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Development and Validation of a Brief Assessment of Social Cognitive Abilities

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DEVELOPMENT AND VALIDATION OF A BRIEF ASSESSMENT OF SOCIAL COGNITIVE ABILITIES

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ABSTRACT

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It has been consistently found that individuals with schizophrenia exhibit impairments across various social cognitive domains, including emotion processing, social perception, and theory of mind. These deficits have been found across illness stages and cannot be accounted for by clinical symptomatology or neurocognitive skills. Further, while it has been well established that there is a link between cognition and functional outcome, social cognition has been found to be uniquely related to functional impairment in the disorder. Despite this evidence, the field is currently lacking efficient ways to identify and characterize these deficits in clinical settings. The Brief Test of Social Cognitive Abilities (BTSCA) was developed in the current study in order to provide a quick, easy to administer test to assess social cognitive abilities in clinical settings. Following the development of the BTSCA from archival item-level data of NCs and individuals with schizophrenia on established social cognitive measures, psychometric properties of the scale and sensitivity of the scale to social cognitive deficits in schizophrenia were examined in a large sample of normal controls and individuals with schizophrenia. Finally, the relationship between the BTSCA, clinical symptomatology, and functional capacity were examined in order to establish clinical utility of the scale. Overall, study findings demonstrate that the BTSCA shows promising psychometric properties and clinical utility as a brief screening measure of social cognitive in individuals with schizophrenia.

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CHAPTER 1: INTRODUCTION

Schizophrenia (SZ) is a heterogeneous disorder that is characterized by constellations of positive, negative, and cognitive symptoms (American Psychiatric Association, 2013; Patel, Cherian, Gohil, & Atkinson, 2014). Recently there has been a growing interest in social cognitive impairments in the disorder. Social cognition is a multidimensional construct that refers broadly to the way an individual thinks and behaves in social situations (Pinkham, 2014). A recent meta-analysis by Savla, Vella, Armstrong, Penn, and Twamley (2013) found that individuals with SZ performed worse than healthy controls across domains of social cognition with varying effect sizes. Additionally, social cognitive deficits have been found in individuals in the prodromal, first-episode, and chronic stage of SZ (Comparelli et al., 2013; Green et al., 2012), with longitudinal studies indicating that these deficits are relatively stable across illness stages (Horan et al., 2012). Although there are overlaps between social cognition and neurocognition (Ventura, Wood, & Hellemann, 2013), impairments in social cognition cannot be accounted for by neurocognitive deficits (Mehta, Thirthalli, Subbakrishna, et al., 2013; Pinkham, Penn, Perkins, & Lieberman, 2003). Studies using factor analysis (Allen, Strauss, Donohue, & van Kammen, 2007; van Hooren et al., 2008), principle component analysis (Williams et al., 2008), and structural equation modeling (Vauth, Rusch, Wirtz, & Corrigan, 2004) have found that social cognition and neurocognition are distinct factors.

It is well established that there is a link between neurocognition and functional outcome in SZ, which has led to its emergence as a treatment target in the disorder (Green, Kern, Braff, & Mintz, 2000; Green, Kern, & Heaton, 2004; Torio et al., 2014). Social cognitive deficits have also been found to be related to functional impairment in the disorder even when neurocognition is controlled for (Couture, Penn, & Roberts, 2006; Pinkham & Penn, 2006; Thaler, Sutton, &

Allen, 2014). In fact, Vauth et al. (2004) found that the relationship between vocational functioning and social cognition was stronger than the relationship between vocational functioning and neurocognition. Similarly, a meta-analysis by Fett et al. (2011) concluded that social cognition was more strongly associated with functional outcome than neurocognition. Others have found that social cognition is a mediator between neurocognition and functional outcome (Martinez-Dominguez, Penades, Segura, Gonzalez-Rodriguez, & Catalan, 2015) and between neurocognition and clinical symptoms (Lam, Raine, & Lee, 2014).

Despite the extensive amount of research that has been done on neurocognitive functioning and its relationship to functional outcome in SZ, neurocognitive deficits are not routinely assessed by clinicians. Survey results indicate that this may be due to lack of understanding regarding the appropriate measures to assess cognitive functioning and/or no access to neuropsychological testing measures (Belgaied et al., 2014; Green et al., 2005). Additionally, many measures of neuropsychological functioning require much more time to administer then what is typically available in an appointment with a psychiatrist. Recognizing the need for brief, easy-to-administer measures of cognition, several brief neuropsychological measures have been developed for use in the disorder that have been found to be sensitive to the neurocognitive deficits seen in SZ (Hurford, Marder, Keefe, Reise, & Bilder, 2011; R. S. E. Keefe et al., 2004; Randolph, Tierney, Mohr, & Chase, 1998). Additionally, preliminary data from the utilization of brief screening tools that were originally developed for assessing cognitive deficits in dementia and neurological disorders, such as the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005), have been positive. For example, the MoCA has been found to be sensitive to cognitive deficits in SZ and related to functional outcome

(Fisekovic, Memic, & Pasalic, 2012; Musso, Cohen, Auster, & McGovern, 2014; Wu, Dagg, & Molgat, 2014).

Following this evidence, as well as evidence that social cognitive deficits are present in the disorder and related to functional outcome (Fett et al., 2011), it will be helpful for clinicians and researchers to be able to routinely screen for these deficits in the disorder in order to inform potential therapeutic targets. Thus, the purpose of the current study is to develop and validate a brief and easy-to-administer screening measure with good psychometric properties that is sensitive to social cognitive abilities in schizophrenia and is clinically meaningful (i.e., it predicts functional outcome). While this measure will be validated for use in individuals with SZ, it may also prove helpful for screening social cognitive abilities across a wide variety of disorders.

CHAPTER 2: LITERATURE REVIEW

The construct of social cognition has been increasingly studied in SZ and has been identified as a treatment target in those with the disorder (Green et al., 2008). Social cognition broadly refers to the processes that are used to communicate with others and guide behavior in the social world and has previously been investigated in the general field of social psychology, as well as in numerous clinical populations (e.g., Cusi, Nazarov, Holshausen, Macqueen, & McKinnon, 2012; Henry, Phillips, & von Hippel, 2014; Pelphrey, Shultz, Hudac, & Vander Wyk, 2011). In 2008, a workshop on social cognition was sponsored by the National Institute of Mental Health (NIMH) in order to reach consensus on the definition, significance, and research directions of social cognition in schizophrenia. Social cognition was defined as, "the mental operations that underlie social interactions, including perceiving, interpreting, and generating responses to the intentions, dispositions, and behavior of others." (Green et al., 2008). Social cognition is not a unitary construct, but is instead made up of several social cognitive processes or domains. In 2012, as part of the Social Cognition Psychometric Evaluation (SCOPE) study, experts studying social cognition not only in SZ, but also in social psychology and autism, identified emotion processing, social perception, attributional style, and theory of mind as primary domains of interest in SZ (Pinkham, 2014). Emotion processing refers to the perception and use of emotional information. Social perception involves identifying and interpreting social cues in others. Attributional style refers to the way an individual explains the causes of social events. Finally, theory of mind refers to the ability to infer the mental state of others (Green et al., 2008; Pinkham et al., 2014). It has been found that individuals with SZ exhibit deficits across these domains (reviewed in Pinkham, 2014; Savla et al., 2013), each of which will be discussed in further detail in subsequent sections.

Social cognition and neurocognition as distinct constructs.

The recognition of social cognition as an area of importance in SZ is highlighted by evidence that it appears to be a related but distinct construct from neurocognition (reviewed in Mehta, Thirthalli, Subbakrishna, et al., 2013). It is well known that individuals with schizophrenia are impaired in a variety of neurocognitive domains, including intellectual functioning (Fioravanti, Carlone, Vitale, Cinti, & Clare, 2005; Khandaker, Barnett, White, & Jones, 2011), attention (Fioravanti et al., 2005), executive functioning, verbal and visual memory and learning (Bilder et al., 200; Fioravanti et al., 2005; Sponheim et al., 2010), working memory (Silver, Feldman, Bilker, & Gur, 2014; Sponheim et al., 2010), processing speed (Sponheim et al., 2010), and motor functioning (Bilder et al., 200; Sponheim et al., 2010). Deficits in these areas could certainly influence social cognitive abilities. For example, attention (Jean Addington & Addington, 1998; Bryson, Bell, & Lysaker, 1997), memory (Bryson et al., 1997), and aspects of early visual processing (Corrigan, Green, & Toomey, 1994; Kee, Kern, & Green, 1998; Sergi & Green, 2003; Wynn, Sergi, Dawson, Schell, & Green, 2005) have been found to correlate with the ability to perceive emotions. Similarly, verbal learning and reasoning (Koelkebeck, 2010), memory (Frith & Corcoran, 2009; Greig, Bryson, & Bell, 2004; Koelkebeck, 2010), executive functioning (Greig et al., 2004), and intellectual functioning (Bertrand, Sutton, Achim, Malla, & Lepage, 2007; Brune, 2003b) have been found to correlate with theory of mind. A meta-analytic study by Ventura et al. (2013) reported correlations ranging from .2 to .3 between neurocognitive and social cognitive abilities. In fact, some have argued that intact neurocognition is a necessary precursor for intact social cognition (Ostrum, 1984; Penn, Corrigan, Bentall, Racenstein, & Newman, 1997). A recent study that assessed 119 individuals with schizophrenia or schizoaffective disorder on measures of neurocognitive and social cognitive functioning provides additional support for this notion. Fanning, Bell, and Fiszdon (2012) found that the majority of

their sample (68%) exhibited deficits on both social cognitive and neurocognitive measures. Among the rest of the sample, 25% had impaired social cognition in the presence of intact neurocognition, while less than 1% had intact social cognition in the presence of impaired neurocognition, suggesting that neurocognitive skills may be a prerequisite for social cognitive skills in individuals with SZ.

However, while overlaps between neurocognitive processes and aspects of social cognition have been found, various factor-analytic studies suggest that social cognition is a distinct construct from neurocognition. Sergi et al. (2007) used structural equation modeling to examine the factor structure of social cognition and neurocognition in 100 individuals diagnosed with SZ or schizoaffective disorder and found that a two-factor model with social cognition and neurocognition as distinct constructs fit the data better than a one-factor model. Allen et al. (2007) performed confirmatory factor analysis on the Wechsler Adult Intelligence Scale – Revised (WAIS-R; Wechsler, 1981) subtests and found that subtests with a social component formed a separate factor from the traditional verbal comprehension, perceptual organization, and working memory factors. Similarly, an exploratory factor analysis performed by van Hooren et al. (2008) with individuals who were vulnerable for psychosis found that neurocognition and social cognition were different constructs. Finally, a recent review by Mehta, Thirthalli, Subbakrishna, et al. (2013) indicated that 8 out of the 9 studies reviewed supported the notion that social cognition and neurocognition are statistically separable constructs.

Furthermore, evidence suggests that there are different brain regions underling neurocognitive and social cognitive abilities. Various neural structures have been implicated in social cognition, including the fusiform gyrus, amygdala, superior temporal sulcus, medial prefrontal cortex, and ventrolateral prefrontal cortex. Broadly, the fusiform gyrus has been

implicated in identification of basic facial features (Hoffman & Haxby, 2000), while the superior temporal sulcus is thought to play a role in processing and interpreting movement of different areas of the face (Hoffman & Haxby, 2000; Pruce, Allison, Bentin, Gore, & McCarthy, 1998) as well as stimuli reflecting biological movement (Grossman et al., 2000). The amygdala directs attention to arousing stimuli and appears to play a particularly important role in the detection of threatening stimuli and the processing of negative emotions (reviewed in Adolphs, 2010). The ventrolateral prefrontal cortex modulates the activity of the amygdala when making attributions regarding facial stimuli (Hariri, Mattay, Tessitore, Fera, & Weinberger, 2003). Finally, the medial prefrontal cortex has been implicated in the ability to infer the mental states of others (reviewed in Amodio & Frith, 2006). While a description of brain regions implicated in various neurocognitive tasks is beyond the scope of this paper, it is important to note that meta-analytic studies have shown that there is limited overlap in brain regions activated during social and nonsocial cognitive tasks (Van Overwalle, 2009, 2011). This provides evidence from another research modality indicating that social cognition and neurocognition are indeed separate constructs.

Finally, and of particular importance, social cognition appears to be uniquely related to impaired functional ability in the disorder. As is true with neurocognition and social cognition, functional ability can be broken down into various domains. At a basic level, functional ability can be separated into the domains of functional outcome and functional capacity (Harvey et al., 2011). Functional outcome, usually measured via self-report questionnaires or clinician ratings, refers to "direct, real-world" outcomes or how an individual is actually functioning at home, at work, and during social situations (Harvey, Velligan, & Bellack, 2007). Functional capacity, usually measured via performance-based measures conducted in the laboratory, refers to the

capability that an individual has to complete functional skills (i.e., shopping, paying bills) regardless of their own actual personal circumstances (Harvey et al., 2007). Studies examining the relationship between neurocognition, social cognition, and functional ability have found that social cognition has direct effects on functional outcome (Brekke, Kay, Lee, & Green, 2005; Horan et al., 2012; Mancuso, Horan, Kern, & Green, 2011) and functional capacity (Mancuso et al., 2011; Meyer & Kurtz, 2009). Other studies have found that social cognition mediates the relationship between neurocognition and functional outcome (Bell, Tsang, Greig, & Bryson, 2009; Brekke et al., 2005; Martinez-Dominguez et al., 2015; Sergi, Rassovsky, Nuechterlein, & Green, 2006) and neurocognition and functional capacity (Addington, Saeedi, & Addington, 2006a; Couture, Granholm, & Fish, 2011; Meyer & Kurtz, 2009). A meta-analytic study by Schmidt, Mueller, and Roder (2011) indicated that social cognition plays a mediating role between neurocognition and functional outcome, with the strongest mediating relationship occurring with the social cognitive domains of emotion processing and social perception. Finally, several studies have found that social cognition is the best predictor of functional capacity among models that also include neurocognition (Pijnenborg et al., 2009; Pinkham & Penn, 2006) and symptomatology (Pijnenborg et al., 2009). A recent meta-analysis of 52 studies examining neurocognition, social cognition, and functional outcome in individuals with nonaffective psychosis concluded that social cognition explained more variance in functional outcome than neurocognition, and that the association between measures of theory of mind and functional outcome were particularly strong (Fett et al., 2011). Thus, while the relationships among neurocognition, social cognition, and functional ability are not completely elucidated, evidence does suggest that neurocognition and social cognition predict unique variance in functional ability, providing further evidence that they are distinct constructs.

Domains of social cognition in schizophrenia research.

Social cognition in SZ is generally discussed according to four domains of social cognition - emotion processing, social perception, attributional style, and theory of mind (Pinkham et al., 2014). Each of these domains will be discussed below. For each domain, the construct, common assessment methods, and relevant findings in SZ will be discussed.

Emotion Processing. Broadly defined, emotion processing (EP) involves the perception and use of emotional information, and includes recognizing emotions, understanding emotions, and managing emotions (Green et al., 2008; Pinkham et al., 2014). The majority of the research in this domain has focused on emotion recognition (ER), or the ability to analyze emotional content from various modalities of communication (Pinkham, 2014). Emotion recognition is primarily measured by emotion identification tasks, where an individual is asked to identify a specific emotion that is being portrayed, and emotion discrimination tasks, where an individual is asked to differentiate between two emotional expressions (Kohler, Walker, Martin, Healey, & Moberg, 2010). Research has focused on the ability to recognize affect from facial expressions, speech, or a combination of the two.

Tasks used in the assessment of the ability to recognize facial affect in schizophrenia include the Penn Emotion Recognition Test (ER-40; Gur et al., 2002), the Facial Emotion Identification Test (FEIT; Kerr & Neale, 1993), the Facial Identification of Affect Test (FIAT; Armstrong & Allen, unpublished manuscript) and the Adult Facial Expressions subtest of the Diagnostic Analysis of Nonverbal Accuracy-2 (DANVA-2-AF; Nowicki & Duke, 1994). Although these tests utilize different stimuli, all involve presenting photographs of faces expressing basic emotions (e.g., happiness, sadness, fear, anger, surprise, neutral) at different intensities and asking the participant to correctly identify the emotion expressed. Emotion discrimination tests are different in that they require participants to differentiate between

emotional expressions. For example, the Facial Emotion Discrimination Test (FEDT; Kerr & Neale, 1993) presents participants with pairs of photographs of two different individuals expressing emotions and asks them to indicate whether the individuals are expressing the same or different emotions. Similar instruments are used to assess the ability of individuals with schizophrenia to identify emotion in speech, including the Voice Emotion Identification Test (VOICE-ID; Kerr & Neale, 1993) the Adult Paralanguage subtest of the DANVA-2 (DANVA-2-AP; Nowicki & Duke, 1994), and the Voice Emotion Discrimination Test (VOICE-DISCRIM; Kerr & Neale, 1993). The VOICE-ID and DANVA-2-AP tasks present individuals with audio of neutral content sentences being conveyed in different emotional tones and ask participants to correctly identify the emotion expressed, while the VOICE-DISCRIM test presents participants with pairs of sentences of either identical or different content that are read in either the same or different prosody, and participants are asked to indicate whether the sentences were conveying the same or different emotion irrespective of the content.

