstrated good psychometric properties (Lehman, 1996). The brief version includes 78 items, and the amount of administration time was not feasible for our research purposes. We used the even briefer version used by Bellack, Bennett, Gearon, Brown, and Yang (2006) which includes 33 items, allowing for computation of seven scales: home concerns, daily activities, family relationships, social relationships, financial concerns, legal concerns, health concerns, and global life quality in two domains: objective quality of life and subjective quality of life (see Appendix B). Increasing scores reflect increasing quality of life.

Penn Emotion Recognition Test (PERT)

Emotion recognition was measured using the 40-item PERT (Gur et al., 2002; Kohler et al., 2003). The items include both high and low intensity angry, fearful, happy, sad, and neutral faces. These faces represent a diversity of ethnicity and age and include both posed and evoked expressions (see Appendix D for an example of stimuli). The task presents each face one at a time and participants are asked to choose which emotion is being expressed from a list of six choices (happy, sad, disgust, fear, anger, no emotion)

reflecting five of the six universal emotions according to Ekman and Friesen (1975). The PERT authors did not include one emotion, surprise, in the list because they claimed it is not a "pure" emotion, saying "its valence depends entirely on the triggering event and it can be any of the other emotions, with a rapid onset" (Kohler et al., 2003). An additional component was added in which participants rated how positive or negative each face looked. Participants made this rating using the Semantic Affective Moniker (Lang, Bradley, & Cuthbert, 2005), an analogue scale ranging from one (good mood) to nine (bad mood) (see Appendix D).

Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)

The RBANS was used as a broad measure of neurocognitive functioning. Randolph, Tierney, Mohr, and Chase (1998) originally developed the RBANS as a screener for use with individuals with schizophrenia and dementia. Other researchers have used it in various populations since, including individuals with anorexia nervosa (Mikos et al., 2008), elderly adults (Duff, Schoenberg, Mold, Scott, & Adams, 2007), and athletes (Killam, Cautin, & Santucci, 2005). It has also been useful as an assessment of a range of abilities in individuals with schizophrenia (Gold, Queern, Iannone, & Buchanan, 1999; Wilk et al., 2002). The RBANS has demonstrated particular efficacy as a brief measure of broad neurocognitive functioning in schizophrenia. The test is sensitive enough to detect impairments in patients, performance is highly related to outcome, it is reliable (Gold et al., 1999), and has demonstrated convergent and discriminant validity in this population (Hobart, Goldberg, Bartko, & Gold, 1999).

Analyses

Analyses were conducted in several steps. First the schizotypy and control groups were compared on demographic and clinical variables. Next, hypothesized group differences were examined on variables of interest. Finally, neurocognition, emotion recognition, symptoms, and quality of life were examined within the schizotypy group with correlational analyses. All variables were normally distributed (skew scores > 1.5) unless otherwise noted.

Power for each of these analyses was examined using G*Power software 3.0.10. This study was powered to detect group differences at an effect size of $d = .55$ using a one-tailed t test with an α level of .05 and a power of $\beta = .80$. Medium effect sizes were expected given the use of a more sensitive, well-validated emotion recognition measure. Previous studies conducted on individuals with schizophrenia have found either large or medium effects ($d = .53$-$.97$) using the less sensitive FEIT (Addington et al., 2006; Mueser et al., 1996). Schizotypy studies have generally found smaller effect sizes when looking at emotion recognition accuracy (Williams et al., 2007; Kee et al., 2004) except for Poreh and colleagues (1994) who found effect sizes up to $d = .88$ with individual emotion categories. In partial support, studies that have found biases when looking at facial emotions have found medium effects ($d = .67$ - $.72$) (Green et al., 2001; Couture et al., 2008). Within schizotypy analyses here are powered to detect small to medium effects ($r = .29$) using two-tailed tests with a power of $\beta = .80$ and $\alpha = .05$. Previous schizotypy studies in emotion recognition have also been powered to detect small to medium correlations (Jahshan & Sergi, 2007; Williams et al., 2007), and given improved methods and a larger sample with more broadly defined symptomology, these effects are expected.

Results

Group Comparisons

Demographics

I first examined group differences on demographic variables. The schizotypy group was 30.30% male and 87.60% Caucasian. The control group had slightly more males (49.10%) and less Caucasian participants (77.80%). Age was positively skewed (skew = 5.06), therefore a nonparametric Man-Whitney U test was employed, revealing that the groups were similar in age ($U = 1092.50$, *n.s.*).

Table 1. Means and Standard Deviations (M(SD)) for Demographic and Clinical Variables for Schizotypy and Control Groups

	Schizotypy (n = 89)	Controls (n = 27)	*t*	*p*
% male	30.30	48.10		
% Caucasian	87.60	77.80		
Age	19.19 (1.39)	19.81 (3.25)	1092.50 [3]	.45
SPQ total[1]	1.41 (0.58)	-1.94 (0.35)	-36.83*	.00
SPQ positive[1]	1.14 (0.92)	-1.75 (0.35)	-24.46*	.00
SPQ negative[1]	1.28 (1.02)	-1.43 (0.34)	-21.40*	.00
SPQ disorganization[1]	1.27 (0.79)	-1.64 (0.51)	-22.58*	.00
QOL subjective[2]	30.41 (6.41)	39.96 (4.94)	7.01 (113)*	.00
QOL objective[2]	-3.93 (5.65)	2.04 (3.97)	6.08 (57.51)*	.00

* $p < .01$, [1]z scores based on gender and ethnicity means, [2]n = 26 controls, [3] Mann Whitney U, SPQ = Schizotypal Personality Questionnaire, QOL = Lehman's Brief Quality of Life Interview

Clinical Variables

Group differences on clinical variables were tested with a series of one-tailed independent t-tests.The schizotypy group demonstrated a range of symptomology, with significant levels of positive, negative, and disorganized schizotypy traits.The schizotypy group as a whole also reported poorer quality of life in both the objective (t (113) = 6.08, $p < .01$) and subjective domains (t (113) = 7.01, $p < .01$). Demographic and clinical variables are presented in Table 1.

Neurocognition

Contrary to my hypothesis, a one-tailed independent t-test revealed that the schizotypy group did not differ from the control group on general neurocognitive ability as measured by the RBANS, (t (113) = -0.93, *n.s.*). As these results were unexpected given prior research, I conducted additional two-tailed t-tests with the individual RBANS indexes as dependent variables. Groups also did not differ on any of the individual indexes other than Immediate Memory, on which the schizotypy group performed significantly better than the control group (t (113) = -2.20, $p < .05$). A trend was also seen on the Attention index in which the control group performed better than the schizotypy group (t (113) = 1.69, p =.10). Means and standard deviations are presented in Table 2.

Emotion Recognition

Differences between the schizotypy and control group on PERT accuracy and valence ratings were examined with one-tailed independent t-tests. As expected, the schizotypy group was significantly less accurate than the control group when labeling the emotion of faces (t (114) = 3.22, $p < .01$) at a medium effect size (d = .74). The hypothesis that the schizotypy group would show a negative bias in their ratings of the

valence of the faces compared to the control group was not supported (t (114) = -0.95, *n.s.*). Results are presented in Table 3.

Table 2. Means and Standard Deviations (M (SD)) for RBANS Index Scores in the Schizotypy and Control Groups

	Schizotypy (n=89)	Control (n=26)	*t*	*p*
Visuospatial/Constructional	96.87 (16.38)	95.50 (19.43)	-0.36	.72
Immediate Memory	97.79 (12.46)	91.81 (11.15)	-2.20	.03
Delayed Memory	97.89 (10.39)	94.42 (12.61)	-1.42	.16
Language	92.16 (14.06)	94.73 (8.61)	1.14	.26
Attention	99.67 (14.23)	105.50 (15.75)	1.69	.10
RBANS Total Index	95.46 (11.67)	94.65 (11.17)	-0.32	.75

Table 3. Means and Standard Deviations (M (SD)) for PERT Scores in the Schizotypy and Control Groups

	Schizotypy (n=89)	Control (n=27)	*t*	*p*
PERT Accuracy	69.13% (10.25)	76.20% (9.05)	3.22	.00
PERT Valence	5.74 (0.45)	5.65 (0.39)	-0.95	.35

Within Schizotypy

The following analyses include only the schizotypy group. The control group was not included here as the schizotypy and control groups are treated and recruited as conceptually different groups of individuals and processes applicable to one group are not assumed to apply to the other. In order to examine the hypothesized relationship between

emotion recognition and neurocognition, I computed Pearson's *r* correlations between neurocognitive performance and emotion recognition accuracy. There was no relationship between RBANS index scores and PERT accuracy scores (all *p*'s > .05). As the hypothesized relationship was not found, it was unnecessary to conduct further analyses controlling for RBANS performance. Data are presented in Table 4.