Research on affect recognition from facial expression has received the most attention in terms of emotion processing research in SZ. It is well established that compared to normal controls, individuals with SZ are impaired in their ability to identify and discriminate general affect from facial expressions (Amminger et al., 2012; Edwards, Pattison, Jackson, & Wales, 2001b; Heimberg, Gur, Erwin, Shtasel, & Gur, 1992; Kohler et al., 2003; Kucharska-Pietura, David, Masiak, & Phillips, 2005; Maat et al., 2015). Deficits in facial emotion recognition were recently confirmed by a large meta-analysis by Kohler et al. (2010) of 86 studies from 1970-2007, which reported large effect sizes for deficits in schizophrenia. Further, these deficits have been found in individuals with first-episode SZ (Allott et al., 2015; Amminger et al., 2012; Comparelli et al., 2013), as well as in those considered high risk for psychosis (Addington, Penn,

Woods, Addington, & Perkins, 2008; Amminger et al., 2012; Comparelli et al., 2013) and in first-degree relatives (Allott et al., 2015). The findings regarding the relationship between illness stage and facial affect recognition are mixed. Cross sectional studies have found evidence of a positive correlation between duration of illness and affect recognition deficits (Kucharska-Pietura et al., 2005), while others have failed to find any significant differences in facial affect recognition ability in groups at different illness stages (Addington et al., 2006a; Pinkham, Penn, Perkins, Graham, & Siegel, 2007). Evidence from longitudinal studies have found that deficits in facial emotion recognition are present even during periods of symptom remission (Maat et al., 2015; Yalcin-Siedentopf et al., 2014), although Maat et al. (2015) also found evidence of improved facial emotion recognition deficits in individuals with schizophrenia who stayed in remission for three years and exacerbated facial emotion recognition deficits in individuals who did not remain in remission.

Findings from studies examining the relationship between facial affect recognition and symptomatology again report mixed findings, with several meta-analytic studies finding that negative symptoms and disorganized symptoms are related to poor emotion recognition (Chan, Li, Cheung, & Gong, 2010b; Fett, Maat, & GROUP Investigators, 2013; Sachs, 2004; Ventura et al., 2013), but others also implicating positive symptoms (Fett et al., 2011; Kohler et al., 2010). Still others have failed to find correlations between positive or negative symptoms and facial affect recognition ability, suggesting that facial emotion recognition may be a trait deficit in the disorder (Allott et al., 2015; Amminger et al., 2012; Comparelli et al., 2013; Goghari & Sponheim, 2013). Individuals with SZ have also been found to show greater deficits in facial affect recognition compared to individuals with affective disorders, including bipolar disorder (Addington & Addington, 1998; Derntl, Seidel, Schneider, & Habel, 2012; Goghari &

Sponheim, 2013; Lee et al., 2013; Yalcin-Siedentopf et al., 2014) and major depression (Weniger, Lange, Ruther, & Irle, 2004). However, there is evidence to suggest that this difference is reduced when individuals with bipolar disorders who also have psychotic features are compared to those with SZ (Thaler, Allen, Sutton, Vertinski, & Ringdahl, 2013; Thaler, Strauss, et al., 2013).

Provided that a general impairment in facial affect recognition across emotions has been well replicated, researchers have also examined impairments according to specific emotional categories. The most consistent finding is that individuals with SZ are impaired in their ability to recognize negative emotions, such as fear, sadness, anger, and disgust (Allott et al., 2015; Barkhof, de Sonneville, Meijer, & de Haan, 2015; Brune, 2005a; Comparelli et al., 2013; Edwards, Pattison, Jackson, & Wales, 2001a; Fett et al., 2013; Goghari & Sponheim, 2013; Kohler et al., 2003; Maat et al., 2015). Several studies have also found that individuals with schizophrenia tend to misattribute neutral faces (e.g, no emotion being expressed) as negative emotional expressions, such as disgust, fear, and anger (Habel et al., 2010; Hooker et al., 2011; Kohler et al., 2003; Pinkham, Brensinger, Kohler, Gur, & Gur, 2011). Taken together, given evidence that deficits in facial emotion recognition have been found across illness phase, in symptomatically remitted individuals, and in first-degree relatives, it has been suggested that deficits in facial emotion recognition, and particularly negative emotions, may be an endophenotype for the disorder or for psychosis in general (Allott et al., 2015; Comparelli et al., 2013; Kohler et al., 2010).

Finally, there is some debate as to whether deficits in facial affect recognition are due to a more general deficit in facial processing. For example, findings from some studies suggest that deficits in facial affect recognition are secondary to impaired face processing (Caharel et al.,

2007; Doop & Park, 2009; Norton, McBain, Holt, Ongur, & Chen, 2009), while others have found that individuals with SZ are specifically impaired in their ability to assess the emotional content in facial expressions compared to non-emotional facial features (Barkhof et al., 2015; Kosmidis et al., 2007; Schneider et al., 2006). Results from a meta-analysis by Chan, Li, Cheung, and Gong (2010) indicate that individuals with SZ are impaired on both emotional and non-emotional face perception tasks. Several studies have used computerized visual scanning tasks and shown that individuals with schizophrenia do not spend as much time looking at the eyes and mouth of faces as normal controls (Loughland, Williams, & Gordon, 2002; Sasson et al., 2007). This may be related to the finding in some studies of a relationship between attention and executive functions and facial emotion recognition in the disorder (Bozikas, Kosmidis, Kioperlidou, & Karavatos, 2004; Dondaine et al., 2014; Kohler, Bilker, Hagendoorn, Gur, & Gur, 2000). Additionally, studies using functional magnetic resonance imaging (fMRI) have found that individuals with SZ have reduced activity in the limbic system and related brain structures (e.g, the amygdala) when completing facial emotion recognition tasks compared to normal controls (Li, Chan, McAlonan, & Gong, 2010), and Anticevic et al. (2013) found evidence for elevated amygdala response when viewing neutral stimuli.

Although it has received less attention than facial emotion recognition, studies have also indicated that individuals with SZ have difficulty recognizing emotional prosody, or the non-linguistic aspects of speech that denote emotion (Amminger et al., 2012; Bozikas et al., 2006; Edwards et al., 2001a; Kucharska-Pietura et al., 2005; Pijnenborg, Withaar, Bosch, & Brouwer, 2007). Hoekert, Kahn, Pijnenborg, and Aleman (2007) conducted a meta-analysis and found a large effect size for deficits in the ability of individuals with SZ to recognize emotion from voice. These deficits have also been found in first-episode schizophrenia (Amminger et al.,

2012), individuals in symptomatic remission (Hoertnagl et al., 2014), individuals considered high risk for the disorder (Amminger et al., 2012; Tucker, Farhall, Thomas, Groot, & Rossell, 2013), and first-degree relatives (Tucker et al., 2013). Similar to the studies on facial affect recognition, studies examining specific emotions have generally found that these deficits are most pronounced for negative emotions (Allott et al., 2015; Bozikas et al., 2006; Edwards et al., 2001a; Hoertnagl et al., 2014; Pijnenborg et al., 2007).

Given that it is clear that individuals typically rely on information from visual and auditory information simultaneously in everyday social interactions, measures have been developed that attempt to provide a more ecologically valid assessment of emotion recognition abilities. Two commonly used measures are the Bell-Lysaker Emotion Recognition Test (BLERT; Bell, Bryson, & Lysaker, 1997b) and Part 1 of the Awareness of Social Inference Test (TASIT; McDonald, Flanagan, Rollins, & Kinch, 2003). The BLERT presents video clips of an actor delivering monologues in different emotional states and asks participants to select the appropriate affect displayed. Part 1 of the TASIT presents videotaped vignettes of an actor portraying different emotional states, and again participants have to select the appropriate emotion present in the vignette. Studies using assessments that combine auditory and visual stimuli for emotion recognition have found that while individuals with SZ do better on these tasks relative to tasks that either provide only auditory or only visual stimuli (Fiszdon, Fanning, Johannesen, & Bell, 2013), they still show deficits compared to heathy controls (de Gelder, Pourtois, & Weiskrantz, 2002; de Jong, Hodiamont, Van den Stock, & de Gelder, 2009).

Social perception. Social perception (SP) involves the interpretation of roles, rules, and context in social situations (Green et al., 2008). It involves the ability to make inferences about social situations or judgments of individual traits based on verbal and nonverbal cues, which is

an important part of social interactions (Savla et al., 2013). Tasks assessing social perception vary. Some tasks, such as the Social Cue Recognition Test (SCRT; Corrigan & Green, 1993), the Profile of Nonverbal Sensitivity (PONS; Rosenthal, Hall, Dimatteo, Rogers, & Archer, 1979), and the Relationship Across Domains Test (RAD; Sergi et al., 2009), present vignettes of social situations and have participants answer questions regarding abstract and concrete social cues or infer the nature of a relationship between two individuals. The SCRT requires participants to watch video vignettes of a social interaction and answer true or false questions about abstract and concrete social cues present in the video (Corrigan & Green, 1993). The PONS presents videotaped scenes of an individual displaying social cues such as facial expressions, voice intonation, and bodily gestures, either alone or in combination. Participants are then asked to correctly select a potential situation that gave rise to the observed social cues (Rosenthal et al., 1979) . The RAD is a paper-and-pencil measure of relationship perception based on relational model theory (Fiske, 1991) that includes short written vignettes involving male-female dyads and asks participants yes or no questions about the likeliness of a future behavior occurring given the relationship presented in the vignette (Sergi et al., 2009). Other commonly used tasks of social perception, including the Schema Component Sequencing Test-Revised (SCRT-R; Corrigan & Addis, 1995) and the Picture Arrangement subtest of the Wechsler Adult Intelligence Scale (WAIS-III PA; Wechsler, 1997), require individuals to arrange written actions (SCST-R) or images of actions (WAIS-III PA) in a socially appropriate order. Social knowledge, which is measured with tasks that assess an individual's knowledge of appropriate social expectations in different social situations, is often thought of as a prerequisite to social perception and is often grouped in the same domain as social perception (Pinkham et al., 2014). A commonly used measure of social knowledge is the Situational Feature Recognition Test (SFRT; Corrigan &

Green, 1993), which is a self-report measure that requires participants to correctly select actions and goals that correspond with particular unfamiliar social situations (e.g., attending a Bar Mitzvah) and familiar social situations (e.g., getting a haircut).

While social perception in schizophrenia has not been studied to the extent of other social cognitive domains, and tasks assessing social perception are rather variable, deficits have been found in individuals with first-episode psychosis (Addington, Saeedi, & Addington, 2006b; Bertrand et al., 2007; Green et al., 2012) and chronic SZ (Addington et al., 2006b; Green et al., 2012), as well as those who are considered high risk for schizophrenia (Green et al., 2012) and in first-degree relatives of individuals with SZ (Baas, van't Wout, Aleman, & Kahn, 2008). Addington et al. (2006b) additionally found stable deficits in social perception in the first-episode and chronic groups in their sample at one-year follow-up. Recently, McCleery et al. (2016) found stability of performance on social perception abilities over a 5-year period in individuals with SZ. Further, in a meta-analysis of social cognition studies conducted between 1980 and 2011, which included 13 studies examining social perception and 7 studies examining social knowledge, Savla et al. (2013) found that while individuals with schizophrenia were impaired across social cognitive domains, the largest effect size was found in the social perception domain (g = 1.04) and a medium effect size (g = .54) was found for social knowledge when assessed separately.

A study by Pinkham and Penn (2006) examined each of the constructs of social cognition and a variety of neurocognitive tests in individuals with SZ, and found that social knowledge measured via the SCRT was the best predictor of interpersonal functioning among all social cognitive and neurocognitive abilities, which they suggested may be an indication that social knowledge is a basic skill required for social interactions. Regarding association with

neuropsychological tasks, it was found that social knowledge was not related to processing speed or immediate memory, but was correlated with executive functioning skills (Pinkham & Penn, 2006). Brain regions involved in social perception deficits include the amygdala, fusiform gyrus, superior temporal sulcus, and the lateral occipital cortex (as reviewed in Aleman, 2014).

Attributional style. The attributional style (AS) domain of social cognition has largely been studied in the context of paranoia and/or persecutory delusions in individuals with SZ (Lee, Horan, & Green, 2015). Attributional style refers to the way in which an individual infers the cause of social events or interactions (Pinkham, 2014). An individual who attributes themselves as the cause of an event is said to be making an internal attribution, while an individual who attributes the cause of an event to someone or something other than themselves is said to be making an external attribution. External attributions can be further classified as personal or situational. An external personal attribution is made when a specific person is inferred to have caused the event, while an external situational attribution refers to instances where situational factors are inferred to have caused an event (McCleery, Horan, & Green, 2014).

Attributional style is typically measured with paper and pencil tasks that present hypothetical situations and ask individuals to make causal attributions, or via self-report from individuals with the disorder (Lee et al., 2015). Two commonly used measures of attributional style are the Internal, Personal, and Situational Attributions Questionnaire (IPSAQ; Kinderman & Bentall, 1997) and the Ambiguous Intentions and Hostility Questionnaire (AIHQ; Combs, Penn, Wicher, & Waldheter, 2007). The IPSAQ is a questionnaire that describes positive and negative social situations and has participants select a cause of the incident from 3 choices that reflect internal, external, and situational attributions (Combs et al., 2007). The AIHQ asks participants to imagine themselves in various vignettes of intentional, accidental, and ambiguous

situations with a negative outcome and write down why the person in the vignette is acting that way towards them and how they would respond to the situation. They also must answer questions based on a likert scale indicating how much they blame the individual (Kinderman & Bentall, 1997).

When situations are ambiguous, it has been found that individuals with paranoid symptomatology tend to make more hostile attributions (An, Zakzanis, & Joordens, 2012; Combs et al., 2009). Additionally, individuals with schizophrenia that experience paranoid symptoms tend to show evidence of an externalizing bias, meaning that they are more likely to make external rather than internal attributions for situations with negative outcomes (Janssen et al., 2006; Langdon, Corner, McLaren, Ward, & Coltheart, 2006; Langdon, Ward, & Coltheart, 2010). Additionally, there is evidence of an increased tendency for individuals with schizophrenia who experience paranoid symptoms to make external personal attributions compared to external situational attributions, which is referred to as the personalization bias, when explaining events with negative outcomes (Aakre, Seghers, St-Hilaire, & Docherty, 2009; Bentall & Corcoran, 2001). Although there have been some studies examining attributional style in individuals with schizophrenia outside the context of paranoid symptoms, the results are varied, with some finding evidence of a tendency to make more internal attributions compared to controls (Mizrahi, Addington, Remington, & Kapur, 2008), some finding evidence of a tendency to make more external attributions compared to controls (Janssen et al., 2006), and others finding no difference in attributional style between individuals with schizophrenia and controls (Combs et al., 2009). A recent large meta-analysis on domains of social cognition in SZ by Savla et al. (2013) found that attributional bias was the only domain that did not show differences between individuals with schizophrenia and normal controls, even when the analysis was done separately

for only those with persecutory delusions. This was particularly interesting given that because of the relatively low number of assessment measures available for attributional style, this was the only domain in the meta-analysis where the same measure was used consistently (Savla et al., 2013). Additionally, a study examining the factor structure of social cognition in individuals with schizophrenia found that measures of attributional style loaded on a separate factor and seemed relatively distinct from other social cognitive factors in that it did not correlate with functional outcome and instead correlated with clinical symptoms (Mancuso et al., 2011). Thus, there is some evidence that attributional style may be more linked with specific paranoid symptomatology rather than being a trait deficit.

Additionally, there is little known about the neural mechanisms underlying attributional style or its relationship with neurocognition (Lee et al., 2015). However, it has been proposed that deficits in attributional style may be due to an inability for individuals to correct normal inaccurate attributions due to impairments in theory of mind (Bentall & Corcoran, 2001; Penn, Sanna, & Roberts, 2008), which will be discussed next.

Theory of mind. Theory of mind (ToM), sometimes referred to as mental state attribution, involves the ability to infer the knowledge, intentions, beliefs, and desires of others, which is important in explaining and predicting another's behavior (Green et al., 2008; Pinkham et al., 2014). It is well-established that individuals with SZ have impairments in theory of mind and several meta-analytic studies provide evidence for large effect sizes that range from .96 to 1.25 for differences in theory of mind ability between SZ and normal controls (Bora, Yucel, & Pantelis, 2009; Savla et al., 2013; Sprong, Schothorst, Vos, Hox, & Van Engeland, 2007). Additionally, deficits in theory of mind have been found in first-episode SZ (Bertrand et al., 2007; Bora & Pantelis, 2013; Green et al., 2012; Kettle, O'Brien-Simpson, & Allen, 2008;

Koelkebeck et al., 2010), first-degree relatives (de Achaval et al., 2010; Ho et al., 2015; Montag et al., 2012), and in individuals who are considered high risk for the disorder (Chung, Kang, Shin, Yoo, & Kwon, 2008; Green et al., 2012). It is not clear whether or not theory of mind is a state or trait deficit in the disorder. Supporting evidence for a state deficit comes from studies indicating that performance on theory of mind tasks do not differ between normal controls and individuals with SZ who are in remission (Corcoran, Mercer, & Frith, 1995; Drury, Robinson, & Birchwood, 1998; Pousa et al., 2008). However, other studies have found evidence supporting theory of mind as a trait deficit (Bora & Pantelis, 2013), including meta-analytic studies that indicat that the presence of theory of mind deficits into periods of remission (Bora et al., 2009; Sprong et al., 2007). Additionally, it is not clear if theory of mind deficits are related to or exacerbated by clinical symptoms, as deficits in theory of mind have been found to be related to disorganized (Abdel-Hamid et al., 2009; Sarfati & Hardy-Bayle, 1999; Sprong et al., 2007), negative (Couture et al., 2011; Kelemen et al., 2005), and positive symptoms (Mehl, Rief, Mink, Lullmann, & Lincoln, 2010). Thus, despite the evidence that individuals with SZ tend to be impaired relative to normal controls, the extent and nature of these deficits has not been clearly elucidated. This may be partly due to the fact that theory of mind is a complex process which has been conceptualized and assessed in multiple ways across studies (Green & Horan, 2010).

A common way that theory of mind is assessed is through first and second-order false belief tasks (Lee et al., 2015). First-order false belief tasks measure the ability to infer the thoughts or emotional state of another, which may differ from reality (e.g., a false belief). Second-order false belief tasks are more complex, as they require individuals to infer what another's thoughts are about others (Byom & Mutlu, 2013; Sprong et al., 2007). False belief stories (Frith & Corcoran, 1996) and false belief picture sequencing (Brune, 2003b) are

commonly used to assess first and second order theory of mind abilities (Lee et al., 2015). These tasks require participants to answer questions assessing their ability to infer the mental state of a character in a written or visual story (Brune, 2003a; Frith & Corcoran, 1996).

Many studies report that individuals with SZ are impaired on second-order theory of mind tasks but perform similar to normal controls on tasks assessing first-order theory of mind (Doody, Götz, Johnstone, Frith, & Cunningham Owens, 1998; Ho et al., 2015; Pickup & Frith, 2001; Shamay-Tsoory et al., 2007), whereas others have found impairment in schizophrenia even on first-order tasks (Drury et al., 1998; Frith & Corcoran, 1996; Mazza, Di Michele, Pollice, Casacchia, & Roncone, 2008; Mo, Su, Chan, & Liu, 2008). Interestingly, Stratta et al. (2011) found evidence to support the notion that first-order and second-order theory of mind tasks may not be hierarchical as assumed, but instead may be distinct constructs.

Another group of theory of mind tasks, which are generally considered second-order theory of mind tasks, are those that require an individual to understand indirect speech, such as irony, hinting, and sarcasm, as it is assumed that understanding pragmatic speech requires that an individual understand another persons' mental state (Shamay-Tsoory et al., 2007; Sprong et al., 2007). An example of a commonly used task to assess ToM in schizophrenia is the Hinting Task (Hinting; Corcoran et al., 1995), which includes several short passage involving a social interaction during which one character hints something indirectly at the other character. Participants are then asked what the character actually meant. Another common measure of theory of mind is The Awareness of Social Inferences Test, Part 2 and Part 3 (TASIT; McDonald et al., 2003), which is a videotaped measure used to assess the ability to detect lies and sarcasm. Participants are shown vignettes of social interactions and then asked questions assessing the characters intentions, beliefs, and meanings. It has been found that individuals with SZ are poor

at inferring hints (Bertrand et al., 2007; Marjoram et al., 2005; Pinkham & Penn, 2006), understanding irony (Herold, Tényi, Lénárd, & Trixler, 2002; Langdon, Coltheart, Ward, & Catts, 2002; Mitchley, Barber, Gray, Brooks, & Livingston, 1998), and detecting lies and sarcasm (Herold et al., 2002; Mitchley et al., 1998; Sparks, McDonald, Lino, O'Donnell, & Green, 2010). Another commonly used measure of theory of mind that is differentiated from the tasks outlined above is the Reading the Mind in the Eyes Test (Eyes; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). This task requires participants to correctly select an expressed emotion from photographs of the eye region of individuals. Although this task may appear more like an emotion recognition test, it differs from emotion recognition tasks because it does not allow the participant to utilize any other facial features to discern the state of the individual in the photograph (Baron-Cohen et al., 2001).

Many researchers have begun to differentiate between cognitive and affective theory of mind, which further highlights the fact that theory of mind is a complex construct that likely encompasses a variety of abilities. Cognitive theory of mind refers to the ability to make inferences regarding the beliefs of others, while affective theory of mind refers to the ability to make inferences regarding the emotions and feelings of others (Shamay-Tsoory et al., 2007). The Eyes test described above is often considered an affective theory of mind task (Baron-Cohen et al., 2001). Thus, while both cognitive and affective theory of mind reference the ability to understand another's mental state, they require different underlying abilities. Support for this notion comes from studies who have found that individuals are specifically impaired on affective theory of mind, rather than cognitive theory of mind in SZ (Herold et al., 2002; Mo et al., 2008; Shamay-Tsoory et al., 2007). Further, lesion and neuroimaging studies indicate that the ventromedial prefrontal cortex plays a unique role in affective theory mind and the dorsolateral

prefrontal cortex plays a unique role in cognitive theory of mind, indicating different underlying neural constructs (as reviewed in Poletti, Enrici, & Adenzato, 2012).

Finally, it has been found in the literature that IQ and cognitive functions such as memory and executive functioning are related to theory of mind abilities, which raises some concern about underlying neurocognitive functions that may account for the theory of mind deficits seen in schizophrenia (as reviewed in Brune, 2005b). However, several studies have found theory of mind deficits across tasks present in individuals with SZ even after controlling for neurocognitive functioning (Bozikas et al., 2011; Brunet, Sarfati, Hardy-Bayle, & Decety, 2003; Corcoran et al., 1995; Frith & Corcoran, 1996; Mitchley et al., 1998; Sarfati & Hardy-Bayle, 1999). Additionally, a meta-analytic study conducted by G. J. Pickup (2008) found that even after controlling for executive functioning, theory of mind functioning was predictive of SZ diagnosis. Thus, the literature in general supports theory of mind as a distinct construct from neuropsychological ability.

Summary

It is well-established that individuals with schizophrenia exhibit neurocognitive deficits that impact functional outcome (for reviews see Bowie & Harvey, 2006; Reichenberg, 2010), and improving cognitive functioning in the disorder is a considered a primary treatment target (Marder & Fenton, 2004). Social cognitive deficits in the disorder appear to be related to, but distinct from, neurocognitive deficits as evidenced by differing brain structures hypothesized to underlie social cognitive and neurocognitive abilities (Van Overwalle, 2009) and the unique relationship that social cognitive skills have with clinical symptomatology and functional outcome (Fett et al., 2011). Research to date indicates that individuals with schizophrenia exhibit impairments across several social cognitive domains, including facial and vocal affect

recognition (Hoekert et al., 2007; Kohler et al., 2010), understanding verbal and nonverbal social cues (Savla et al., 2013), and the ability to infer the mental state of others (Sprong et al., 2007). Additionally, individuals with schizophrenia tend to attribute the cause of negative events to others rather than themselves (Savla et al., 2013). Importantly, deficits in social cognition have been found to explain additional variance in functional outcome beyond that which is explained by neurocognition (Fett et al., 2011), making social cognition a prime therapeutic target in the disorder (Roberts & Velligan, 2012). Further, there is evidence to suggest that impairments in social cognition cannot be entirely accounted for by neurocognitive deficits and have been found to occur across illness phase (Mehta, Thirthalli, Naveen Kumar, et al., 2013). However, it is also evident in the above literature review that there is a large amount of heterogeneity in the research findings regarding various aspects of social cognition. Social cognition is clearly a complex multidimensional construct that is relatively young in the field of schizophrenia research compared to research on neurocognitive deficits. Several challenges in this field have been highlighted, which will be discussed in the following section.

Current challenges in social cognition research

Given that social cognition is an emerging area of study in SZ, there is still a lack of consensus regarding various aspects of the construct. For instance, some measures have been criticized for lacking ecological validity, as there are notable differences between how social cognition is measured in the laboratory and the real world (Green et al., 2008; Vaskinn, Sergi, & Green, 2009; Vauth et al., 2004; Yager & Ehmann, 2006). For example, measures of affect recognition have typically utilized unimodal static stimuli, such as pictures of faces (Green, Lee, & Ochsner, 2013). However, there have been several measures developed, such as the BLERT (Bell, Bryson, & Lysaker, 1997a) and the TASIT (McDonald et al., 2003) described above, that have relied on videotaped vignettes that propose to provide a more ecologically valid assessment

of affect recognition. Importantly, individuals with schizophrenia have also been found to be impaired on measures that are considered more ecologically valid (Bazin et al., 2009; Chung, Mathews, & Barch, 2011).

Perhaps even more surprising, although the 2008 NIMH workshop (Green et al., 2008) and the 2014 SCOPE study (Pinkham et al., 2014) attempted to provide a consensus on the most important domains present in schizophrenia research and their definitions, there is still no general agreement on which abilities define these constructs. Given that there is not a consensus on which abilities make up the domains of social cognition, it follows that there are a variety of ways that impairments within each construct are measured. These challenges have been hypothesized as a potential reason as to why there is such heterogeneity in research findings (Green et al., 2013; Green et al., 2008; Pinkham et al., 2014).

Further, despite the heterogeneous methods that are used to assess social cognition, many of the measures currently used have not been assessed for their psychometric properties (Green et al., 2008; Pinkham et al., 2014). Again, this makes it difficult to compare and synthesize current results in the field. While experts in the field are working to address these issues, it is clear that the field of social cognition is still in need of psychometrically sound assessment measures.

Rationale for Development of Brief Social Cognition Measure

Given the vast amount of research that has been done regarding the extensive neurocognitive deficits present in SZ and the well-known impact that neurocognitive deficits have on functional outcome (for a review see Keefe & Harvey, 2012), it is surprising that many clinicians do not routinely assess for these deficits. It has been suggested that clinicians, including psychiatrists, may lack knowledge regarding appropriate assessment measures of

cognitive functioning or may not have the time or the resources to administer these tests (Belgaied et al., 2014; Green et al., 2005).

Several brief measures of neurocognition have been developed for use in SZ, such as the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph et al., 1998) and the Brief Assessment of Cognition in Schizophrenia (BACS; Keefe et al., 2004), which take approximately 30 minutes to administer. Additionally, assessments with even shorter administration time have been developed, such as the Screen for Cognitive Impairment in Psychiatry (SCIP; Purdon, 2005) and the Brief Cognitive Assessment Tool for Schizophrenia (B-CATS; Hurford et al., 2011), which take approximately 10-15 minutes to administer. Given that the "gold standard" test for assessing cognitive deficits, the MATRICS Consensus Cognitive Battery (MCCB; Nuechterlein et al., 2008) takes 60-90 minutes to administer, all of these tests represent substantially shorter assessment times. It is quite impressive that these brief measures have been found to correlate with more extensive neuropsychological batteries and explain variance in functional outcome measures (Cuesta et al., 2011; Fervaha, Agid, Foussias, & Remington, 2014; Hurford et al., 2011; Keefe, Poe, Walker, & Harvey, 2006; Velligan et al., 2004).

Recently, brief screening tools that were originally developed to monitor cognitive functioning and treatment change in dementia and other neurological disorders in the medical field have been examined in schizophrenia. The Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) is one such cognitive screening tool that is well-validated and extensively used in research and clinical settings to assess cognition (Strauss, Sherman, & Spreen, 2006). Additionally, the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005) was more recently developed as a similar brief screening tool that has been found to be

more sensitive to mild cognitive dysfunction. The MoCA is a 30-point screening item that assesses attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation with an average 10 minute administration time (Nasreddine et al., 2005). A few studies have recently examined the utility of the MoCA as a brief screener for cognitive impairment in individuals with SZ. Musso et al. (2014) examined the utility of the MoCA in an outpatient sample of individuals with serious mental illness, including SZ, and found that it had high sensitivity. Additionally, a study by Wu et al. (2014) examined the utility of the MoCA in an inpatient sample of individuals with SZ, and also found evidence of good sensitivity. They also found that the MoCA was related to educational level, illness severity, and negative symptomatology (Wu et al., 2014). Importantly, both of these studies demonstrated the clinical utility of the MoCA, as Musso et al. (2014) found that performance on the MoCA was related to functional outcome and Wu et al. (2014) found that MoCA performance was correlated with length of hospital stay.

Given that social cognitive abilities have been shown to differentiate SZ and NCs and have a unique relationship with functional outcome (Fett et al., 2011), the field will benefit from the ability to screen for social cognitive deficits in individuals with SZ to best understand impairments in the disorder and potentially inform treatment. Additionally, although the measure in the current study will be validated on an SZ sample, there are a variety of disorders that exhibit social cognitive deficits. Thus, brief screening measures could eventually aid in differential diagnoses if different patterns of social cognitive deficits are found across diagnostic categories. Researchers could also benefit from such a screening tool. Given the heterogeneity in the measures currently used to assess social cognitive functioning in SZ, not only could a brief measure be administered by various professionals in a variety of settings, but these findings

could be compared across studies. Finally, a brief social cognitive measure could be utilized in clinical trials or as an outcome measure, as there are currently approaches being developed in order to improve social cognition in those who have deficits (e.g., Bartholomeusz et al., 2013).

Research Aims and Study Hypotheses

The aim of the current study is to develop and provide initial validation of a brief, easy-to-administer screening tool of social cognitive abilities for use in individuals with SZ. Items for the screening tool will be developed based on findings from standardized social cognitive measures that we have previously administered to a large number of normal controls and individuals with schizophrenia. Based on the above review of the literature, we will choose items from measures that assess emotion processing, social perception, and theory of mind (Green et al., 2008; Pinkham et al., 2014). Although attributional style has also been recognized as a potential important domain of social cognition in SZ (Green et al., 2008; Pinkham et al., 2014), we chose not to include items of attributional style on our brief measure. Our reason for this was because attributional style is least likely to be a trait deficit in the disorder, and items on developed tests of attributional style rely on subjective judgments and are not easily scored as either correct or incorrect (Combs et al., 2007; Kinderman & Bentall, 1997). Recent studies have also found that measures of attributional style appear to be separate from other social cognition measures in meta-analyses and have different relationships with symptomatology and outcome (Buck, Healey, Gagen, Roberts, & Penn, 2016; Mancuso et al., 2011).

Given that we will be choosing items based on those that have been shown to differentiate between SZ and NCs, we hypothesize that our brief measure will be sensitive to the social cognitive deficits seen in the disorder. Additionally, we will examine psychometric properties of these items on a large sample of NCs, and finally validate the scale on a sample of individuals with NC and SZ. It is hypothesized that individuals with SZ will perform worse than

controls on the total score derived from the measure, and potentially on domain scores if the results provide evidence of domains being present.

We will also examine correlations between our newly developed measure and clinical symptom ratings. Based on our literature review, it is hypothesized that there will be moderate correlations between the measures, but that these correlations will be larger for negative symptoms (Fett et al., 2013; Ventura et al., 2013). We will also examine correlations between our final measure and a measure of functional capacity, as we believe it is critical to demonstrate that the brief instrument is clinically useful. Based on prior research, it is hypothesized that our final measure will be correlated with a measure of functional ability (Fett et al., 2011). Finally, we will conduct an exploratory analysis of the relative utility of our developed social cognition screening measure and a similar brief cognition screening measure, to explain the variance in functional capacity.