Table 4. Pearson's Correlations Between RBANS Index Scores and PERT Accuracy

	PERT Accuracy	Visuospatial/ Constructional	Immediate Memory	Delayed Memory	Language	Attention
PERT Accuracy	--					
Visuospatial/ Constructional	.07	--				
Immediate Memory	.10	.18	--			
Delayed Memory	.12	.41**	.43**	--		
Language	-.08	.13	.11	.15	--	
Attention	.01	.22*	.27*	.23*	.15	--
RBANS Total Index	.07	.66**	.59**	.68**	.52**	.60**

* $p < .05$
** $p < .01$

I examined the relationship between emotion recognition symptoms next. As SPQ scores were ordinal data (not on a precise scale), I used Spearman's rho correlations. The hypothesis that emotion recognition accuracy would be differentially related to the

examined symptom dimensions was not supported; there was no correlation between symptoms and emotion recognition accuracy (all *p*'s > .05). PERT valence ratings, however, were positively correlated with only SPQ disorganization ($r = .31$, $p < .05$); more negative ratings were associated with higher levels of disorganization symptoms. All other correlations were nonsignificant (all *p*'s < .05). Table 5 contains these correlations.

Table 5. Spearman's Correlations Between SPQ Factors and PERT Variables

	SPQ positive	SPQ negative	SPQ disorganization
SPQ Positive	--		
SPQ Negative	-.29*	--	
SPQ Disorganization	.11	-.36*	--
PERT Accuracy	-.02	.11	-.14
PERT Valence	.16	-.08	.31*

* $p < .05$

Next I considered the relationship between PERT variables and quality of life. This was done using Pearson's *r* correlations, except when examining PERT valence ratings; Spearman's correlations were used for valence ratings as these are ordinal data. PERT accuracy scores were unrelated to quality of life (all *p*'s > .05). There was, however, a relationship between PERT valence ratings and quality of life. Subjective quality of life was negatively correlated with PERT valence ratings; increasing negative ratings were associated with poorer quality of life ($r = -.24$). All other correlations were nonsignificant (all *p*'s > .05). Follow-up investigation of these same correlations within the control group revealed no such relationship between PERT variables and subjective or objective quality of life (all *p*'s > .05), although these analyses were probably

underpowered because of the small number of controls in the study. Correlations for the schizotypy group are presented in Table 6.

Table 6. Pearson's Correlations Between PERT Variables and Quality of Life

	PERT Accuracy	PERT Valence	QOL Objective	QOL Subjective
PERT Accuracy	--			
PERT Valence	.05	--		
QOL objective	-.19	-.01	--	
QOL subjective	-.12	-.24*	.36*	--

* $p < .05$

Discussion

Facial emotion recognition is an important aspect of social interaction that emerges early in development and allows individuals to communicate and interpret their social worlds. This skill has been widely investigated in individuals with schizophrenia. Research has consistently shown that this ability is impaired in these individuals and that this impairment has a large impact on functional outcome. Despite the large body of existing research, many questions remain. Specifically, it is unclear whether poor emotion recognition represents a specific area of deficit or a more generalized deficit and whether this deficit reflects a state-like vulnerability present in individuals at risk for developing schizophrenia. The current literature involving individuals with schizophrenia has not provided clear answers to these questions for two reasons, confounds associated with research on chronically, severely mentally ill individuals and limited methodology. The few studies that have investigated emotion recognition in at-risk samples, while offering substantial insight into this phenomenon, have also employed limited samples and methodology.

The current study investigated emotion recognition in college students at risk for developing schizophrenia identified by responses on a self-report questionnaire. This study addresses prior limitations in that it avoids confounds associated with severe mental illness by using a relatively unimpaired sample, includes a broad range of schizotypal symptomology similar to that seen in schizophrenia, and uses an improved facial emotion recognition task including more culturally representative stimuli, and examined subjective ratings in addition to facial emotion identification accuracy scores.

As predicted, the current study revealed impaired facial emotion recognition abilities in individuals with schizotypy. The present data provide intriguing evidence that emotion recognition deficits reflect an important vulnerability marker for schizophrenia-spectrum pathology. These deficits were present in the schizotypy group as a whole, and accuracy recognizing emotions was unrelated to any specific schizotypy trait. Deficits were not associated with particular schizotypy traits nor can they be attributed to the effects of severe mental illness such as medication or hospitalization.

Unexpectedly, our schizotypy group did not show a broad deficit in neuropsychological tasks. In fact, on the immediate memory index the schizotypy group performed significantly better than the control group. Although most schizotypy research has found some evidence of neurocognitive impairment in individuals with schizotypy compared to controls, as mentioned above this has not been true of all research with psychometric schizotypy. At least two studies have failed to find neurocognitive deficits in individuals with psychometrically-defined schizotypy (Jahshan & Sergi, 2007; Lenzenweger & Gold, 2000). These studies also used university samples. It is possible that psychometric schizotypy does not overlap completely with schizophrenia vulnerability. However, given the large body of research supporting this method (Chapman et al., 1994; Kwapil, Miller, Zinser, Chapman, & Chapman, 1997; Gooding, Tallent, & Matts, 2007), it is unlikely that these individuals are not at increased risk. More likely is that college students with schizotypy may represent the least impaired individuals and/or have a number of protective factors such as high intelligence, better memory, or limited environmental stressors that have allowed them to overcome other

difficulties associated with genetic vulnerability. It may be only those individuals with these strengths that are able to function in a college environment.

While schizotypy as a group did not show a systematic valence bias, disorganization symptoms were related to subjective perception of emotional faces as being more negative. This is consistent with what has been observed more generally for patients with schizophrenia – that patients with disorganization tend to report seeing faces as being angry (Cohen et al., 2009). This raises two important issues for future research to consider. First, combining schizotypy into one group potentially obscures differences between individuals with different symptoms. Second, previous studies that have not examined the full range of schizotypy may produce results that apply to only a particular subtype and not to schizotypy as a whole. Since disorganized schizotypy traits are often not assessed in schizotypy studies (e.g., those using the other self-report schizotypy scales (Chapman et al., 1995)), it is critical that one employ instruments that assess a full range of schizotypal traits.

One of the more general concerns of this study was whether or not facial emotion recognition ability was related to general quality of life. Our results suggest that while individuals with schizotypy may be less accurate at recognizing emotions, this is unrelated to quality of life. Rather, their subjective appraisals of the mood of emotional faces are related to self-reported quality of life. It is those individuals who see more negative faces that also say their quality of life is lower. Perceiving others' emotions as negative could have an impact on social enjoyment, or feeling that one's life is not enjoyable (perhaps due to symptoms) may lead individuals to see the social world as more negative. Biased interpretation of emotional valence in faces may be a factor that

leads to social misunderstandings such as misinterpretation of others' intentions, failure to comprehend social situations, and trouble learning how to react to and express emotions. It may also affect the development of social schema that accurately predict others' behavior. This could offer explanations for why many individuals with schizotypy report less enjoyment in social situations (Kwapil, 1998; Horan et al., 2007) and may be less accurate in interpreting social cues (Meehl, 1990; Kendler et al., 1995).