CHAPTER 3: METHOD

Participants

The current study included 133 participants. Three samples of participants were included: 1) a sample of 74 heterogenous undergraduate students (UGS; 44.6% male; mean age = 20.1 years) 2) a sample of 30 normal controls (NC; 60.0% male; mean age = 36.0 years) and 3) a sample of 29 individuals with schizophrenia (SZ; 79.3% male; mean age = 45.6 years). Additional demographic information is found in the results section. All participants were between the ages of 18-65, able to provide informed consent, spoke English as a primary language, and did not have significant hearing or vision impairment that would interfere with testing procedures. The Structured Clinical Interview for the DSM-5 (First, Karg, & Spitzer, 2015) was used to identify or confirm diagnoses in the NC and SZ groups. Individuals in the SZ group met criteria for a DSM-5 diagnosis of schizophrenia, while individuals in the NC group were excluded if they met criteria for a current DSM-5 mood, anxiety, or psychotic disorder. Exclusion criteria for the SZ and NC groups included: 1) history of traumatic brain injury 2) current or past medical condition or neurological condition known to significantly affect the central nervous system 3) currently (within the past week) taking medication that may affect central nervous system function, with the exception of medication that is specified for the treatment of schizophrenia and its symptoms and 4) diagnosis of substance abuse or dependence in the last 6 months. Additionally, individuals in the NC group were excluded if they reported a diagnosis of bipolar disorder or schizophrenia in a first-degree relative.

Measures

Participants in the study were evaluated using 1) Screening and Diagnostic Measures, 2) Clinical Symptom Measures, 3) Intellectual and Cognitive Functioning Measures, 4) Functional

Outcome Measures, and a 5) Brief Social Cognition Measure. Information regarding these measures is provided in the following sections.

Screening and Diagnostic Measures. In addition to the measures listed below, demographic and clinical information for the UGS group, including medical history and family history, were collected from a brief clinical interview and demographic questionnaire. Demographic and clinical information for the NC and SZ groups were collected from phone screening, demographic questionnaires, and medical records.

Visual Acuity Check. A visual acuity check was administered by having participants read from a Snellen eye chart that was placed 4 feet in front of them. All participants were administered the visual acuity check in order to ensure that they did not have visual impairments that would interfere with their ability to complete tasks.

Structured Clinical Interview for DSM-5 (SCID-5). The SCID-5 (First et al., 2015) is a semi-structured interview used to gather and record information to systematically evaluate criteria for DSM-5 diagnoses. The SCID-5 was used to confirm a diagnosis of schizophrenia in the SZ group and to confirm that individuals in the NC group did not meet criteria for a DSM-5 mood, anxiety, or psychotic disorder.

Clinical Symptom Measures.

Symptom Checklist-90-Revised (SCL-90-R). The SCL-90-R (Derogatis & Unger, 2010) is a 90-item self-report questionnaire that is commonly used to screen for the presence of psychological and psychiatric symptoms. Participants are asked to rate the severity of symptoms experienced within the past week on a scale from 0 (not-at-all) to 4 (extremely). Items assess symptoms that cluster around somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoia, and psychoticism. A total distress score,

the General Severity Index (GSI), was calculated by averaging the ratings on each item. The SCL-90-R was administered to the UGS group in order to provide a broad clinical characterization of the sample.

Brief Psychiatric Rating Scale (BPRS). The BPRS (Overall & Gorham, 1962) is an 18-item clinician administered rating scale designed to assess positive, negative, and affective symptoms associated with schizophrenia and other psychiatric disorders. Items are rated on a scale from 1 (absent) to 7 (extremely severe) based on the participants subjective report of symptoms over the past two weeks and/or by behavior observed by the clinician. A total score of the scale is derived by summing the ratings on each of the 18 items. Additionally, four factors have been identified and are commonly reported in schizophrenia research, which include thought disturbance, anergia, affect, and disorganization (Mueser, Curran, & McHugo, 1997). The BPRS was administered to the NC and SZ groups in order to assess current symptomatology.

Schedule for the Assessment of Positive Symptoms (SAPS). The SAPS (Andreasen, 1984) is a 34-item clinician administered rating scale used to asses positive psychotic symptoms. Items are rated on a scale of 0 (absent) to 5 (severe) based on the participants subjective report of symptoms over the past two weeks and/or by behavior observed by the clinician. A total score of the scale is derived by summing the ratings on each of the 34 items. Four additional total scores can also be derived pertaining to the symptom categories of hallucinations, delusions, bizarre behavior, and positive formal thought disorder. The SAPS was administered to the NC and SZ groups in order to assess current positive symptomatology.

Schedule for the Assessment of Negative Symptoms (SANS). The SANS (Andreasen, 1983) is a 30-item clinician administered rating scale used to assess negative psychotic

symptoms. Items are rated on a scale of 0 (absent) to 5 (severe) based on the participants subjective report of symptoms over the past two weeks and/or by behavior observed by the examiner. A total score of the scale is derived by summing the ratings on each of the 30 items. Additionally, scores for an emotional expressivity and a motivation/pleasure subscale were calculated. The emotional expressivity subscale is made up of items assessing affective flattening and alogia, and the motivation/pleasure substance is made of items assessing avolition and anhedonia-asociliaty (Blanchard & Cohen, 2006). The SANS was administered to the NC and SZ groups in order to assess current negative symptomatology.

Intellectual and Cognitive Functioning Measures. Measures of intellectual and cognitive functioning were administered to the SZ and NC groups. Three subtests from the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III; Wechsler, 1997) were administered in order to estimate full-scale intelligence and premorbid intelligence. Total scores on each of the WAIS-III subtests are converted to age-corrected scaled scores. Estimated full scale intelligence scores can be calculated based on a regression equation using the Vocabulary and Block Design scaled scores (Ringe, Saine, Lacritz, Hynan, & Cullum, 2002), and estimated premorbid intelligence can be calculated based on a regression equation using the Vocabulary and Matrix Reasoning scaled scores (Schoenberg, Scott, Duff, & Adams, 2002).

WAIS-III Block Design Subtest. The Block Design subtest of the WAIS-III assesses perceptual reasoning by having individuals use blocks to recreate increasingly complex designs within a specified time limit.

WAIS-III Vocabulary Subtest. The Vocabulary subtest of the WAIS-III is used to assess vocabulary knowledge by having individuals provide definitions of increasingly difficult words.

WAIS-III Matrix Reasoning Subtest. The Matrix Reasoning subtest of the WAIS-III assesses perceptual reasoning by having individuals solve increasingly complex visual puzzles.

Montreal Cognitive Assessment (MoCA). The MoCA (Nasreddine et al., 2005) is a 30-point cognitive screening measure that was originally designed to assess mild cognitive dysfunction. It assesses the domains of visuospatial skills/executive functioning, naming, memory, attention, language, abstract reasoning, and orientation. It takes an average of 10 minutes to administer. The MoCA was administered to the NC and SZ groups as a brief screening measure of cognition.

Functional Capacity Measure. The UPSA was administered to the NC and SZ groups in order to evaluate functional outcome.

UCSD Performance-Based Skills Assessment (UPSA). The UPSA (Patterson, Goldman, McKibbin, Hughs, & Jeste, 2001) is a performance-based measure of functional capacity that assesses skills in five domains: planning recreational activities, finance, communication, transportation, and household care. Raw scores are obtained for each of the five subscales and then transformed into a 0 to 20 point scale by dividing the raw score by the subscale total possible points and multiplying by 100. These transformed subscale scores are then summed to provide a summary score ranging from 0 to 100.

Brief Social Cognition Measure. The Brief Test of Social Cognitive Abilities (BTSCA) was developed as part of the current study as a screening measure of social cognitive abilities.

Brief Test of Social Cognitive Abilities (BTSCA). The BTSCA is a paper and pencil test designed to provide a brief screening tool to assess social cognitive deficits in individuals with SZ. The BTSCA was created based on items from social cognitive tests that have been given to a large sample of normal controls and individuals with schizophrenia in our prior research,

including the Bell-Lysaker Emotion Recognition Test (BLERT), the Facial Identification of Affect Test (FIAT), the Situational Feature Recognition Test (SFRT), the Reading the Eyes in the Mind test (Eyes), the Hinting Test (Hinting), and the Picture Arrangement subtest (PA) of the WAIS-III. Items from each of these tasks were retained to be included on the BTSCA, with the exception of items from the BLERT due to the stimuli being videotaped vignettes. Each of these measures was previously described in the literature review and so will not be described in detail here. However, refer to Table 1 for a brief summary.

This initial version of the BTSCA consists of 44 items, with items thought to assess ER, SP, ToM. The ER domain includes 24 black and white photographs selected from the Penn Affect Recognition pictures (Gur et al., 2002), in addition to two practice items. The SP domain contains four unfamiliar situations from the SFRT and four items from the WAIS-III PA test. The ToM domain contains eight items from the Eyes test and four items from the Hinting test. Additionally, the practice items from the SFRT, PA, Eyes, and Hinting tests were retained to be included on the BTSCA, but are not included in the analyses. Total scores and domain scores were used as the primary scores to interpret the results in the current study. Additional information about procedures used to develop the BTSCA and the scores used in each analysis are provided in the data analysis section below.

Table 1.

Summary of tests used in Brief Test of Social Cognitive Abilities (BTSCA) item selection

Test	SC Domain	Response Format/Stimuli	Item Scoring
BLERT	ER	Select correct emotion expressed in videotaped monologue	0-1
FIAT	ER	Select correct emotion expressed in photographs	0-1
SFRT	SP	Select correct actions/goals related to familiar/unfamiliar scenario from lists	0-6 actions 0-6 goals
PA	SP	Correctly sequence cards portraying characters in social situations	0-2
Eyes	ToM	Select correct emotion expressed in photographs of eyes	0-1
Hinting	ToM	Infer meaning behind hint given by character in scenario read by examiner	0-2

Note. SC Domain = social cognitive domain assessed by test; ER = Emotion Recognition; SP = Social Perception; ToM = Theory of Mind; BLERT = Bell-Lysaker Emotion Recognition Test; FIAT = Facial Identification of Affect Test; SFRT = Situational Feature Recognition Test; PA = Picture Arrangement; Eyes = Reading the Eyes in the Mind Test; Hinting = Hinting Test.

Procedure.

Participants in the UGS group (N = 74) were recruited from the University of Nevada, Las Vegas (UNLV) psychology subject pool. Participants signed up for an appointment through UNLV Sona-Systems and presented to the Neuropsychology Research Program (NRP) lab at UNLV to further evaluate inclusionary/exclusionary criteria and complete the research battery. Assessments were administered by trained doctoral level graduate students and trained research assistants under the supervision of a graduate student. Participants were compensated at a rate of one hour of research credit per hour of participation.

Participants in the NC (N = 30) and SZ (N = 29) groups were recruited from posted advertisements in the general community and online. Participants in the SZ group were also recruited from postings and brief announcements to staff at Mojave Mental Health. Participants interested in the study contacted researchers by phone on a dedicated secure phone line that was only accessible by research staff. Participants were administered a brief phone screen to determine if the participant met initial eligibility criteria. If initial criteria were met, participants were scheduled for in-person appointment at the NRP lab to further evaluate inclusionary/exclusionary criteria and complete the research battery. Notably, a majority of participants in the SZ group who were recruited from Mojave Mental Health completed the phone screen and research battery in-person at an office at Mojave Mental Health. All assessments were administered by trained doctoral level graduate students and participants were compensated at a rate of $10.00 per hour of participation.

All procedures were approved by the UNLV Institutional Review Board (IRB) and all participants provided informed consent prior to completing any study procedures. Throughout the assessments, participants were provided with breaks when requested or deemed appropriate by the examiner. The current study was conducted in three phases, as described below.

Phase One. The first phase focused on item selection, where existing data from normal controls and individuals with schizophrenia who had previously been assessed with social cognitive measures was examined at the item level to identify items for possible inclusion on the BTSCA. Items from archival data of the BLERT, FIAT, SFRT, PA, Eyes, and Hinting tasks were examined. Once candidate items were identified from existing social cognition tests, some were modified in order to allow them to be administered in paper and pencil format. For example, if an item assessing ability to recognize sadness was identified as discriminating

between individuals with SZ and NC on the BLERT, a picture for a sad face may have been used as the BTSCA stimuli rather than the BLERT video clip.

Phase Two. The second phase involved collecting BTSCA data on undergraduate students (UGS group) to examine psychometric properties of the scale that was designed in phase one. Demographic and clinical information for the UGS group, including medical history and family history, was collected from a brief clinical interview and demographic questionnaire. Participants then completed the BTSCA and SCL-90-R.

Phase Three. The third phase involved administering the BTSCA, made of up items selected in phases one and two, along with other assessment measures, to individuals with SZ and NCs to examine whether the items performed consistent with expectations, demonstrated acceptable psychometric properties, and showed evidence of being clinically useful. Participants were interviewed with the SCID-5 and were administered the demographic questionnaire and visual acuity check. If eligibility was met, the participants administered a symptom rating interview to assess symptomatology, followed by the BTSCA, intellectual and cognitive measures, and functional capacity measure.

Data Analysis.

Data Entry and Screening. All screening and diagnostic measures were scored twice and entered twice into a Microsoft Excel database by graduate students or research assistants who were trained on the measure and standardized procedure for scoring.

Preliminary Analyses. Descriptive statistics were calculated for demographic characteristics for the entire sample. Demographic differences were assessed by comparing the NC and SZ groups on age, years of education, estimated IQ, gender, and ethnicity. Clinical characteristics were assessed by comparing the NC and SZ groups on total and symptom category scores of the BTSCA, SAPS, and SANS.

Main Analyses. Main analyses of each phase are discussed below.

Phase One. Sensitivity and specificity of the item-level data from the BLERT, FIAT, SFRT, PA, Eyes, and Hinting tasks were calculated in order to identify items that appear particularly sensitive to social cognitive deficits in SZ. Results were examined for items that had a high specificity and sensitivity. While ideal items would have greater than .80 sensitivity and specificity, in this initial stage of test development items were also selected to reflect a range of difficulty in normal controls based on percent correct/incorrect for each item. We also intended for one item from each test to be passed by all individuals with SZ, to provide a validity check and ensure participants understood the task instructions.

Phase Two. The BTSCA was given to a large group of undergraduate subjects in order to conduct analyses on the reliability/precision and validity of the measure. Although we originally planned to exclude individuals with an elevated SCL-90-R score and examine psychometric properties of the BTSCA in the UGS group only, this was not possible due to the lack of variance in the data given that the majority of the responses on the BTSCA are dichotomous. As such, the BTSCA scores for the NC and SZ groups were also included in the analysis in order to provide an increased subject number and sufficient variance in the data.

Internal consistency served as an index of reliability and was assessed by calculating Cronbach's alpha coefficient for each domain as well as for the total score. Primary emphasis was placed on the domain scores because inter-item consistency was expected to vary among items from different domains. Item-total correlations were also computed in order to examine the correlation between each item and the respective total domain score. A confirmatory factor analysis on the BTSCA test scores was conducted to further demonstrate construct validity.

Phase Three. Hypothesis 1 predicted that the SZ group would perform significantly worse than the NC group on the total and domain scores of the BTSCA. A univariate analysis of covariance (ANCOVA) examined group differences between the SZ and NC groups with group as a between subjects variable, BTSCA total score serving as a within subjects variable, and age as a covariate.

A mixed-model ANCOVA was then used to compare the groups on the three social cognitive domains of the BTSCA. Prior to the analysis, domain scores were calculated to account for the fact that the tests are on different scales of measurement. Domain scores were calculated by first calculating the average correct for each test, then summing the average correct for the tests relevant to the domain and dividing by the total number of tests (i.e., SP domain score = [average correct items on the SFRT test + average correct items on the PA test] / 2). Group served as a between subjects variable, domain scores served as within subjects variables, and age was a covariate. Following a significant result, follow-up univariate ANCOVAs for each domain were used to test post-hoc comparisons. Given the results of these analyses, we also examined the ability of the BTSCA total and domain scores to discriminate between the SZ and NC groups using receive operating characteristic (ROC) analyses.

Hypothesis 2 predicted that scores on the BTSCA would be moderately correlated with clinical symptom ratings in the SZ group and that these correlations would be higher for negative symptoms compared to positive symptoms. In order to test this hypothesis, correlation coefficients were calculated for the BTSCA total score and the total and symptom category SAPS and SANS scores. Additionally, correlation coefficients were examined for the three domain scores and the SAPS, SANS, and BPRS total and symptom category scores.

Hypothesis 3 predicted that scores on the BTSCA and UPSA would be correlated in the SZ group. In order to test hypothesis 3, correlation coefficients were calculated between the BTSCA total and subtest scores and the UPSA subtest scores. As a secondary exploratory analysis, we examined the relative ability of the BTSCA and the MoCA to predict UPSA performance in the SZ group. Examination of correlation coefficients between the MoCA and the BTSCA indicated that the two measures were highly correlated. Therefore, we conducted one simple regression with MoCA as the predictor variable and a separate simple regression with BTSCA as the predictor variable. Given that this was exploratory in nature, we did not have a priori hypotheses.