While the PERT is an improvement over other existing facial emotional stimuli and shows promise as a more sensitive measure of emotion recognition, especially in individuals less impaired than patients with schizophrenia, it still does not approximate the manner in which facial expressions of emotion are experienced in daily life. Using dynamic rather than static emotional expressions may reveal further emotional processing abnormalities (Archer et al., 1994). Emotional expressions are also often accompanied by a variety of body movements and contextual cues which are used to interpret emotion. The use of stimuli that more closely resemble faces encountered outside of the laboratory would increase external validity of future studies.

Also of note is that this study did not allow for determination of "differential deficit" as mentioned in the introduction. While the schizotypy group did not show broad neurocognitive impairments, it is possible that subtle impairments in processes such as facial recognition or visual scanning/attention may be responsible for emotion recognition deficits. While the schizotypy group did not differ significantly from the control group on the attention index of the RBANS, performance was lower in this area. Attention is also a function that previous research has shown is related to emotion recognition in schizophrenia (Bryson, Bell, & Lysaker, 1997; Addington & Addington,

1998; Kee et al., 1998; Kohler et al., 2000; Combs & Gouvier, 2004) and in schizotypy (Poreh et al., 1994). More sensitive measures of attention such as that used by Combs and Gouvier (2004) may reveal significant differences, and would allow for closer examination. Further research using matched control tasks is needed to examine these variables and to conclusively determine whether a differential deficit is demonstrated.

In summary, our results support previous research suggesting that poor emotion recognition is associated with vulnerability to psychosis (Kee et al., 2004; Williams et al., 2007). Emotion recognition appears to be impaired in all individuals at risk for schizophrenia as it is unrelated to symptoms. Furthermore, emotion recognition is related to functioning even in those individuals who are relatively unimpaired globally. Although the precise mechanisms involved are still unclear, this study offers evidence that emotion recognition is impaired even when broad neurocognitive deficits are not seen, and that this may be related to more social cognitive processes. Finally, more research is needed to delineate the relationships between emotion recognition processes, symptoms, and social functioning.

References

Addington, J., & Addington, D. (1991). Positive and negative symptoms of schizophrenia: Their course and relationship over time. *Schizophrenia Research, 5*(2), 51-59.

Addington, J., & Addington, D. (1998). Facial affect recognition and information processing in schizophrenia and bipolar disorder. *Schizophrenia Research, 32*(3), 171-181.

Addington, J., & Addington, D. (2000). Neurocognitive and social functioning in schizophrenia: A 2.5 year follow-up study. *Schizophrenia Research, 44*(1), 47-56.

Addington, J., Saeedi, H., & Addington, D. (2006). Facial affect recognition: A mediator between cognitive and social functioning in psychosis?. *Schizophrenia Research, 85*(1), 142-150.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed). Text revision. Washington, DC: Author.

Anderson, A., McNeil, D., & Reddon, J. (2002). Evaluation of Lehman's Brief Quality of Life Interview in assessing outcome in psychiatric rehabilitation in people with severe and persistent mental disorder. *Social Work in Mental Health, 25*(1), 43 59.

Andreasen, N. (1997). The evolving concept of schizophrenia: From Kraepelin to the present and future. *Schizophrenia Research, 28*(2-3), 105-109.

Andreasen, N. C., Arndt, S., Alliger, R., Miller, D., & Flaum, M. (1995). Symptoms of schizophrenia: Methods, meanings, and mechanisms. *Archives of General Psychiatry 52*(5), 341-351.

Arango, C., Buchanan, R. W., Kirkpatrick, B., & Carpenter, W. T. (2004) The deficit syndrome in schizophrenia: Implications for the treatment of negative symptoms. *European Psychiatry, 19*(1)*,* 21-26.

Arndt, S., Andreasen, N. C., Flaum, M., Miller, D., & Nopoulos, P. (1995). A longitudinal study of symptom dimensions in schizophrenia: Prediction and patterns of change. *Archives ofGeneral Psychiatry, 52*(5)*,* 352-360.

Baron, M., Gruen, R., Asnis, L., & Lord, S. (1985). Familial transmission of schizotypal and borderline personality disorders. *American Journal of Psychiatry, 142*(8), 927-934.

Barrantes-Vidal, N., Fananas, L., Rosa, A., Caparros, B., Riba, M. D., & Obiols, J. E. (2002).Neurocognitive, behavioral, and neurodevelopmental correlates of

schizotypy clusters in adolescents from the general population. *Schizophrenia Research, 61*(2-3), 293-302.

Bellack, A., Bennett, M., Gearon, J., Brown, C., & Yang, Y. (2006). A randomized clinical trial of a new behavioral treatment for drug abuse in people with severe and persistent mental illness. *Archives of General Psychiatry, 63*(4), 426-432.

Bergida, H. & Lenzenweger, M. F. (2006). Schizotypy and sustained attention: Confirming evidence from an adult community sample. *Journal of Abnormal Psychology, 115*(3)*,* 545-551.

Blashfield, R. (1973). An evaluation of the DSM-II classification of schizophrenia as a nomenclature. *Journal of Abnormal Psychology, 82*(3)*,* 382-389.

Bleuler, E. (1950) *Dementia Praecox of the Group of Schizophrenias* (J. Zinkin, Trans.) New York, NY: International Universities Press. (Original work published 1911).

Braff, D. (1993). Information processing and attention dysfunctions in schizophrenia. *Schizophrenia Bulletin, 19*(2), 233-259.

Brekke, J., Kay, D., Lee, K., & Green, M. (2005). Biosocial pathways to functional outcome in schizophrenia. *Schizophrenia Research, 80*(2-3)*,* 213-225.

Brewer, W. J., Francey, S. M., Wood, S. J., Jackson, H. J., Pantelis, C. Phillips, L. J., et al. (2005). Memory impairments identified in people at ultra-high risk for psychosis who later develop first-episode psychosis. *American Journal of Psychiatry, 162*(1), 71-78.

Brune, M. (2003). Theory of mind and the role of IQ in chronic disorganized schizophrenia. *Schizophrenia Research, 60*(1), 57-64.

Bryson, G., Bell, M., & Lysaker, P. (1997). Affect recognition in schizophrenia: A function of global impairment or a specific cognitive deficit. *Psychiatry Research, 71*(2), 103-113.

Carpenter, W. T., Heinrichs, D.W., & Alphs, L. D. (1985). Treatment of negative symptoms. *Schizophrenia Bulletin, 11*(3)*,* 440-452.

Chapman, L., & Chapman, J. (1973). Problems in the measurement of cognitive deficits. *Psychological Bulletin, 79*(6)*,* 380-385.

Chapman, L., & Chapman, J. (1978). The measurement of differential deficit. *Journal of Psychiatric Research, 14(1-4),* 303-311.

Chapman, L., Chapman, J., Kwapil, T., Eckblad, M., & Zinser, M. (1994). Putatively psychosis-prone subjects 10 years later. *Journal of Abnormal Psychology, 103*(2), 171-183

Chen, W., Hsiao, C., & Lin, C. (1997). Schizotypy in community samples: The three factor structure and correlation with sustained attention. *Journal of Abnormal Psychology*, *106*(4), 649-654.

Chung, Y., Kang, D., Shin, N., Yoo, S., & Kwon, J. (2008). Deficit of theory of mind in individuals at ultra-high-risk for schizophrenia. *Schizophrenia Research*, *99*(1-3), 111-118.

Cohen, A.S., Nienow, T. M., Dinzeo, T. J., Docherty, N. M. (2009). Attribution biases in schizophrenia: Relationships to clinical and functional impairments. *Psychopathology 42*(1), 40-46.

Combs, D. R. & Gouvier, W. D. (2004). The role of attention in affect perception: An examination of Mirsky's four factor model of attention in chronic schizophrenia. *Schizophrenia Bulletin, 30*(4), 727-738.

Compton, M., Chien, V., & Bollini, A. (2007). Psychometric properties of the Brief Version of the Schizotypal Personality Questionnaire in relatives of patients with schizophrenia spectrum disorders and non-psychiatric controls. *Schizophrenia Research*, *91*(1-3), 122-131.

Couture, S., Penn, D., Addington, J., Woods, S., & Perkins, D. (2008). Assessment of social judgments and complex mental states in the early phases of psychosis. *Schizophrenia Research*, *100*(1), 237-241.

Crow, T. J. (1980). Molecular pathology of schizophrenia: more than one disease process? *British Medical Journal, 280*(6207), 66-68.

Crow, T. J. (1985). The two syndrome concept: origins and current status. *Schizophrenia Bulletin 11*(3), 471-186.

Dougherty, F., Bartlett, E., & Izard, C. (1974). Responses of schizophrenics to expressions of the fundamental emotions. *Journal of Clinical Psychology, 30*(3), 243-246.

Duff, K., Schoenberg, M., Mold, J., Scott, J., & Adams, R. (2007). Normative and retest data onthe RBANS cortical/subcortical index in older adults. *Journal of Clinical and Experimental Neuropsychology, 29*(8)*,* 854-859.

Edwards, J. (2002). Emotion recognition via facial expression and affective prosody in schizophrenia: a methodological review. *Clinical Psychology Review, 22*(6), 789.

Ekman, P. (1973). Universal facial expressions in emotion. *Studia Psychologica*, 15, 140-147.

Ekman, P. & Friesen, W. V. (1975). Unmasking the face. Englewood Cliffs, NJ: Prentice Hall.

Erlenmeyer-Kimling, L., & Cornblatt, B. (1987). High-risk research in schizophrenia: A summary of what has been learned. *Journal of Psychiatric Research, 21*(4), 401-411.

Fenton, W.S. & McGlashan, T. H. (1991). Natural history of schizophrenia subtypes: II. Positive and negative symptoms and long-term course. *Archives of General Psychiatry, 48*(11), 978-986.

Fernyhough, C., Jones, S., Whittle, C., Waterhouse, J., & Bentall, R. (2008). Theory of mind, schizotypy, and persecutory ideation in young adults. *Cognitive Neuropsychiatry*, *13*(3), 233-249.

Gerbaldo, H., Cassady, S., & Helisch, A. (1995). Negative symptoms and the course of positive symptoms in deficit schizophrenia. *Psychopathology, 28*(3)*,* 121-126.

Gold, J. M., Queern, C. Q., Iannone, V. N., & Buchanan, R. W. (1999) Repeatable Battery for the Assessment of Neuropsychological Status as a screening test in schizophrenia, I: Sensitivity, reliability, and validity. *American Journal of Psychiatry, 156*(12), 1944-1950.

Goldberg, S. C. (1985). Negative and deficit symptoms in schizophrenia do respond to neuroleptics. *Schizophrenia Bulletin, 11*(3), 453-456.

Gooding, D., Tallent, K., & Matts, C. (2005). Clinical status of at-risk individuals 5 years later: Further validation of the psychometric high-risk strategy. *Journal of Abnormal Psychology, 114*(1), 170-175.

Gooding, D., Tallent, K., & Matts, C. (2007). Rates of avoidant, schizotypal, schizoid and paranoid personality disorders in psychometric high-risk groups at 5-year follow up. *Schizophrenia Research, 94*(1-3), 373-374.

Gottesman, I., & Gould, T. (2003). The endophenotype concept in psychiatry: Etymology and strategic intentions. *American Journal of Psychiatry, 160*(4), 636-645.

Green, M. (1996). What are the functional consequences of neurocognitive deficits in schizophrenia?. *American Journal of Psychiatry, 153*(3), 321-330.

Green, M., & Nuechterlein, K. (1999). Should schizophrenia be treated as a neurocognitivedisorder?. *Schizophrenia Bulletin, 25*(2), 309-319.

Green, M., Kern, R., Braff, D., & Mintz, J. (2000). Neurocognitive deficits and functional outcome in schizophrenia: Are we measuring the 'right stuff'?. *Schizophrenia Bulletin, 26*(1), 119-136.

Green, M., Williams, L., & Davidson, D. (2001). Processing of threat-related affect is delayed in delusion-prone individuals. *British Journal of Clinical Psychology*, *40*(2), 157-165.

Gruenberg, A., Kendler, K., & Tsuang, M. (1985). Reliability and concordance in the subtyping of schizophrenia. *American Journal of Psychiatry, 142*(11), 1355-1358.

Gur, R.C., Sara, R., Hagendoorn, M., Marom, O., Hughett, P., Macy L., et al. (2002). A method for obtaining 3-dimensional facial expressions and its standardization for use in neurocognitive studies. *Journal of Neuroscience Methods, 115*(2), 137-143.

Hall, J., Harris, J., Sprengelmeyer, R., Sprengelmeyer, A., Young, A., Santos, I., et al. (2004). Social cognition and face processing in schizophrenia. *British Journal of Psychiatry, 185*(2), 169-170.

Heider, D., Angermeyer, M., Winkler, I., Schomerus, G., Bebbington, P., Brugha, T., et al. (2007). A prospective study of quality of life in schizophrenia in three European countries. *Schizophrenia Research*, *93*(1-3), 194-202.

Heimberg, C., Gur, R., Erwin, R., & Shtasel, D. (1992). Facial emotion discrimination: III. Behavioral findings in schizophrenia. *Psychiatry Research, 42*(3), 253-265.

Herbener, E., Hill, S., Marvin, R., & Sweeney, J. (2005). Effects of antipsychotic treatment on emotion perception deficits in first-episode schizophrenia. *American Journal of Psychiatry, 162*(9), 1746-1748.

Hobart, M. P., Goldberg, R., Bartko, J. J., & Gold, J. M. (1999). Repeatable Battery for the Assessment of Neuropsychological Status as a screening test in schizophrenia II: Convergent/discriminant validity and diagnostic group comparisons. *American Journal of Psychiatry, 156*(12), 1951-1957.

Horan, W., Blanchard, J., Gangestad, S., & Kwapil, T. (2004). The psychometric detection of schizotypy: Do putative schizotypy indicators identify the same latent class?. *Journal of Abnormal Psychology, 113*(3)*,* 339-357.

Hutton, S., Puri, B., Duncan, L., Robbins, T., Barnes, T., & Joyce, E. (1998). Executive function in first-episode schizophrenia. *Psychological Medicine*, *28*(2), 463-473.

Irani, F., Platek, S., Panyavin, I., Calkins, M., Kohler, C., Siegel, S., et al. (2006). Self-face recognition and theory of mind in patients with schizophrenia and first degree relatives. *Schizophrenia Research*, *88*(1-3), 151-160.

Izard, C. (1994). Innate and universal facial expressions: Evidence from developmental and cross-cultural research. *Psychological Bulletin, 115*(2), 288-299.

Jahshan, C., & Sergi, M. (2007). Theory of mind, neurocognition, and functional status in schizotypy. *Schizophrenia Research, 8*9(1), 278-286.

Johnston, Katsikitis, & Carr. (2001). A generalised deficit can account for problems in facial emotion recognition in schizophrenia. *Biological Psychology, 58*(3), 203-227.

Johnston, P., Stojanov, W., Devir, H., & Schall, U. (2005). Functional MRI of facial emotion recognition deficits in schizophrenia and their electrophysiological correlates. *European Journal of Neuroscience, 22*(5), 1221-1232.

Kantor, R. E., Wallner, J. M., & Winder, C. L. (1953). Process and reactive schizophrenia. *Journal of Consulting Psychology, 17*(3), 157-162.

Kee, K., Green, M., Mintz, J., & Brekke, J. (2003). Is emotion processing a predictor of functional outcome in schizophrenia?. *Schizophrenia Bulletin, 29*(3)*,* 487-497.

Kee, K., Horan, W., Mintz, J., & Green, M. (2004). Do the siblings of schizophrenia patients demonstrate affect perception deficits?. *Schizophrenia Research, 67*(1), 87-94.