CHAPTER 4: RESULTS

Phase One.

As stated above, we sought to select items to include on the BTSCA that would assess the social cognitive domains of Emotion Recognition (ER), Social Perception (SP), and Theory of Mind (ToM) by examining archival data of normal controls (NC) and individuals with schizophrenia (SZ) who had previously been assessed on tests of social cognition in our lab. For each of the aforementioned domains, item-level performance on tests identified in the literature as assessing the relevant domain were examined and results are reported below (see Table 1 for brief description of tasks). Item level accuracy data for items ultimately included in the BTSCA can be found in Table 2.

Selection of Emotion Recognition Items. In order to select items that are sensitive and specific to ER deficits in SZ, we first examined performance of 50 NCs and 25 SZs who had previously been administered the BLERT. We calculated sensitivity and specificity values for the three visual-only items in each emotional condition of the BLERT (happy, sad, anger, disgust, neutral, surprise).

In the happy condition, none of the NCs missed any of the items, resulting in 100% specificity. Intuitively, sensitivity was poor with the highest value being .32. Similarly, items in the anger condition had good specificity (.80 to 1.00), but poor sensitivity (.14 to .20), indicating that the BLERT items in these conditions were relatively easy for both the NC and SZ groups. In contrast, two out of three items in the fear condition had adequate sensitivity (.68 to .78) but low specificity (.24 to .44), indicating that these items were relatively difficult for both groups. Items in the sad condition and two out of three items in the neutral condition had good specificity with values ranging from .80 to .88, and while their sensitivity values (.46 to .48) were higher

compared to the items in the happy and anger conditions, they still did not rise to an acceptable level. Similarly, two out of the three items in the disgust condition had adequate specificity (.72 to .80) but low sensitivity (.54 to .56). Lastly, one item from the fear condition (sensitivity =.68; specificity = .64), one item from the disgust condition (sensitivity = .70; specificity = .60), and one item from the neutral condition (sensitivity = .62; specificity = .72) had values approaching acceptable levels of sensitivity and specificity.

Given that the BLERT items require participants to watch videotaped vignettes and so could not be directly included on the BTSCA, we also examined item-level data from 65 controls who were administered the FIAT. The stimuli used for the FIAT were taken from the Penn Affect Recognition pictures (Gur et al., 2002), which is the stimuli set ultimately used to select items assessing ER for the BTSCA. Prior studies in our lab have examined performance on the FIAT in individuals with bipolar disorder and normal controls, but not on individuals with schizophrenia. As a result, we examined the percentage of the NC group that answered each item correct in the same emotional categories that are assessed with the BLERT. The results are discussed by emotional category below.

Consistent with findings from the BLERT, the happy items were easy for the NC group as evidenced by greater than 98% of the group getting each item correct, regardless of high or low intensity expression of emotion in the photograph. Additionally, items in the neutral condition resulted in correct responses in between 72% and 99% of NCs. Examination of the sad and fear items in the high intensity conditions also indicated that the items were easy for NCs, as greater than 80% of the NC group got these items correct. The anger and disgust items in high intensity condition were more variable, with percent correct ranging from 55% to 70% in the anger condition and 25% to 85% in the disgust condition. In the low intensity conditions,

performance was much more variable in the sad, disgust, and angry conditions. Percentage of NCs getting low intensity items correct ranged from 30% to 86% in the sad condition, 20% to 89% in the disgust condition, and 7% to 62% in the anger condition. Lastly, items in the low intensity fear condition resulted in poor performance in the NC group, with only between 2% an 28% of individuals getting the items correct.

In summary, both the BLERT and the FIAT evidenced that items assessing the recognition of happiness were easy for both groups. However, given that examination of performance on items from the other emotional categories was variable, we decided to include four items from each emotional category (happiness, sadness, fear, anger, disgust, neutral) on the BTSCA in order to get an adequate sample of items that could be used to examine ER. Within each emotion category, we included two male faces and two female faces, and included individuals of differing ethnicities. These items will be referred to as "Faces" in the reminder of the paper.

Selection of Social Perception items. In order to select items that are sensitive and specific to SP deficits in SZ, we examined item-level data from the SFRT and PA tasks. The SFRT was previously administered to 50 individuals with schizophrenia and 24 normal controls. As stated above, the SFRT asks participants to choose correct goals and actions usually associated with five familiar situations and five unfamiliar situations. In order to calculate sensitivity and specificity, action scores were dichotomized as correct if 4-6 correct actions were identified. This same criterion was used to dichotomize the goal scores. With the exception of one familiar situation that resulted in low specificity (.50) and low sensitivity (.40) in correctly identified goals and one familiar situation that resulted in low specificity (.20) in correctly identified actions, the remaining situations had relatively high specificity and low sensitivity.

Therefore, we decided to include the four unfamiliar situations, as literature has shown that individuals with SZ have particular difficulty correctly identifying actions and goals in unfamiliar situations (Corrigan, Bulcan, & Toomey, 1996).

Item performance of 50 SZ and 24 NC on the PA task were next examined. On the PA task, items are scored on a scale of 0-2. Scores were dichotomized so that a score of 1 or 2 was considered correct. Out of 10 items, three had low specificity values ranging from .24 to .50, and were not chosen for inclusion on the BTSCA. Of the remaining seven items, three items with specificity values >.95 were retained for the BTSCA. A final item with a specificity of .61 and a sensitivity of .92 was also chosen in order to ensure that social perception items also reflected items of difficulty for the NC group (see Table 2).

Selection of Theory of Mind items. To select items that are sensitive and specific to ToM deficits in SZ we examined item-level data from the Hinting and Eyes tasks. The Eyes task was administered to 25 NC and 50 SZ. As was true in selecting items assessing ER, we sought to include both male and female stimuli from the Eyes task. Examination of the item-level accuracy information on items depicting male eyes, four items had specificity >.90 and sensitivity >.40 and were included in the BTSCA. Six of the items depicting eyes of a female had specificity >.90. We chose to retain the four items that also had the highest sensitivity, which ranged from .36 to .60 (see Table 2). Lastly, items from the Hinting task were examined in a sample of 22 normal controls and 50 individuals with SZ. Given that Hinting task items are scored on a scale from 0-2, scores of 1 and 2 were collapsed and scored as correct in order to dichotomize scores. Two items were dropped because of low specificity values of .35 and 75. Given that the remaining six items all showed good specificity, the four items with the highest sensitivity values were chosen to include on the BTSCA. Table 2 shows the items included on the initial version of

the BTSCA, along with accuracy information by group. However, items from the FIAT are not included due to having no SZ group to compare NC data to. Therefore, in addition to the items listed in Table 2, there are 24 Faces items were also included on the BTSCA.

Table 2.

Item-level accuracy information of items included on the BTSCA by Group

Item	SZ	NC		
	% Incorrect	% Incorrect	Sensitivity	Specificity
SFRT				
Item 1 Actions	18.0	0.0	.18	1.00
Item 1 Goals	22.0	0.0	.22	1.00
Item 2 Actions	44.0	15.0	.44	.85
Item 2 Goals	64.0	35.0	.64	.65
Item 3 Actions	20.0	10.0	.20	.90
Item 3 Goals	28.0	10.0	.28	.90
Item 4 Actions	28.0	5.0	.28	.95
Item 4 Goals	28.0	10.0	.28	.90
PA				
Item 1	38.6	4.0	.39	.96
Item 2	61.4	12.0	.61	.88
Item 3	54.5	0.0	.55	1.00
Item 4	91.7	30.4	.92	.70
Eyes				
Item 1	56.0	8.0	.56	.92
Item 2	36.0	4.0	.36	.96
Item 3	36.0	4.0	.36	.96
Item 4	46.0	4.0	.46	.96
Item 5	58.0	8.3	.58	.92
Item 6	38.0	4.0	.38	.96
Item 7	40.0	4.0	.40	.96
Item 8	60.0	4.0	.60	.96
Hinting				
Item 1	16.0	0.0	.16	1.00
Item 2	30.0	0.0	.30	1.00
Item 3	36.0	9.1	.36	.90
Item 4	18.0	0.0	.18	1.00

Note. BTSCA = Brief Test of Social Cognitive Abilities; NC = Normal Control; SZ = Schizophrenia; SFRT = Situational Features Recognition Test; PA = Picture Arrangement test; Eyes = Reading the Eyes in the Mind test; Hinting = Hinting test. Accuracy information not available for the 24 items used to assess emotion recognition on BTSCA.

Phase Two.

The BTSCA, which includes the items that were selected in phase one, was administered to 74 undergraduates (UGS), 30 normal controls, and 29 individuals with schizophrenia. There was a lack of variability in the UGS data, which is to be expected given that the BTSCA was designed to detect impairment rather than quantify levels of performance within the general population. In other words, most undergraduates would be expected to perform at near perfect levels on the BTSCA. Only those with social cognitive deficits would be expected to reliably fail BTSCA items. Based on this consideration, item-level reliability analyses on the BTSCA scores were calculated for the entire sample (UGS, NC, SZ).

Internal Consistency Reliability. Results of the item level reliability analyses are presented in Tables 3-6. Internal consistency reliability of the BTSCA was examined using Cronbach's alpha coefficient for each domain score (ER, SP, ToM) as well as for the BTSCA total score. Internal consistency reliability for the BTSCA total score was good, as measured by standardized alpha (.85) and coefficient alpha for consistency agreement (α = .83, 95% CI [.78, .87]). Corrected item-total correlations and alpha-if-item deleted values were calculated to assess whether items on the BTSCA could be revised or removed to increase internal consistency. Notably, one item depicting a happy emotion was dropped from the analysis because it had zero variance (i.e., every participant got it correct). Corrected-item-total-correlations suggested that one sad item from the Faces test was negatively correlated (r=-.08) with the total BTSCA score, and the remaining corrected-item-total correlations ranged from .01 to .51, suggesting that there are several items that could be considered for removal if the scale is measuring a single construct. However, alpha-if-item deleted values ranged from .82 to .84, suggesting that Cronbach's alpha would decrease or stay the same if individual items were deleted from the measure (see Table 3). Cronbach's alpha, corrected item-total correlations, and

alpha-if-item-deleted values were also calculated for items thought to assess ER (Table 4), SP (Table 5), and ToM (Table 6) separately.

Internal consistency reliability for the ER items was poor (Table 4), as measured by standardized alpha (.65) and coefficient alpha for consistency agreement (α = .59, 95% CI [.48, .68]). Item analyses resulted in six items being flagged for removal based on alpha-if-item deleted that would have results in more than minimal improvement in alpha. These items included two items in the sad condition, one item in the disgust condition, and one item in the anger condition, and one item from the happy condition. In addition, one item conveying happy emotion was not included in the analysis because all participants got it correct, and thus there was no variability. Removal of these items indicated Cronbach's alpha would be improved to r = .69. Given that happy and sad emotions are the most accurately identified emotions in normal and clinical populations, it could be anticipated that near perfect performance would be attainted on these items in the present sample. However, since these emotion categories may have special significance for some clinical disorders (e.g., depression), these items were retained in the scale so that it might be useful for assessing clinical disorders whose primary symptoms might negatively impact performance on the items.

Table 3.

Item Analysis to Improve Internal Consistency for the BTSCA scale

Item	Alpha-if-item-deleted	Corrected Item-Total Correlation
Faces Item 1: Fear	.83	.17
Faces Item 2: Anger	.82	.21
Faces Item 3: Neutral	.82	.20
Faces Item 4: Disgust	.82	.34
Faces Item 5: Happy	.83	.42
Faces Item 6: Disgust	.82	.37
Faces Item 7: Sad	.83	.25
Faces Item 8: Anger	.82	.36
Faces Item 9: Happy	. 83	.07
Faces Item 10: Neutral	.83	.26
Faces Item 11: Neutral	.83	.45
Faces Item 12: Sad	.83	.33
Faces Item 13: Anger	.83	.45
Faces Item 14: Disgust	.83	.01
Faces Item 15: Neutral	.83	.30
Faces Item 16: Anger	.83	.14
Faces Item 18: Sad	.83	.17
Faces Item 19: Fear	.82	.35
Faces Item 20: Happy	.83	.10
Faces Item 21: Fear	.82	.36
Faces Item 22: Anger	.83	.10
Faces Item 23: Sad	.83	-.08
Faces Item 24: Disgust	.83	.24
SFRT Item 1: Actions	.82	.51
SFRT Item 1: Goals	.86	.34
SFRT Item 2: Actions	.82	.48
SFRT Item 2: Goals	.84	.20
SFRT Item 3: Actions	.82	.56
SFRT Item 3: Goals	.82	.45
SFRT Item 4: Actions	.82	.42
SFRT Item 4: Goals	.82	.47
PA Item 1	.82	.47
PA Item 2	.82	.47
PA Item 3	.82	.35
PA Item 4	.83	.10
Eyes Item 1	.83	.19
Eyes Item 2	.83	.30
Eyes Item 3	.82	.47
Eyes Item 4	.83	.27
Eyes Item 5	.83	.26
Eyes Item 6	.82	.40
Eyes Item 7	.82	.30
Eyes Item 8	.82	.29
Hinting Item 1	.83	.27
Hinting Item 2	.82	.31
Hinting Item 3	.82	.38
Hinting Item 4	.83	.25

Note. Coefficient alpha for the 48-item scale was .83. SFRT = Situational Features Recognition Test; PA = Picture Arrangement; Eyes = Reading the Eyes in the Mind Test; Hinting = Hinting Test Item 23 from the Faces test was removed from the analysis due to zero variance.

Table 4.

Item Analysis to Improve Internal Consistency for Emotion Recognition domain

Item	Alpha-if-item-deleted	Corrected Item-Total Correlation
Faces Item 1: Fear	.57	.22
Faces Item 2: Anger	.58	.14
Faces Item 3: Neutral	.57	.28
Faces Item 4: Disgust	.56	.31
Faces Item 5: Happy	.57	.31
Faces Item 6: Disgust	.56	.26
Faces Item 7: Sad	.57	.21
Faces Item 8: Fear	.56	.33
Faces Item 9: Happy	.59	.07
Faces Item 10: Neutral	.57	.20
Faces Item 11: Neutral	.56	.34
Faces Item 12: Sad	.56	.31
Faces Item 13: Anger	.56	.37
Faces Item 14: Disgust	.61	-.03
Faces Item 15: Neutral	.57	.28
Faces Item 16: Anger	.59	.10
Faces Item 18: Sad	.57	.20
Faces Item 19: Fear	.56	.27
Faces Item 20: Happy	.59	.03
Faces Item 21: Fear	.55	.35
Faces Item 22: Anger	.58	.13
Faces Item 23: Sad	.61	-.07
Faces Item 24: Disgust	.58	.16

Note. Coefficient alpha for the 23-item scale was .59. Item 23 was removed from the analysis due to zero variance.

Internal consistency reliability for the SP items was the highest of the three domains and in the acceptable range, as measured by standardized alpha (.75) and coefficient alpha for consistency agreement (α = .74, 95% CI [.67, .80]). Because the SFRT took a relatively long time to administer, scores for Action and Goal items were examined to determine whether either could be excluded from the SP domain to decrease redundancy and increase efficiency of the test. Comparisons between the NC and SC group suggest that the action items provided better

discrimination, F (1,57) = 13.11, p < .005, compared to the goal items, F (1,57) = 1.58, p = .21, so the action items were retained in the final version of the BTSCA. Item analyses also indicated one picture arrangement item had a small item-total-correlation (r=.03), though alpha-if-item deleted values indicate that removal of the item would result in minimal improvement in overall alpha (Table 5).

Internal consistency reliability for the ToM items was in the questionable range as measured by standardized alpha (.70) and coefficient alpha for consistency agreement (α = .69, 95% CI [.60, .76]). Item-total correlations ranged from .20 to .47, though alpha-if-item deleted values indicate that removal of items would result in overall alpha being the same or very minimally higher (see Table 6).

Table 5.

Item Analysis to Improve Internal Consistency for Social Perception domain

Item	Alpha-if-item-deleted	Corrected Item-Total Correlation
PA Item 1	.46	.49
PA Item 2	.49	.48
PA Item 3	.41	.51
PA Item 4	.15	.60
SFRT Item 1: Actions	.17	.58
SFRT Item 1: Goals	.26	.56
SFRT Item 2: Actions	.36	.55
SFRT Item 2: Goals	-.01	.61
SFRT Item 3: Actions	.26	.57
SFRT Item 3: Goals	.22	.58
SFRT Item 4: Actions	.33	.43
SFRT Item 4: Goals	.25	.20

Note. Coefficient alpha for the 12-item scale was .74

Table 6.