Kelemen, O., Kéri, S., Must, A., Benedek, G., & Janka, Z. (2004). No evidence for impaired 'theory of mind' in unaffected first-degree relatives of schizophrenia patients. *Acta Psychiatrica Scandinavica*, *110*(2), 146-149.

Kendler, K., Gruenberg, A., & Tsuang, M. (1985). Subtype stability in schizophrenia. *American Journal of Psychiatry 142*(7), 827-832.

Kerns, J. (2006). Schizotypy facets, cognitive control, and emotion. *Journal of Abnormal Psychology, 115*(3), 418-427.

Kerr, S., & Neale, J. (1993). Emotion perception in schizophrenia: Specific deficit or further evidence of generalized poor performance?. *Journal of Abnormal Psychology, 102*(2), 312-318.

Killam, C., Cautin, R., & Santucci, A. (2005). Assessing the enduring residual neuropsychological effects of head trauma in college athletes who participate in contact sports. *Archives of Clinical Neuropsychology, 20*(5), 599-611.

Kline, J., Smith, J., & Ellis, H. (1992). Paranoid and nonparanoid schizophrenic processing of facially displayed affect. *Journal of Psychiatric Research, 26*(3), 169-182.

Kohler, C. G., Turner, T. H., Bilker, W. B., Brensinger, C. M., Siegel, S. J., Kanes, S. J., et al. (2003). Facial emotion recognition in schizophrenia: Intensity effects and error pattern. *American Journal of Psychiatry, 160*, 1768-1774.

Kohler, C., Bilker, W., Hagendoorn, M., Gur, R., & Gur, R. (2000). Emotion recognition deficit in schizophrenia: Association with symptomatology and cognition. *Biological Psychiatry, 48*(2)*,* 127-136.

Kraepelin E. (1971). Dementia Praecox and Paraphrenia. (R. M. Barclay, Trans.), G.M. Robertson, (Ed.) New York, NY: Robert E. Krieger. (Original work published 1919).

Kucharska-Pietura, K., David, A., Masiak, M., & Phillips, M. (2005). Perception of facial and vocal affect by people with schizophrenia in early and late stages of illness. *British Journal of Psychiatry, 187*(6)*,* 523-528.

Kwapil, T. (1998). Social anhedonia as a predictor of the development of schizophrenia spectrum disorders. *Journal of Abnormal Psychology*, *107*(4), 558-565.

Kwapil, T., Miller, M., Zinser, M., Chapman, J., & Chapman, L. (1997). Magical ideation and social anhedonia as predictors of psychosis proneness: A partial replication. *Journal of Abnormal Psychology, 106*(3), 491-495.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2005). International affective picture system (IAPS): Affective ratings of pictures and instruction manual. Technical Report A-6.:University of Florida, Gainesville, FL.

Laurent, A., Biloa-Tang, M., Bougerol, T., Duly, D., Anchisi, A., Bosson, J., et al.(2000). Executive/attentional performance and measures of schizotypy in patients with schizophrenia and in their nonpsychotic first-degree relatives. *Schizophrenia Research, 46*(2-3)*,* 269-283.

Lehman A. (1995). *Evaluating Quality of Life for Persons with Severe Mental Illness: Assessment Toolkit.*: Cambridge, Mass: The Evaluation Center at Health Services Research Institute.

Lehman, A. (1996). Measures of quality of life among persons with severe and persistent mental disorders. *Social Psychiatry and Psychiatric Epidemiology, 31*(2), 78-88.

Lenzenweger, M. (2006). Schizotaxia, schizotypy, and schizophrenia: Paul E. Meehl's blueprint for the experimental psychopathology and genetics of schizophrenia. *Journal of Abnormal Psychology, 115*(2)*,* 195-200.

Lenzenweger, M., & Gold, J. (2000). Auditory working memory and verbal recall memory in schizotypy. *Schizophrenia Research*, *42*(2), 101-110.

Lenzenweger, M., & Korfine, L. (1992). Confirming the latent structure and base rate of schizotypy: A taxometric analysis. *Journal of Abnormal Psychology, 101*(3), 567 571.

Leppánen, J., Niehaus, D., Koen, L., Du Toit, E., Schoeman, R., & Emsley, R. (2006). Emotional face processing deficit in schizophrenia: A replication study in a South African Xhosa population. *Schizophrenia Research, 84*(2-3), 323-330.

Leppänen, J., Niehaus, D., Koen, L., Du Toit, E., Schoeman, R., & Emsley, R. (2008). Deficits in facial affect recognition in unaffected siblings of Xhosa schizophrenia patients: Evidence for a neurocognitive endophenotype. *Schizophrenia Research, 99*(1-3)*,* 270-273.

Levine, E., Jonas, H., & Serper, M. (2004). Interpersonal attributional biases in hallucinatory prone individuals. *Schizophrenia Research*, *69*(1), 23-28.

Liddle, P. (1987). The symptoms of chronic schizophrenia: A re-examination of the positive negative dichotomy. *British Journal of Psychiatry, 151*, 145-151.

Malla, A., Norman, R., Williamson, P., & Cortese, L. (1993). Three syndrome concept of schizophrenia: A factor analytic study. *Schizophrenia Research, 10*(2), 143-150.

Mandal, M., Jain, A., Haque-Nizamie, S., Weiss, U., & Schneider, F. (1999). Generality and specificity of emotion-recognition deficit in schizophrenic patients with positive and negative symptoms. *Psychiatry Research, 87*(1), 39-46.

Marjoram, D., Miller, P., McIntosh, A., Cunningham Owens, D., Johnstone, E., & Lawrie, S. (2006). A neuropsychological investigation into 'Theory of Mind' and enhanced risk of schizophrenia. *Psychiatry Research*, *144*(1), 29-37.

Meehl, P.E. (1962). Schizotaxia, schizotypy, and schizophrenia. *American Psychologist 17*(12), 827-838.

Meehl, P.E. (1990). Toward an integrated theory of schizotaxia, schizotypy, and schizophrenia. *Journal of Personality Disorders*, *4*(1), 1-99.

Mikos, A., McDowell, B., Moser, D., Bayless, J., Bowers, W., Andersen, A., et al. (2008). Stability of neuropsychological performance in anorexia nervosa. *Annals of Clinical Psychiatry, 20*(1)*,* 9-13.

Milev, P., Ho, B., Arndt, S., & Andreasen, N. (2005). Predictive values of neurocognition and negative symptoms on functional outcome in schizophrenia: A longitudinal first episode study with 7-year follow-up. *American Journal of Psychiatry, 162*(3),495-506.

Morel, B. A. (1890) Traite des maladies mentales. [Treatise on Mental Illness]. Paris, France:Masson.

Moritz, S., Andresen, B., Jacobsen, D., Mersmann, K., Wilke, U., Lambert, M., et al. (2001). Neuropsychological correlates of schizophrenic syndromes in patients treated with atypical neuroleptics. *European Psychiatry, 16*(6), 354-361.

Mueser, K., Doonan, R., Penn, D., Blanchard, J., Bellack, A., Nishith, P., et al. (1996). Emotion recognition and social competence in chronic schizophrenia. *Journal of Abnormal Psychology, 105*(2)*,* 271-275.

Nordgaard, J., Arnfred, S., Handest, P., & Parnas, J. (2008). The diagnostic status of first rank symptoms. *Schizophrenia Bulletin*, *34*(1), 137-154.

Ostrom, T. M. (1984). The sovereignty of social cognition. In R. S.Wyer & T. K.Srull (Eds.), *Handbook of social cognition: Vol. 1*. Hillsdale, NJ: Erlbaum.

Penn, D., Corrigan, P., Bentall, R., Racenstein, J., & Newman, L. (1997). Social cognition in schizophrenia. *Psychological Bulletin, 121*(1), 114-132.

Penn, D., Sanna, L., & Roberts, D. (2008). Social cognition in schizophrenia: An overview. *Schizophrenia Bulletin, 34*(3), 408-411.

Phillips, M., Williams, L., Senior, C., Bullmore, E., Brammer, M., Andrew, C., et al. (1999). A differential neural response to threatening and non-threatening negative facial expressions in paranoid and non-paranoid schizophrenics. *Psychiatry Research: Neuroimaging, 92*(1), 11-31.

Pickup, G. (2006). Theory of mind and its relation to schizotypy. *Cognitive Neuropsychiatry*, *11*(2),177-192.

Pinkham, A., Penn, D., Perkins, D., Graham, K., & Siegel, M. (2007). Emotion perception and social skill over the course of psychosis: A comparison of individuals 'at-risk' for psychosis and individuals with early and chronic schizophrenia spectrum illness. *Cognitive Neuropsychiatry, 12*(3), 198-212.

Poreh, A., Whitman, R., Weber, M., & Ross, T. (1994). Facial recognition in hypothetically schizotypic college students: The role of generalized poor performance. *Journal of Nervous and Mental Disease, 182*(9), 503-507.

Premkumar, P., Cooke, M., Fannon, D., Peters, E., Michel, T., Aasen, I., et al. (2008). Misattribution bias of threat-related facial expressions is related to a longer duration of illness and poor executive function in schizophrenia and schizoaffective disorder. *European Psychiatry, 23*(1), 14-19.

Rado, S. (1956). *Psychoanalysis of behavior; collected papers*. Oxford England: Grune & Stratton.

Rado, S., & Daniels, G. (1956). *Changing concepts of psychoanalytic medicine*. Oxford England: Grune & Stratton.

Raine, A. (1991). The SPQ: A scale for the assessment of schizotypal personality based on DSM-III-R criteria. *Schizophrenia Bulletin, 17*(4), 555-564.

Raine, A., Reynolds, C., Lencz, T., & Scerbo, A. (1994). Cognitive-perceptual, interpersonal, and disorganized features of schizotypal personality. *Schizophrenia Bulletin, 20*(1), 191-201.

Randolph, C., Tierney, M. C., Mohr, E, Chase, T. N. (1998). The Repeatable Batter for the Assessment of Neuropsychological Status (RBANS): Preliminary clinical validity. *Journal of Clinical and Experimental Neuropsychology, 20*(3), 310-319.

Reynolds, C., Raine, A., Mellingen, K., Venables, P., & Mednick, S. (2000). Three-factor model of schizotypal personality: Invariance across culture, gender, religious affiliation, family adversity, and psychopathology. *Schizophrenia Bulletin, 26*(3), 603-618.

Roitman, S., Cornblatt, B., Bergman, A., & Obuchowski, M. (1997). Attentional functioning in schizotypal personality disorder. *American Journal of Psychiatry*, *154*(4), 655-660.

Rossi, A., & Daneluzzo, E. (2002). Schizotypal dimensions in normals and schizophrenic patients: A comparison with other clinical samples. *Schizophrenia Research, 54*(1-2), 67-75.

Sachs, G., Steger-Wuchse, D., Kryspin-Exner, I., Gur, R., & Katschnig, H. (2004). Facial recognition deficits and cognition in schizophrenia. *Schizophrenia Research, 68*(1), 27-35.

Salem, J., Kring, A., & Kerr, S. (1996). More evidence for generalized poor performance in facial emotion perception in schizophrenia. *Journal of Abnormal Psychology, 105*(3), 480-483.

Schneider, F., Gur, R., Gur, R., & Shtasel, D. (1995). Emotional processing in schizophrenia: Neurobehavioral probes in relation to psychopathology. *Schizophrenia Research, 17*(1), 67-75.

Schneider, F., Gur, R., Koch, K., Backes, V., Amunts, K., Shah, N., et al. (2006). Impairment in the specificity of emotion processing in schizophrenia. *American Journal of Psychiatry,163*(3), 442-447.

Schneider, K. (1959). *Clinical psychopathology. (5th ed.) (Trans. by M. W. Hamilton)*. Oxford England: Grune & Stratton.

Sergi, M., Rassovsky, Y., Nuechterlein, K., & Green, M. (2006). Social perception as a mediator of the influence of early visual processing on functional status in schizophrenia. *American Journal of Psychiatry, 163*(3)*,* 448-454.

Sergi, M., Rassovsky, Y., Widmark, C., Reist, C., Erhart, S., Braff, D., et al. (2007). Social cognition in schizophrenia: Relationships with neurocognition and negative symptoms. *Schizophrenia Research, 90*(1-3), 316-324.

Shean, G., Murphy, A., & Meyer, J. (2005). Social cognition and symptom dimensions. *Journal of Nervous and Mental Disease, 193*(11), 751-755.

Siever, L. J. & Davis, K. L. (2004). The pathophysiology of schizophrenia disorders: perspectives from the spectrum. *American Journal of Psychiatry 161*(3), 398-413.

Siever, L., Koenisberg, H. W., Harvey, P., Mitropoulou, H. P., Laruelle, M., Abi Darghan, A., et al. (2002*).* Cognitive and brain function in schizotypal personality disorder. *Schizophrenia Research 54*(1-2)*,* 157-167.

Simon, A., Dvorsky, D., Boesch, J., Roth, B., Isler, E., Schueler, P., et al. (2006). Defining subjects at risk for psychosis: A comparison of two approaches. *Schizophrenia Research, 81*(1)*,* 83-90.

Sitskoorn, M. M., Aleman, A., Ebisch, S. J. H., Appels, M. C. M., & Kahn, R. S. (2004). Cognitive deficits in relatives of patients with schizophrenia: A meta-analysis. *Schizophrenia Research 71*(2-3), 285-295.

Spaulding, W. D. (1986). Assessment of adult-onset pervasive behavior disorders. In A. Ciminero, K. Calhoun, & H. Adams (Eds.), *Handbook of behavioral assessment* 2nd ed. New York: Wiley.

Stirling, J., Hellewell, J., & Hewitt, J. (1997). Verbal memory impairment in schizophrenia: No sparing of short-term recall. *Schizophrenia Research, 25*(2), 85-95.

Strauss, J., Carpenter, W., & Bartko, J. (1974). Speculations on the processes that underlie schizophrenic symptoms and signs: III. *Schizophrenia Bulletin 1*(11), 61-69.

Tandon, R., Belmaker, R., Gattaz, W., Lopez-Ibor, J., Okasha, A., Singh, B., et al. (2008). World Psychiatric Association Pharmacopsychiatry Section statement on comparative effectiveness of antipsychotics in the treatment of schizophrenia. *Schizophrenia Research, 100*(1-3)*,* 20-38.

Thaker, G., Moran, M., Adami, H., & Cassady, S. (1993). Psychosis proneness scales in schizophrenia spectrum personality disorders: Familial vs. nonfamilial samples. *Psychiatry Research, 46*(1), 47-57.

Toomey, R., & Schuldberg, D. (1995). Recognition and judgment of facial stimuli in schizotypal subjects. *Journal of Communication Disorders, 28*(3), 193-203.

Toomey, R., Seidman, L., Lyons, M., Faraone, S., & Tsuang, M. (1999). Poor perception of nonverbal social-emotional cues in relatives of schizophrenic patients. *Schizophrenia Research, 40*(2), 121-130.

Tsoi, D., Lee, K., Khokhar, W., Mir, N., Swalli, J., Gee, K., et al. (2008). Is facial motion recognition impairment in schizophrenia identical for different emotions? A signal detection analysis. *Schizophrenia Research, 99*(1-3)*,* 263-269.

Voglmaier, M., Seidman, L., Niznikiewicz, M., Dickey, C., Shenton, M., & McCarley, R. (2005). A comparative profile analysis of neuropsychological function in men and women with schizotypal personality disorder. *Schizophrenia Research*, *74*(1), 43-49.

Waldeck, T., & Miller, L. (2000). Social skills deficits in schizotypal personality disorder. *Psychiatry Research, 93*(3)*,* 237-246.

Wasserman, D., Sorensen, J., Delucchi, K., Masson, C., & Hall, S. (2006) Psychometric evaluation of the quality of life interview, brief version, in injection drug users. *Psychology of Addictive Behaviors, 20*(3), 316-321.