Item Analysis to Improve Internal Consistency for Theory of Mind domain

Item	Alpha-if-item-deleted	Corrected Item-Total Correlation
Eyes Item 1	.67	.30
Eyes Item 2	.68	.25
Eyes Item 3	.66	.44
Eyes Item 4	.67	.33
Eyes Item 5	.67	.36
Eyes Item 6	.67	.28
Eyes Item 7	.66	.36
Eyes Item 8	.67	.29
Hinting Item 1	.67	.33
Hinting Item 2	.64	.47
Hinting Item 3	.65	.43
Hinting Item 4	.69	.20

Note. Coefficient alpha for the 12-item scale was .69

Confirmatory Factor Analysis. Based on the results of the item analysis, EQS Version 6.2 (Bentler & Wu, 2012) was used to conduct confirmatory factor analysis (CFA) to examine the latent variables of the social cognitive measures in the total sample. Three models were examined and these models are presented in Table 7. The one-factor model (M1) was examined to determine whether the BTSCA items were best understood as evaluating one general social cognitive latent construct. The three-factor model (M3) examined whether the social cognitive measures were assessing the three hypothesized latent constructs of social perception (SP), theory of mind (ToM), and emotion recognition (ER). The hierarchical model included three first-order factors representing SP, ToM, and ER, as well as a second order social cognition factor. This model was evaluated to determine whether including a second order social cognition construct would better account for the relationships among the first order factors.

Table 7.

Confirmatory factor analysis models for the social cognitive measures

Variable	M1	M3	HM	
			1st order	2nd order
Social Perception (SP)				
SFRT Total Actions	1	1	1	1
Picture Arrangement Total	1	1	1	1
Theory of Mind (ToM)				
Hinting Total	1	2	2	1
Eyes Total	1	2	2	1
Emotion Recognition (ER)				
Faces Total	1	3	3	1

Note. M1 = one-factor model M3 = three-factor model, HM = Hierarchical model; SFRT = Situational Feature Recognition Test

Summary scores were calculated on the raw scores for each of the social cognitive measures on the BTSCA and these scores were used in the analyses. For factor three, ER, one score was specified to load by itself on the factor. There has been extensive discussion about the validity of models with single items serving as a lone factor indicator. Hayduk and Littvay (2012) have argued that single indicator factors are not only possible but desirable for development of complex theory-driven latent variable models, as was the case for the current study. Because it is not possible to simultaneously estimate a measurement error variance and the factor variance for single indicator factors, the factor loading for this single-item indicator was fixed at 1 and the factor variance was fixed at 0 to allow the residual measurement error variance to be estimated.

In order to evaluate model fit a number of fit indices were examined including the Chi-square (χ^2), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Akaike's Information Criterion (AIC). The model χ^2 reflects the degree of agreement

between the hypothesized model and the actual data (Hu & Bentler, 1999). The CFI provides an indication of incremental model fit by comparing the hypothesized model to the independence model (Bentler, 1990). The RMSEA is a parsimony index that reflects fit between the hypothesized model and the population covariance matrix (Steiger, 1990). The AIC is a relative fit index that reflects model parsimony by taking into account model complexity based on degrees of freedom (Akaike, 1987). While cut offs for each of these scores are debated, generally accepted values that provide evidence of good model fit include a χ^2 value that is not statistically significant (Hoyle, 2000), CFI values greater than or equal to .95, and an RMSEA less than or equal to .06 (Hu & Bentler, 1999). For the AIC, lower values indicate better model fit (Akaike, 1987) so the lowest value was used to determine optimal model fit.

Due to violation of multivariate normality as indicated by a Mardia's coefficient greater than 3 (Mardia, 1970), robust estimation procedures were used for the CFA. Results are presented in Table 8. All models provided excellent fit of the data as indicated by non-significant χ^2 values, CFI's greater than .95, and RMSEA's less than .06. The AIC values for these models were also relatively small. The three-factor and hierarchical models provided better fit of the data based on the χ^2 value when compared to the one-factor model. The hierarchical model had a slightly smaller AIC compared to the three-factor model, and the three-factor model had a smaller χ^2 value compared to the hierarchical model. Although each model has strengths, the three-factor model is preferred because it is more parsimonious than the HM model and has a stronger theoretical basis than the one-factor model. As seen in Table 8, items in the three-factor model exhibited good to excellent loadings on their respective factors, ranging from .55 – 1.0.

Table 8.

Confirmatory factor analysis results for the social cognitive measures

Model	*S-B*χ^2	*CFI*	*RMSEA* [90%CI]	*AIC*
1 factor model	3.69*	1.00	.000[.000-.103]	-6.31
3 factor model	1.26*	1.00	.000[.000-.104]	-4.74
Hierarchical model	1.69*	1.00	.000[.000-.118]	-4.31

Note. *$p > .05$. $N = 132$; *S-B*χ^2 = Satorra-Bentler scaled chi-square; *CFI* = comparative fit index; *RMSEA* = root mean square error of approximation; *AIC* = Akaike's information criterion

Table 9.

Factors and variable loadings

Variable	SP factor	ToM factor	ER Factor
Social Perception (SP)			
SFRT Total Actions	.55	--	--
Picture Arrangement Total	.55	--	--
Theory of Mind (ToM)			
Hinting Total	--	.57	--
Eyes Total	--	.78	--
Emotion Recognition (AR)			
Faces Total	--	--	1.00

Note. SFRT = Situational Feature Recognition test; SP = Social Perception; ToM = Theory of Mind; ER = Emotion Recognition

Phase Three.

Given support for the three-factor model composed of SP, ToM, and ER factors that was identified in phase two of the study, the third phase of the study focused on group differences in BTSCA performance between the NC and SZ group.

Preliminary analyses.

Demographic Differences. Demographic variables for the study group are presented in Table 10. Age, years of education, and estimated full scale IQ were compared between groups using a one-way ANOVA (Table 10). Results indicated that the SZ group was significantly older, had fewer years of education, and had a lower IQ than the NC group. Gender and ethnicity were compared between groups and no significant gender or ethnicity differences were found (Table 10). Based on these results, correlational analyses were used to examine the relationship between age and outcome variables in the main analyses and age was included as a covariate in subsequent analyses. Although the SZ group also had significantly less education and lower IQ scores than the NC group, we normally see differences in years of education and IQ between those with SZ and NCs and do not control for these variables, as they would essentially be controlling for the independent variable of interest (group).

Table 10.

Demographic Information by Group

Variable	Group		*F*	*p*
	NC	SZ		
	Mean (*SD*)	Mean (*SD*)		
Age (years)	36.1 (11.6)	45.8 (9.1)	13.13	<.05
Education (years)	14.3 (2.4)	11.73 (2.2)	3.79	<.001
Estimated IQ	106.5 (14.7)	84.9 (17.0)	28.01	<.001
			χ^2	*p*
Gender (% male)	61.3	76.7	1.68	.20
Ethnicity (%)			0.84	.69
Caucasian	58.1	46.7		
African American	19.4	26.7		
Other	22.6	26.7		

Note. NC = normal control; SZ = schizophrenia

Symptom Differences. BPRS, SAPS, and SANS total and symptom category scores were compared between groups using a one-way ANOVA (see Table 11). Significant group differences were found on total and symptom category scores as expected, indicating that the SZ group was currently (within the past two weeks) experiencing more general, positive and negative symptoms than the NC group. Symptom scores suggest that the schizophrenia group was experiencing mild to moderate symptoms at the time of the evaluation.

Table 11.

Symptom Ratings by Group.

Variable	Group		*F*	*p*
	NC	SZ		
	Mean (*SD*)	Mean (*SD*)		
BPRS				
Thought Disturbance	4.1 (0.3)	11.1 (4.8)	61.05	<.001
Anergia	4.6 (1.6)	7.2 (3.6)	13.30	.001
Affect	7.1 (2.1)	10.9 (4.2)	18.93	<.001
Disorganization	3.2 (0.5)	4.8 (2.0)	16.81	<.001
Total	21.3 (2.9)	38.1 (9.3)	86.76	<.001
SAPS				
Hallucinations	0.0 (.0)	4.6 (4.1)	37.43	<.001
Delusions	0.0 (.0)	7.7 (8.8)	23.03	<.001
Bizarre Behavior	0.1 (.3)	0.9 (1.1)	16.80	<.001
Thought Disorder	0.5 (1.5)	4.3 (4.8)	17.80	<.001
Total	0.6 (1.7)	23.4 (17.2)	52.34	<.001
SANS				
Emotional Expressivity	0.1 (0.3)	0.8 (0.9)	18.95	<.001
Motivation/Pleasure	0.1 (0.2)	1.3 (0.9)	51.45	<.001
Total	3.3 (6.1)	32.0 (19.9)	56.82	<.001

Note. NC = normal control; SZ = schizophrenia; BPRS = Brief Psychiatric Rating Scale; SAPS = Scale for the Assessment of Positive Symptoms; SANS = Scale for the Assessment of Negative Symptoms

Main Analyses.

Hypothesis 1: Group differences on BTSCA. Hypothesis 1 predicted that the SZ group would perform significantly worse than the NC group on the total and domain scores of the BTSCA. Table 12 contains descriptive statistics for the BTSCA score and F values for group comparisons. Given that our preliminary results revealed significant age differences between groups, the relationship between age and BTSCA total score was examined and a significant correlation was found, $r = -.31$, $n = 59$, $p < .05$. As a result, age was included as a covariate in the analysis. A one-way ANCOVA (see Table 12) with diagnosis as the between subjects variable, BTSCA total score as the within subjects variable, and age as the covariate, was used to test hypothesis 1. Results indicated that the SZ group performed significantly worse than the NC group on the BTSCA total score, F (1,56) = 28.49, $p < .001$, $\eta^2 = .337$.

Given the results of the ANCOVA for the BTSCA total score, we chose to further examine group differences on the Emotion Recognition (ER), Social Perception (SP), and Theory of Mind (ToM) factors identified in the CFA. While we hypothesized that individuals with SZ would likely do worse than NCs on tests comprising the BTSCA, we did not make specific hypotheses regarding domain scores because the BTSCA factor structure was not identified. Given the results of the factor analysis, we chose to examine group differences on the Emotion Recognition (ER), Social Perception (SP), and Theory of Mind (ToM) factors of the BTSCA. Factor analysis domain scores were calculated for each factor by first calculating the percentage correct for each test (Faces, SFRT, PA, Hinting, Eyes). The percent correct for each test was calculated because the tests have different scales of measurement which would results in differential weighting of each test to the total factor score if raw scores were simply summed.

The percent correct test score for Faces was used as the ER domain score, since this domain was assessed only by that test. The average of the percent correct for the SFRT and PA tests was used as the SP domain score. The average of the percentage correct for the Hinting test and Eyes Tests were used for the ToM domain score. This method of calculating factor scores was preferred over other methods (e.g., regression based factor scores) because it has direct application in clinical settings where average scores can be easily calculated and interpreted.

Mixed model ANCOVA was used to examine differences between the SZ and NC groups on the ER, SP, and ToM social cognition factor scores. In this ANCOVA, group served as the between subjects variable and BTSCA domain (ER, SP, ToM) was the within subjects variable. Given the significant age differences between the groups, we examined the relationship between the domain scores and age and found a significant correlation in the ER (r = -.32, n = 59, p < .05), SP (r = -.49, n = 59, p <.001), and ToM (r = -.28, n = 59, p <.05) domains. As a result, age was included as a covariate in the analyses. Results of the analysis indicated a significant main effect for group, F (1, 56) = 28.49, p < .001, η^2 = .337, and a significant group by BTSCA domain interaction effect, F (1,56) = 3.09, p < .05, η^2 = .05, although the main effect for social cognition domain was not significant, F (1,56) = 2.20, p = .12, η^2 = .038, nor was the main effect for age, F(1,56) = 2.74, p = .103, η^2 = .047.

The social cognitive domain by group interaction effect is presented in Figure 1. The scores presented in Figure 1 are standardized (z) scores that were calculated based on the mean and SD from the control group for each of the social cognitive domains. These scores were calculated because they allow for comparisons based on absolute differences between groups and across social cognitive domains. In the figure, the SZ participants scores for each social cognitive domain are compared to the NC groups performance in a standardized manner, with

the NC groups performance set to a mean = 0 and a SD = 1, making discernable the magnitude of differences between groups on each social cognitive measure and the differences between performance on the social cognitive measures within the schizophrenia groups. Examination of between group differences for each social cognitive domain indicated significant differences between groups on each domain, with the schizophrenia group performing worse than controls (see Table 12). To compare social cognitive domains within the SZ group, a repeated measures ANOVA of the standard scores for each domain was conducted. Results indicated a significant overall effect for social cognitive domain, F (2,56) = 4.89, $p < .05$, $\eta^2 = .149$. Contrasts indicated that the ToM domain was significantly different from the ER domain, $F(1,28) = 5.83$, $p < .05$, $\eta^2 = .172$, and the SP domain, F (1,28) = 5.83, $p < .05$, $\eta^2 = .172$. Considered together, these findings suggest that the interaction effect was due to relatively greater impairment on the ToM domain compared to ER and SP domains in participants with SZ when compared to NCs.

Table 12.

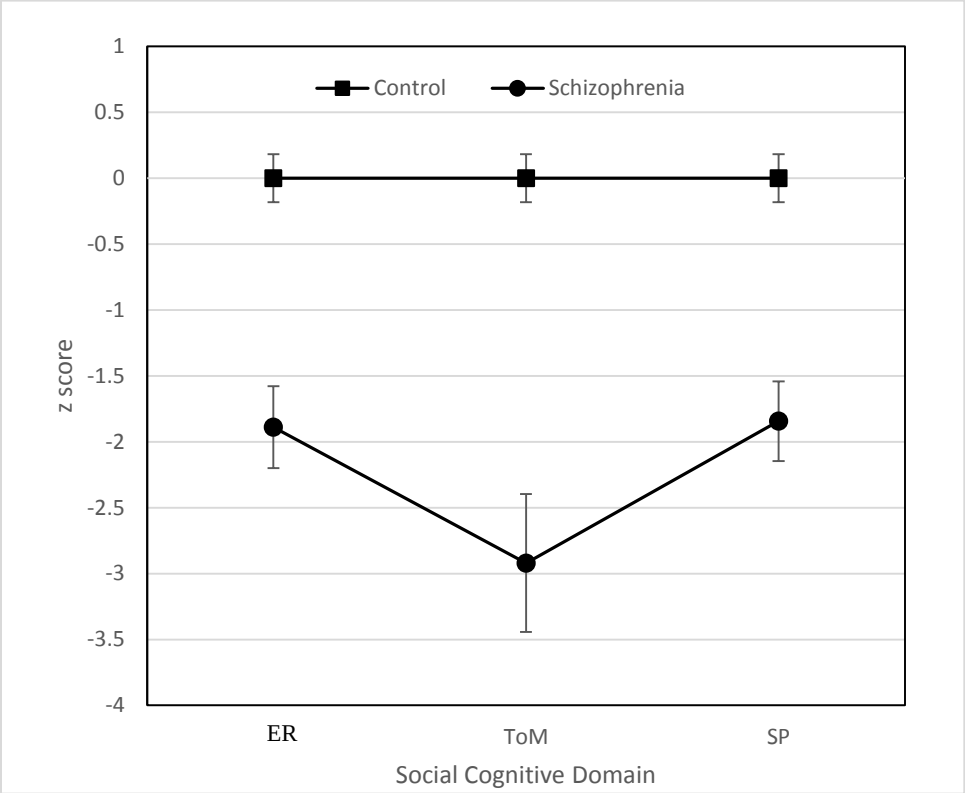
BTSCA Descriptive Information by Group

BTSCA Variable	Group				
	Control		Schizophrenia		
	Mean[a] (*SE*)	% Correct [a] (SE)	Mean[a] (*SE*)	% Correct [a] (SE)	*F*
BTSCA Total	62.1 (1.3)	83.6 (2.2)	52.3 (1.6)	66.5 (2.2)	28.71**
ER Domain	20.7 (.40)	86.3 (1.7)	18.0 (.41)	75.1 (1.7)	20.06**
Faces Total	20.7 (.40)	86.3 (1.7)	18.0 (.41)	75.1 (1.7)	20.06**
SP Domain	27.8 (.66)	80.7 (2.8)	24.3 (.67)	64.7 (2.8)	14.96**
SFRT Total	23.3 (.50)	92.9 (2.1)	20.5 (.50)	85.5 (2.1)	5.83*
PA Total	5.5 (.40)	68.4 (4.9)	3.5 (.40)	43.9 (5.4)	11.01*
ToM Domain	13.7 (.49)	85.3 (3.1)	10.2 (.50)	63.9 (3.1)	21.76**
Eyes Total	7.2 (.30)	90.4 (3.7)	5.5 (.31)	68.7 (3.8)	15.92**
Hinting Total	6.41(.30)	80.17 (3.7)	4.78 (.30)	59.74 (3.9)	13.57**

Note. [a]Means reported are estimated marginal means controlling for age; * $p > .05$; ** $p > .001$; CN = controls; SZ = schizophrenia; BTSCA = Brief Test of Social Cognitive Abilities; ER = Emotion Recognition; SP = Social Perception; ToM = Theory of Mind; PA = Picture Arrangement

Figure 1.