Webb, C., & Levinson, D. (1993). Schizotypal and paranoid personality disorder in the relatives of patients with schizophrenia and affective disorders: A review. *Schizophrenia Research, 11*(1), 81-92.

Wilk, C. M., Gold, J. M., Batko, J. J., Dickerson, F. Fenton, W. S., Knable, M., et al. (2002). Test-retest stability of the Repeatable Battery for the Assessment of Neuropsychologial Status in Schizophrenia. *American Journal of Psychiatry, 159*(9),838-844.

Williams, B., Henry, J., & Green, M. (2007). Facial affect recognition and schizotypy. *Early Intervention in Psychiatry*, *1*(2), 177-182.

Wood, S., Pantelis, C., Proffitt, T., Phillips, L., Stuart, G., Buchanan, J., et al. (2003). Spatial working memory ability is a marker of risk-for-psychosis. *Psychological Medicine*, *33*(7), 239-1247.

World Health Organization. (2001) *Mental health: New understanding, new hope*. Geneva:World Health Organization.

Wout, M., Aleman, A., Kessels, R., Laroi, F., & Kahn, R. (2004). Emotional processing in a non clinical psychosis-prone sample. *Schizophrenia Research, 68*(2), 271-281.

Wu, E., Shi, L., Birnbaum, H., Hudson, T., & Kessler, R. (2006). Annual prevalence of diagnosed schizophrenia in the USA: A claims data analysis approach. *Psychological Medicine, 36*(11), 1535-1540.

Wuthrich, V., & Bates, T. (2005). Reliability and validity of two Likert versions of the Schizotypal Personality Questionnaire (SPQ). *Personality and Individual Differences, 38*(7), 1543-1548.

Wuthrich, V., & Bates, T. (2006). Confirmatory factor analysis of the three-factor structure of the schizotypal personality questionnaire and chapman schizotypy scales. *Journal of Personality Assessment, 87*, 292-304

Yung, A., Phillips, L., Yuen, H., Francey, S., McFarlane, C., Hallgren, M., et al. (2003). Psychosis prediction: 12-month follow up of a high-risk ('prodromal') group. *Schizophrenia Research, 60*, 21-32.

Appendix A

Schizotypal Personality Questionnaire

All responses were indicated on a 5-point Likert scale ranging from -2 strongly disagree, -1 disagree, 0 neutral, 1 agree, 2 strongly agree. Increasing scores reflect increasing levels of the relevant trait. All items were combined to compute a total schizotypy score.

Positive schizotypy = sum of Ideas of Reference, Odd beliefs/Magical thinking, Unusual Perceptual Experiences, Suspiciousness

Disorganized schizotypy= sum of Odd Behavior and Odd Speech

Negative schizotypy= sum of Social Anxiety, No Close Friends, Constricted Affect, Suspiciousness

Items for each schizotypy factor are listed below.

Ideas of Reference
Do you sometimes feel that things you see on the TV or read in the newspaper have a special meaning for you?
Have you ever noticed a common event or object that seemed to be a special sign for you?
Do you sometimes see special meanings in advertisements, shop windows, or in the way things are arranged around you?
I am aware that people notice me when I go out for a meal or to see a film.
Do some people drop hints about you or say things with a double meaning?
When shopping, do you get the feeling that other people are taking notice of you?
When you see people talking to each other, do you often wonder if they are talking about you?
Do you sometimes feel that other people are watching you?
Do you sometimes feel that people are talking about you?
Odd Beliefs/Magical Thinking
Have you had experiences with the supernatural?
Do you believe in telepathy (mind-reading)?
Are you sometimes sure that other people can tell what you are thinking?
Do you believe in clairvoyance (psychic forces, fortune telling)?
Can other people feel your feelings when they are not there?
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)?

Unusual Perceptual Experiences
Have you often mistaken objects or shadows for people, or noises for voices?

Have you ever had the sense that some person or force is around you, even though you cannot see anyone?
When you look at a person or yourself in a mirror, have you ever seen the face change right before your eyes?
I often hear a voice speaking my thoughts aloud.
Have you ever seen things invisible to other people?
Do everyday things seem unusually large or small?
Does your sense of smell sometimes become unusually strong?
Do you ever suddenly feel distracted by distant sounds that you are not normally aware of?
Are your thoughts sometimes so strong that you can almost hear them.

Suspiciousness
I am sure I am being talked about behind my back.
Do you often feel that other people have it in for you?
Do you sometimes get concerned that friends or co-workers are not really loyal or trustworthy?
I feel I have to be on my guard even with friends.
Do you often pick up hidden threats or put-downs from what people say or do?
Have you found that it is best not to let other people know too much about you?
I often feel that others have it in for me.
Do you often have to keep an eye out to stop people from taking advantage of you?

Odd Behavior
Other people see me as slightly eccentric (odd).
People sometimes comment on my unusual mannerisms and habits.
Sometimes other people think that I am a little strange.
Some people think that I am a very bizarre person.
I am an odd, unusual person.
I have some eccentric (odd) habits.
People sometimes stare at me because of my odd appearance.

Odd Speech
People sometimes find it hard to understand what I am saying.
I sometimes jump quickly from one topic to another when speaking.
I sometimes forget what I am trying to say.
I often ramble on too much when speaking.
Some people find me a bit vague and elusive during a conversation.
I sometimes use words in unusual ways.
Do you tend to wander off the topic when having a conversation?
I find it hard to communicate clearly what I want to say to people.
People occasionally comment that my conversation is confusing.

Social Anxiety
I sometimes avoid going to places where there will be many people because I will get anxious.

I get very nervous when I have to make polite conversation.
Do you ever get nervous when someone is walking behind you?
I get anxious when meeting people for the first time.
Do you often feel nervous when you are in a group of unfamiliar people?
I feel very uncomfortable in social situations involving unfamiliar people.
I would feel very anxious if I had to give a speech in front of a large group of people.
I feel very uneasy talking to people I do not know well.

No close Friends
I have little interest in getting to know other people.
I prefer to keep myself to myself.
I am mostly quiet when with other 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?
Writing letters to friends is more trouble than it is worth
I tend to keep in the background on social occasions
I attach little importance to having close friends.
Do you feel that you cannot get "close" to people.

Constricted Affect
People sometimes find me aloof and distant.
I am not good at expressing my true feelings by the way I talk and look.
I rarely laugh and smile.
My "nonverbal" communication (smiling and nodding during a conversation) is not very good.
I am poor at returning social courtesies and gestures.
I tend to avoid eye contact when conversing with others.
I do not have an expressive and lively way of speaking.
I tend to keep my feelings to myself.

Appendix B

Lehman's Quality of Life Brief Interview

Item	1	2	3	4	5	6	7
Select the item that best describes how you feel about your life in general.*	Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
Select the item that best describes where you have been living during the past month.	In a house or apartment alone or with a spouse, friend, family or children.	In a house, apartment of boarding home with a part-time mental health professional.	In a treatment program with a full-time mental health professional	In a hospital or nursing home.	In a jail or prison	On the streets or in an emergency shelter for the homeless.	
Select the item that best describes how you feel about the privacy you have where you live.*	Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
During the past month, did you work at a job for pay?	No	1-5 days	6-10 days	11-15 days	16 or more days		.
During the past month, did you go to school?	No	1-5 days	6-10 days	11-15 days	16 or more days		.
During the past month, did you	No	1-5 days	6-10 days	11-15	16 or more days		.

do volunteer work?				days			
During the past month, did you keep house or take care of children?	No	1-5 days	6-10 days	11-15 days	16 or more days		.
During the past month, did you go to a day program?	No	1-5 days	6-10 days	11-15 days	16 or more days		.
Which of these activities did you consider your main activity during the past month?	Working at a job for pay	Going to school	Doing volunteer work	Keeping house, taking care of children	going to a day program	None of these	.
Select the item that best describes how you feel about the amount of fun you have*	Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
Select the item that best describes how you feel about how you spend your time.*	Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
How often do you talk to a member of your family on the telephone?	Daily	Weekly	Monthly	Less than Monthly	Not At All	.	.
How often do you get together with a member of your family?	Daily	Weekly	Monthly	Less than Monthly	Not At All	.	.
Select the item that best describes how you feel about the way things are in general between you and your family.*	Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
How often do you spend time	Daily	Weekly	Monthly	Less than	Not At	.	.