Interaction effect for Social Cognitive Domain by Group



Note. ER = Emotion Recognition; ToM = Theory of Mind; SP = Social Perception; Scores are standardized (z) scores calculated based on the mean and SD from the control group for each domain.

Although not originally proposed as part of the dissertation, given support from the ANCOVA for social cognitive domain and total score differences between the SZ and NC groups, examination of each scores' ability to discriminate between groups was further examined using receiver operating characteristic (ROC) analyses. ROC analyses allow for examination of score differences in sensitivity, specificity, positive and negative predictive values, positive and negative likelihood ratios, and a number of other indices of classification. In the current study, ROC analyses were accomplished using the NC group as the control. The three social cognitive domain scores (ER, ToM, SP) and the BTSCA total score were entered simultaneously into the

ROC analyses. The area under the curve (AUC) was used to determine each test score's ability to distinguish between the groups. An AUC of 1.0 indicates perfect classification, and an AUC of 0.5 indicates classification that is no better than chance (Hosmer & Lemeshow, 2000). Thus, a larger AUC associated with a particular BTSCA score indicated increased predictive discrimination between participants with schizophrenia and normal controls. Comparisons between the AUCs for each of the social cognitive domains were used to determine significant differences in the AUCs according to the method described by Hanley and McNeil (1983).

Results of the ROC analyses are presented in Figure 2 and Table 13. Figure 2 presents the ROC curves and Table 13 contains the AUCs, standard error of the AUCs, 95% confidence intervals and asymptotic significance levels for each AUC. The asymptotic significance level provides an indication of the degree to which each score is able to improve over chance prediction. All domain scores demonstrated good classification accuracy based on AUC's greater than .80, and the BTSCA total score demonstrated excellent classification with an AUC of .901. The BTSCA total score had the highest AUC, followed by the ToM, ER and SP domain scores, respectively. Asymptotic significance levels indicated the BTSCA total score and the ToM, SP, and ER domain scores provided significantly better classification than chance. Comparisons of the AUCs indicated that the BTSCA total score provided significantly better classification than the SP domain score, although there were not significant differences between the magnitude of the AUCs for the other score comparisons (see Table 14). Also, while the ROC analyses reported here are for the 59 NC and SZ participants which were the focus of the previous ANCOVA, comparable analyses were conducted that combined all the UGS participants with the NC participants into one group, and compared that group's performance to the SZ group (these results are not presented). Results were highly similar regarding classification accuracy, albeit

somewhat lower, for each of the BTSCA scores, e.g., AUC's for the BTSCA total, ToM, AR, and SP scores were .851, .816, .807, and .744, respectively. Results for the reduced sample are presented and preferred because balanced groups are desirable for ROC analysis. Balanced groups are more closely matched on demographic variables such as age that might influence classification accuracy and they avoid distortions in classification indices that can occur when a disproportionately larger number of participants make up one of the groups of interest.

Table 13.

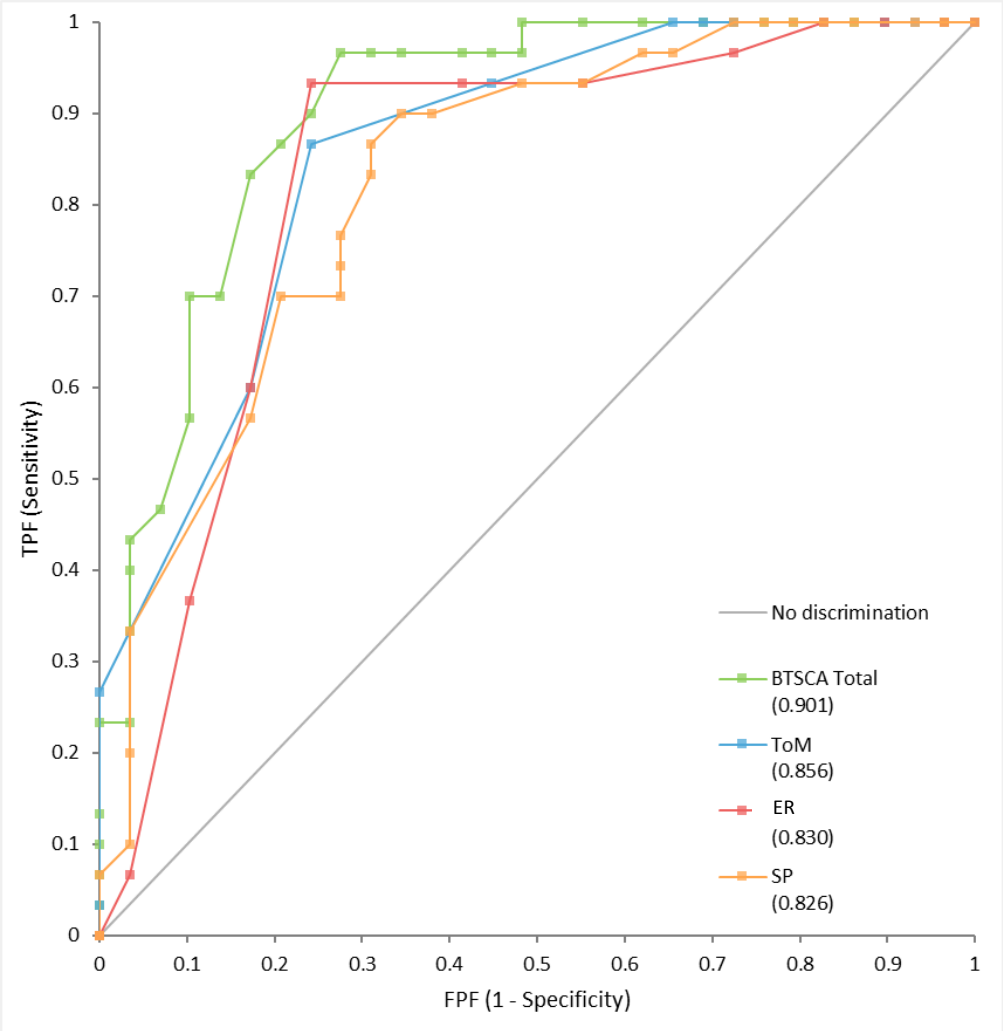
Receiver Operating Characteristic (ROC) Analyses for Social Cognitive Domains

Subscale Score	AUC	95% CI of AUC	SE of AUC	*p*
BTSCA	.901	0.820 to 0.980	.041	<0.001
ToM	.856	0.761 to 0.951	.048	<0.001
SP	.826	0.720 to 0.932	.061	<0.001
ER	.830	0.716 to 0.943	.058	<0.001

Note. BTSCA = Brief Test of Social Cognitive Abilities; ToM = Theory of Mind; SP = Social Perception; ER = Emotion Recognition.

Figure 2.

ROC curves for the BTSCA social cognitive domains and total score



Note. BTSCA = Brief Test of Social Cognitive Abilities; ToM = Theory of Mind; SP = Social Perception; ER = Emotion Recognition.

Table 14.

Receiver Operating Characteristic (ROC) Area under the ROC Curve (AUC) differences between BTSCA Total and Domain scores, Ordered from Greatest to Least Area Under the AUC

Contrast	Difference	95% CI of AUC	*SE*	*z*	*p**
BTSCA - SP	.075	.001 to .149	.038	2.00	<0.05
BTSCA - ER	.071	-.013 to .155	.043	1.66	0.10
BTSCA - ToM	.045	-.038 to .128	.042	1.06	0.29
ToM - SP	.030	-.066 to -.194	.066	0.96	0.34
AR - SP	.004	-.673 to -.912	.072	0.48	0.63
ToM - ER	.026	-.082 to -.140	.057	0.52	0.605

Note. BTSCA = Brief Test of Social Cognitive Abilities; ToM = Theory of Mind; SP = Social Perception; ER = Emotion Recognition

Tables 15-18 present the sensitivity, specificity and other classification indices for the BTSCA total score and the ER, ToM, and SP domain scores (prior probability = .49). BTSCA scores reported in the tables are percentage correct scores because these scores are more easily interpretable compared to raw scores. Positive and negative likelihood ratios are also included for the like BTSCA total score, as these ratios can aid in understanding the likelihood that a score obtained would occur in an individual with SZ. Youden's index (Sensitivity + Specificity – 1) was used to determine optimal cutoff scores, which indicated the maximum likelihood of detecting SZ while minimizing the likelihood of a false positives identifications (Youden, 1950).

As can be seen from Table 15, the optimal cut-off score for the BTSCA total score was 76. This score had a sensitivity of .97, a specificity of .78, a positive likelihood ratio (LR+) of 3.46, a negative likelihood ratio (LR-) of .04, and correctly classified 50 participants (29 TP, 21 TN) or 84.7% of the sample. For ER domain score (see Table 16) the optimal cutoff score was 79. This score had a sensitivity of .93 and a specificity of .76 and also correctly classified 50 participants (28 TP, 22 TN). The optimal cutoff score for ToM was 75 (see Table 17), which had a sensitivity of .87 and a specificity of .76. It correctly classified 48 participants (26 TP, 22 TN), or 81.4% if the sample. Finally, for the SP domain (Table 18), a score of 71 provided the

best classification. This score correctly classified 46 participants (26 TP, 20 TN) or 78.0% of the entire sample.

Table 15.

Classification Accuracy Statistics and Optimal Threshold Value for the Brief Test of Social Cognitive Abilities (BTSCA) total score

BTSCA (%	TP	FP	TN	FN	Sn	Sp	PPV	NPV	LR+	LR-	YI
39	30	28	1	0	1.00	0.03	0.52	1.00	1.03	0.00	0.034
42	30	26	3	0	1.00	0.10	0.54	1.00	1.11	0.00	0.103
47	30	25	4	0	1.00	0.14	0.55	1.00	1.16	0.00	0.138
49	30	24	5	0	1.00	0.17	0.56	1.00	1.20	0.00	0.172
51	30	23	6	0	1.00	0.21	0.57	1.00	1.20	0.00	0.207
56	30	22	7	0	1.00	0.24	0.58	1.00	1.32	0.00	0.241
58	30	21	8	0	1.00	0.28	0.59	1.00	1.39	0.00	0.276
60	30	20	9	0	1.00	0.31	0.60	1.00	1.45	0.00	0.310
63	30	18	11	0	1.00	0.38	0.63	1.00	1.61	0.00	0.379
65	30	16	13	0	1.00	0.45	0.65	1.00	1.82	0.00	0.448
68	30	14	15	0	1.00	0.52	0.68	1.00	2.08	0.00	0.517
69	29	14	15	1	0.97	0.52	0.67	0.94	2.02	0.06	0.484
70	29	13	16	1	0.97	0.55	0.69	0.94	2.16	0.05	0.518
72	29	12	17	1	0.97	0.59	0.71	0.94	2.37	0.05	0.553
74	29	10	19	1	0.97	0.66	0.74	0.95	2.85	0.05	0.622
75	29	9	20	1	0.97	0.69	0.76	0.95	3.13	0.04	0.656
76	**29**	**8**	**21**	**1**	**0.97**	**0.72**	**0.78**	**0.95**	**3.46**	**0.04**	**0.691**
77	27	7	22	3	0.90	0.76	0.79	0.88	3.75	0.13	0.659
78	26	6	23	4	0.87	0.79	0.81	0.85	4.14	0.16	0.660
81	25	5	24	5	0.83	0.83	0.83	0.83	4.88	0.20	0.661
81	21	4	25	9	0.70	0.86	0.84	0.74	5.00	0.35	0.562
83	21	3	26	9	0.70	0.90	0.88	0.74	7.00	0.33	0.597
84	17	3	26	13	0.57	0.90	0.85	0.67	5.70	0.48	0.463
85	14	2	27	16	0.47	0.93	0.88	0.63	6.71	0.57	0.398
85	13	1	28	17	0.43	0.97	0.93	0.62	14.3	0.59	0.399
86	12	1	28	18	0.40	0.97	0.92	0.61	13.3	0.62	0.366
88	10	1	28	20	0.33	0.97	0.91	0.58	11.0	0.69	0.299
89	7	1	28	23	0.23	0.97	0.88	0.55	7.67	0.79	0.199
90	7	0	29	23	0.23	1.00	1.00	0.56	∞	0.77	0.233
90	4	0	29	26	0.13	1.00	1.00	0.53	∞	0.87	0.133
91	3	0	29	27	0.10	1.00	1.00	0.52	∞	0.90	0.100
92	2	0	29	28	0.07	1.00	1.00	0.51	∞	0.93	0.067
94	1	0	29	29	0.03	1.00	1.00	0.50	∞	0.97	0.033
96	0	0	29	30	0.00	1.00	-	0.49	-	1.00	0.000

Note. Optimal cutoff score appears in bold font. Base rate of schizophrenia in sample is 49.2%. TP = true positives; FP = false positives; TN = true negatives; FN = false negatives; Sn = sensitivity; Sp = specificity; PPV = positive predictive value; NPV = negative predictive value; LR+ = positive likelihood ratio; LR- = negative likelihood ratio; YI = Youden's Index.

Table 16.

Classification Accuracy Statistics and Optimal Threshold Values for the Emotion Recognition (ER) domain score

ER (% Correct)	TP	FP	TN	FN	Sn	Sp	PPV	NPV	YI
54	30	28	1	0	1.00	0.03	0.52	1.00	0.034
58	30	26	3	0	1.00	0.10	0.54	1.00	0.103
63	30	24	5	0	1.00	0.17	0.56	1.00	0.172
67	29	21	8	1	0.97	0.28	0.58	0.89	0.243
71	28	16	13	2	0.93	0.45	0.64	0.87	0.382
75	28	12	17	2	0.93	0.59	0.70	0.89	0.520
79	**28**	**7**	**22**	**2**	**0.93**	**0.76**	**0.80**	**0.92**	**0.692**
83	18	5	24	12	0.60	0.83	0.78	0.67	0.428
88	11	3	26	19	0.37	0.90	0.79	0.58	0.263
92	2	1	28	28	0.07	0.97	0.67	0.50	0.032
96	0	0	29	30	0.00	1.00	-	0.49	0.000

Note. Optimal cutoff score appears in bold font. Base rate of schizophrenia in sample is 49.2%. TP = true positives; FP = false positives; TN = true negatives; FN = false negatives; Sn = sensitivity; Sp = specificity; PPV = positive predictive value; NPV = negative predictive value; YI = Youden's Index.

Table 17.

Classification Accuracy Statistics and Optimal Threshold Values for the Theory of Mind (ToM) domain score

ToM (% correct)	TP	FP	TN	FN	Sn	Sp	PPV	NPV	YI
19	30	27	2	0	1.00	0.07	0.53	1.00	0.069
25	30	26	3	0	1.00	0.10	0.54	1.00	0.103
38	30	24	5	0	1.00	0.17	0.56	1.00	0.172
44	30	21	8	0	1.00	0.28	0.59	1.00	0.276
50	30	20	9	0	1.00	0.31	0.60	1.00	0.310
63	30	19	10	0	1.00	0.34	0.61	1.00	0.345
69	28	13	16	2	0.93	0.55	0.68	0.89	0.485
75	**26**	**7**	**22**	**4**	**0.87**	**0.76**	**0.79**	**0.85**	**0.625**
81	18	5	24	12	0.60	0.83	0.78	0.67	0.428
88	8	0	29	22	0.27	1.00	1.00	0.57	0.267
94	1	0	29	29	0.03	1.00	1.00	0.50	0.033
100	0	0	29	30	0.00	1.00	-	0.49	0.000

Note. Optimal cutoff score appears in bold font. Base rate of schizophrenia in sample is 49.2%. TP = true positives; FP = false positives; TN = true negatives; FN = false negatives; Sn = sensitivity; Sp = specificity; PPV = positive predictive value; NPV = negative predictive value; YI = Youden's Index.

Table 18.