with a friend who does not live with you?				Monthly	All		
How often do you phone a friend who does not live with you?	Daily	Weekly	Monthly	Less than Monthly	Not At All	.	.
How often do you make plans ahead of time to do something with a friend?	Daily	Weekly	Monthly	Less than Monthly	Not At All	.	.
How often do you spend time with someone you consider more than a friend, like a boyfriend, girlfriend or you spouse?	Daily	Weekly	Monthly	Less than Monthly	Not At All	.	.
Select the item that best describes how you feel about the amount of friendship in your life.*	Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
Select the item next to the amount of money you had to spend on yourself during the past month, not counting money for room and board (housing and meals)	Less than $20	$20 to $50	$51 to $100	More than $100		.	.
In the past month, did you have enough money for food?	Yes	No	.	.	.	.	.
In the past month, did you have enough money for clothes?	Yes	No	.	.	.	.	.

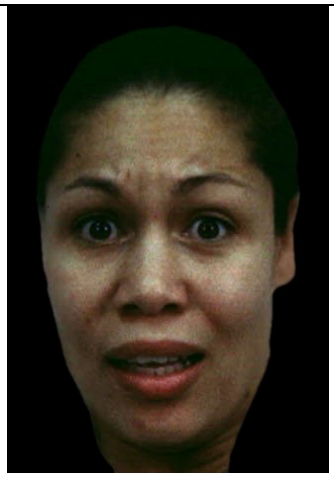
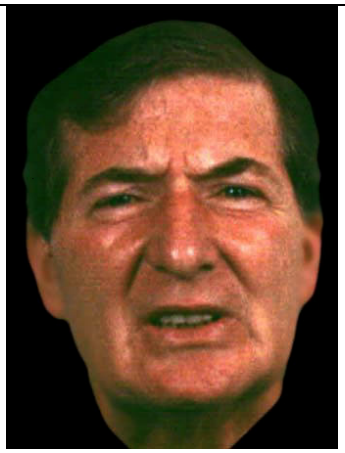
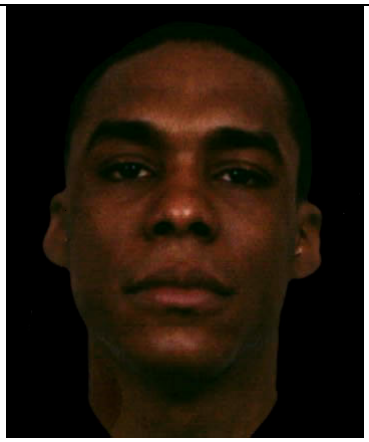
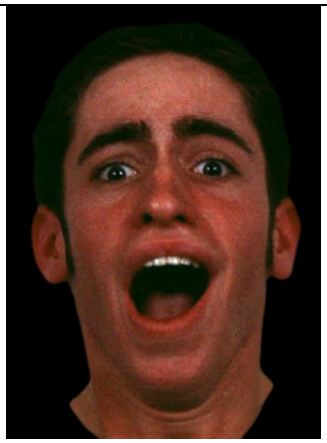
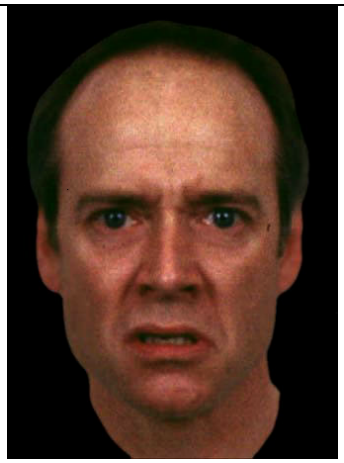
In the past month, did you have enough money for housing?	Yes	No	.	.	.	.	.
In the past month, did you have enough money for transportation?	Yes	No	.	.	.	.	.
In the past month, did you have enough money for fun?	Yes	No	.	.	.	.	.
Select the item that best describes how you feel about how well off you are in financially.*	Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
In the past month were you the victim of any violent crime like assault, rape, mugging or robbery?	Yes	No	.	.	.	.	.
In the past month were you the victim of any non-violent crime like a theft, burglary or being cheated?	Yes	No	.	.	.	.	.
In the past month have you been arrested or picked up for any crime?	Yes	No	.	.	.	.	.
Select the item that best describes how you feel about the protection you have against being robbed or attacked.*	Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
Overall, how would you rate your health?	Excellent	Very Good	Good	Fair	Poor	.	.

Select the item that best describes how you feel about your health in general.*	Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted

* Denotes items subjective quality of life items. All other items objective quality of life.

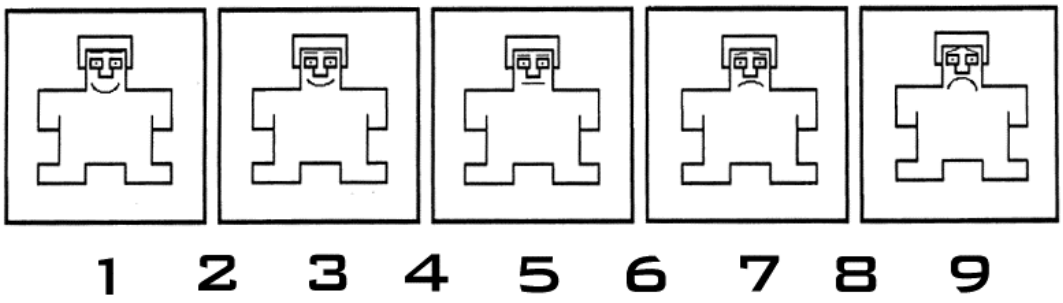
Appendix C

Example of PERT Stimuli


Appendix D

Semantic Affective Moniker



Vita

Laura Brown was born in Baton Rouge, Louisiana, to Linda and Danny Brown in March of 1984. She spent her early years living with her mother, father, older brother Christopher Brown, and younger brother Aaron Brown in Walker, Louisiana. During her high school years, her parents divorced and Laura remained with her mother in Walker as did her younger brother Aaron. Laura has since maintained a close bond with her mother, whom she now refers to as her "best friend."

As a child, Laura was always a high achiever and performed at the top of her class in most subjects. She enjoyed mostly English and writing. Laura received a number of rewards in English for highest overall class grade. During high school, Laura maintained this pattern and graduated from Walker High School in May of 2002. Laura's earliest career goal included writing, law, biology, and psychology. She attended college at Louisiana State University in Baton Rouge with the intention of obtaining a degree in English and moving on to law school afterwards. This goal shifted as Laura began to take social science courses and became interested in psychological research. She changed her major to psychology. Laura also had a keen interest and fascination with Roman culture and language and took a number of Latin courses, which she thoroughly enjoyed. She eventually obtained a bachelor's degree in psychology with a minor in Latin in December of 2006.

During her undergraduate years, Laura enrolled in a number of research courses in which she had the opportunity to conduct research related activities with a number of professors in the Louisiana State University psychology department. These experiences led to Laura's interest in psychology as a career and research in schizophrenia-spectrum

pathology in particular. After graduating, Laura spent one additional semester conducting research with Dr. Alex Cohen at Louisiana State University, focusing on individuals at risk for schizophrenia-spectrum disorders. The following semester she applied to a number of clinical psychology graduate programs with a focus on research in this area. After attending interview day at Louisiana State University, Laura decided to remain at Louisiana State University and continue her research with Dr. Cohen as a clinical psychology graduate student. At present, Laura is a third year student in this program and she continues to conduct the same research that initially piqued her interest in clinical psychology. Her specific interest in this area is social cognitive processes, social behavior, and emotion in individuals who are at risk for developing schizophrenia and related disorders.