Classification Accuracy Statistics and Optimal Threshold Values for the Social Perception (SP) domain score

SP (% correct)	TP	FP	TN	FN	Sn	SP	PPV	NPV	YI
25	30	28	1	0	1.00	0.03	0.52	1.00	0.034
33	30	27	2	0	1.00	0.07	0.53	1.00	0.069
40	30	25	4	0	1.00	0.14	0.55	1.00	0.138
42	30	24	5	0	1.00	0.17	0.56	1.00	0.172
44	30	23	6	0	1.00	0.21	0.57	1.00	0.207
46	30	22	7	0	1.00	0.24	0.58	1.00	0.241
48	30	21	8	0	1.00	0.28	0.59	1.00	0.276
54	29	19	10	1	0.97	0.34	0.60	0.91	0.311
56	29	18	11	1	0.97	0.38	0.62	0.92	0.346
58	28	16	13	2	0.93	0.45	0.64	0.87	0.382
60	28	14	15	2	0.93	0.52	0.67	0.88	0.451
63	27	11	18	3	0.90	0.62	0.71	0.86	0.521
67	27	10	19	3	0.90	0.66	0.73	0.86	0.555
71	**26**	**9**	**20**	**4**	**0.87**	**0.69**	**0.74**	**0.83**	**0.556**
73	25	9	20	5	0.83	0.69	0.74	0.80	0.523
75	23	8	21	7	0.77	0.72	0.74	0.75	0.491
77	22	8	21	8	0.73	0.72	0.73	0.72	0.457
79	21	8	21	9	0.70	0.72	0.72	0.70	0.424
81	21	6	23	9	0.70	0.79	0.78	0.72	0.493
83	17	5	24	13	0.57	0.83	0.77	0.65	0.394
85	10	1	28	20	0.33	0.97	0.91	0.58	0.299
88	6	1	28	24	0.20	0.97	0.86	0.54	0.166
96	3	1	28	27	0.10	0.97	0.75	0.51	0.066
98	2	0	29	28	0.07	1.00	1.00	0.51	0.067
100	0	0	29	30	0.00	1.00	-	0.49	0.000

Note. Optimal cutoff score appears in bold font. Base rate of schizophrenia in sample is 49.2%. TP = true positives; FP = false positives; TN = true negatives; FN = false negatives; Sn = sensitivity; Sp = specificity; PPV = positive predictive value; NPV = negative predictive value; YI = Youden's Index.

Hypothesis 2. Correlations between the BTSCA and clinical symptoms. Correlations were calculated between the BTSCA score and clinical symptomatology measured by the SAPS and SANS in the schizophrenia group, with the hypothesis that moderate correlations would be present but that these correlations would be larger for negative symptoms. Prior studies have found differing correlations among different tests of social cognition, so we also included scores from each cognitive domain of the BTSCA in the analysis. Results are presented in Table 19 and indicate that total score on the BTSCA was significantly correlated with overall negative

symptoms measured by the SANS (*r*=-.32) and with the thought disorder component of the SAPS (*r*=-.34). For the BTSCA domain scores, ToM domain score was negatively correlated with SANS total (*r*=-.36), ER domain score was significantly positively correlated with SAPS delusions (*r*=.34), and both the ER domain score (*r*=-.30) and SP domain score (*r*=-.33) were negatively correlated with SAPS thought disorder.

Table 19.

Correlations between BTSCA and Symptom Rating scores for the schizophrenia group.

Symptom Rating	BTSCA Score			
	ER	SP	ToM	Total
SANS				
Emotional Expressivity	-.15	-.17	.10	-.05
Motivation/Avolition	-.14	-.15	.12	-.03
Total	.01	-.25	-.36*	-.32*
SAPS				
Hallucinations	-.05	-.10	-.10	-.11
Delusions	.34*	.12	.28	.26
Bizarre Behavior	-.13	-.07	.14	.06
Thought Disorder	-.30*	-.33*	-.26	-.34*
Total	.05	-.12	.01	-.05

Note. $*p < .05$; $n = 29$; BTSCA = Brief Test of Social Cognitive Abilities; SANS = Schedule for the Assessment of Negative Symptoms; SAPS = Schedule for the Assessment of Positive Symptoms; BPRS = Brief Psychiatric Rating Scale; SP = Social Perception; ER = Emotion Recognition; ToM = Theory of Mind; Total = BTSCA total.

Hypothesis 3. Clinical Utility of the BTSCA. We also hypothesized that the BTSCA and UPSA would be correlated in the SZ group, demonstrating clinical utility of the BTSCA in predicting functional outcomes. Given that prior studies have reported unique relationships between certain social cognitive domains and specific functional outcomes, correlation analyses were conducted between the BTSCA total and domain scores and each of the UPSA subtest scores in the SZ group. Results of these analyses are presented in Table 20. Magnitude of

correlations suggest medium to large effects sizes for all of the BTSCA-UPSA correlations (Cohen, 1992). The BTSCA total score generally demonstrated the largest correlations with the UPSA scores, although this was not always the case. Pattern of correlations suggested that the UPSA Planning score had relatively smaller and nonsignificant correlations with all BTSCA scores, while the UPSA Household score demonstrated significant correlations that were of relatively similar magnitude for each of the BTSCA domain scores. The ToM domain was more strongly correlated with the UPSA Communication score in comparison to the SP and ER domain scores. The SP and ER domain scores demonstrated larger correlations with UPSA Transportation (and possibly Finance) scores in comparison to the ToM domain score.

Table 20.

Correlations between BTSCA and UPSA scores for the schizophrenia group.

UPSA Score	BTSCA Score			
	ER	SP	ToM	Total
Planning	.28	.33	.27	.35
Finance	.54**	.56**	.46*	.61**
Communication	.31	.36	.55**	.51**
Transportation	.56**	.46*	.27	.47*
Household	.53**	.52**	.49*	.60**
Summary	.47*	.40*	.46*	.52**

Note. *$p < .05$; ** $p < .01$; $n = 29$; USPA = UCSD Performance-Based Skills Assessment; BTSCA = Brief Test of Social Cognitive Abilities; SP = Social Perception; ER = Emotion Recognition; ToM = Theory of Mind; Total = BTSCA total.

Secondary Analysis. Finally, we conducted an initial exploratory analysis to compare the BTSCA and the MoCA in their utility of predicting functional capacity assessed by the UPSA. First, we examined the relationship between the MoCA total score and the BTSCA total and domain scores. It was found that the MoCA total score was significantly correlated with the BTSCA total score (r=.79, n = 29, p <.001). Therefore, we chose to run two separate regressions

with UPSA total score as the dependent variable. Results of these regressions indicated that performance on the MoCA (R^2 = .36, F(1,26) = 13.87, p < .001) and performance on the BTSCA (R^2 = .38, F(1,26) = 15.36, p = .001) both independently predicted performance on the UPSA.

CHAPTER 5: DISCUSSION

There is a great deal of evidence that individuals with SZ exhibit deficits in social cognition and that these deficits are uniquely related to impairments in functional outcome. However, the field is currently lacking an efficient way to identify and characterize these deficits in individuals with the disorder in clinical settings. The Brief Test of Social Cognitive Abilities (BTSCA) was developed in the current study as a brief, easy to administer screening tool to assess social cognitive abilities with an emphasis on clinical applications. The current study provides information regarding the psychometric properties of the initial version of the BTSCA, the sensitivity of the BTSCA to social cognitive deficits in SZ, and the clinical utility of the BTSCA. Findings demonstrated that the BTSCA shows promising results as a brief screening measure of social cognition in individuals with SZ.

Regarding the development of the BTSCA, the measure was designed to have content and construct validity. Historically, while much of the construct validity support for psychological tests has been gathered after the tests have been published, recent developments in psychometrics indicate that construct validity for tests should be built in when the tests are initially developed. Consistent with this, the items included on the BTSCA were selected from the FIAT, SFRT, PA, Eyes, and Hinting Tests based on data collected in prior social cognition studies of schizophrenia conducted in our laboratory. Notably, in support of the current approach to BTSCA development, the psychometric properties of the Eyes, Hinting, and Penn Emotion Recognition Tests (ER-40) were recently evaluated in NC and SZ groups as part of the Social Cognition Psychometric Evaluation (SCOPE) study (Pinkham et al., 2016), which is a multi-site effort aimed at selecting social cognition tests with strong psychometric properties to be used in clinical trials. In the initial psychometric study, the Hinting task was found to have excellent

psychometric properties, distinguish between SZ and NC groups, and uniquely predict functional capacity. The ER-40, which is face affect identification task using very similar stimuli as was used on the BTSCA, was also found to have adequate psychometric properties, though it was unclear if it added any contribution to assessing emotion recognition beyond the BLERT. Given that the BLERT utilizes videotaped vignettes and therefore was not chosen as items in the BTSCA because of limitations imposed on administration (computer vs. paper and pencil), this finding from the SCOPE study provides support for the use of static faces to assess emotion recognition in SZ, such as the ones used in the Faces task of the BTSCA. The Eyes task was also found to have adequate psychometric properties, though it was suggested that the relationship between the task and vocabulary skills be explored further (Pinkham et al., 2016). Taken together, these findings provide additional support for the tests that were examined to retain items for the BTSCA.

Regarding the psychometric properties of the BTSCA, examination of the internal consistency of the entire scale showed high reliability but the average inter-item correlation was poor. This was not surprising, as the scale was made up of a large number of items and we chose items meant to assess several different social cognitive domains, and so expected that individual items may not correlate as strongly with the overall scale score as they would within their respective social cognitive domains. While items on the SP and ToM domains indicated lower internal consistency reliability than the commonly reported acceptable value of .80, lower than expected internal consistency reliability may have been due to the fact that our sample was made up of mostly normal controls who were expected to do well on the test. The ER domain showed the poorest internal consistency and poor inter-item correlations. This occurred because several items were included that assessed each of the basic emotion categories (happy, sad, anger, fear,

disgust), despite the fact that individuals with SZ tend to have more difficulty recognizing negative emotions (Kohler et al., 2003; Fett et al. 2013), and emotions such as sad and happy are typically accurately identified by controls and to a lesser degree, individuals with SZ. However, recognition of certain emotions may have particular significance in some clinical disorders. For example, accurate identification of happy and sad emotions may be relevant in assessing social cognition in individuals with depression (LeMoult, Jooermann, Sherdell, Wright, & Gotlib, 2009). Therefore, despite poor internal consistency of this scale in the current sample, we chose to retain all emotional categories in the scale. Group comparisons indicated the BTSCA ER domain distinguished between controls and individuals with schizophrenia providing support for the validity and usefulness of the scale in evaluating this social cognitive domain.

Confirmatory factor analyses provided evidence that the scales included to assess the domains of ER, SP, ToM were in fact assessing the three intended latent constructs. Additionally, findings in the current study that these domain scores showed unique patterns of correlation with the UPSA and were differentially impaired in the SZ (discussed below) provide provide additional support for the distinction between social cognitive domains as well as complex multidimensional theoretical models that have been proposed to explain social cognition (Mancuso et al., 2011; Ocshner, 2008). While social cognition is a complex construct and the domains measured on the BTSCA do not provide a comprehensive assessment of proposed social cognitive abilities, the domains of ER, SP, and ToM represent three out of the four core social cognitive areas outlined by the SCOPE study (Pinkham et al., 2016). The usefulness in distinguishing between the three domains included in the BTSCA for clinical and research purposes warrants further investigation, although there is evidence that these social cognitive domains are uniquely associated with activation of differentiated neural circuits and

neurotransmitter disturbances (Henry, von Hippel, Molenberghs, Lee, & Sachdev, 2016; Green, Horan, & Lee, 2015) and predictive of different functional outcomes (Mancuso et al., 2011; Green, Horan, & Lee, 2015; Buck et al., 2016).

Furthermore, group comparisons between the factors identified in the analyses suggested that all domains differentiated between the NC and SZ groups, although differences in magnitude of impairment in domain differences were present. While the SZ group performed significantly worse than the NC group on all factors, ToM was the most impaired relative to the other domains. The pattern of performance was such that the SZ group performed almost three standard deviations below the NC group mean, while the SZ group performance on SP and ER domains were at approximately two standard deviations below NCs. Despite relative differences, the overall conclusion that can be drawn is that all of the BTSCA scales are quite sensitive to social cognitive deficits in SZ, consistent with the growing evidence from studies using more comprehensive measures that have established presence of social cognitive deficits in the disorder. The current results thus suggest that not only is the BTSCA capable of distinguishing between SP, ToM, and ER domains, but that these domains are useful in identifying patterns of social cognitive deficits in SZ.

ROC analysis conducted to determine the usefulness in the BTSCA scores in discriminating between individuals with schizophrenia and controls provided evidence of the usefulness of the BTSCA for this purpose. Optimal cut off scores for each of the scales, given a based rate of approximately 50% schizophrenia in the current sample, were able to correctly classify more than 85% of the overall sample. As would be expected, the BTSCA total score provided the best classification because it reflects the broadest and most reliable index of social cognition. The total score has an AUC of .901 which suggests excellent classification, although

negligible differences were present between it and the BTSCA domain scores. Furthermore, using a cut score of 76 on the total BTSCA score resulted in a LR+ of 3.46 and a LR- of .04, which demonstrates clinical usefulness for the scale and means that obtaining a positive BTSCA screen (i.e., total score percentage ≤ 76) leads to a small increase in the probability of SZ and obtaining a negative BTSCA screen (i.e., total score percentage >76) leads to a moderate decrease in the probability of SZ. Of note, although cutoff scores were identified in the current sample for each domain and the BTSCA total score, there are a number of important considerations in selecting cutoff scores that were not directly addressed in this study. Selecting an appropriate cutoff score should be made based on an understanding of the reason for the evaluation, the base rate of the disorder in the population being evaluated, and the costs associated with misdiagnosis of schizophrenia. Also, different cut-off scores are optimal under different conditions, as would be the case when discriminating SZ from healthy control groups or discriminating between SZ and other clinical disorders. In this sense, cut-off values are not universal and should be selected based on the goals of the evaluation and characteristics of the population that is being evaluated. Further investigation of cutoff scores of the BTSCA in differing contexts or populations would be an area of future research.

Finally, similar to more comprehensive assessments of social cognitive abilities, it was found that performance on the BTSCA was correlated with negative symptoms in individuals with SZ, although the magnitude of this correlation was weak. Examination of the correlations between the ER, SP, and ToM domains and clinical symptoms indicated that ToM was the only domain with a significant correlation with negative symptoms. Additionally, and perhaps more importantly, performance on the BTSCA in the SZ group was significantly correlated with performance on the UPSA subscales and total score. A differential pattern of correlations was

present, indicating unique relationships between specific BTSCA scores and specific functional outcomes, which is consistent with prior research indicating unique patterns of association (Mancuso, 2011). While we could not infer causality from our correlational findings, research has suggested that negative symptoms may be a mediator variable between ToM and functional outcome (Mehta, Thirthalli, Kumar, Kumar, & Gangadhar, 2014; Ventura et al., 2015), suggesting that this may be an interesting relationship to continue to explore in future research. Regression analysis conducted to examine the ability of the BTSCA scores to predict functional capacity on the UPSA indicated that the BTSA score accounted for approximately 38% of the variability in functional abilities assessed by the UPSA. This model was statistically significant but maybe more importantly, indicated a moderate to large effect size which was similar to effect sizes observed in more comprehensive batteries (Couture et al., 2006), suggesting that the BTSCA has initial validity as a brief screening tool of social cognitive abilities in SZ. Finally, it is noteworthy that we found a large correlation between the MoCA and the BTSCA. Research has indicated moderate to strong correlations between social and nonsocial cognitive tests (Mehta, Thirthalli, Subbakrishna, et al., 2013) which was observed in this study. While these associations are expected, it has also been demonstrated that social cognitive abilities recruit distinct brain regions (Henry et al., 2016; Van Overwalle, 2009, 2011) and provide different information regarding functional outcome (Fett et al., 2011). Therefore, it is likely that the MoCA and BTSCA are providing unique information.

There are a number of limitations to the current study. First, a larger number of subjects in our sample with more variability in responses would have allowed a more robust test of the factor structure of the BTSCA and may have addressed low internal consistency estimates for some of the BTSCA items. Though we had strong theoretical reason to believe out that our scale

was measuring the ER, SP, and ToM domains, several studies have found differing factor structures between SZ and NC samples. The extent to which differences in factor structure between studies are attributable to the type of factor analysis used (EFA vs CFA), the tests used to assess social cognitive domains, differences in populations, or other factors remains largely unknown. However, for the current study, although findings were consistent with the proposed theoretical model, increased sample size would provide greater confidence in the stability of the factor structure identified using CFA. A larger sample of individuals with SZ would have also allowed for regression analyses aimed at predicting symptoms and functional outcomes based on the BTSCA scores, rather than relying or correlation analyses to examine associations among these variables. However, results of the correlation analyses do provide support for differing pattern of association between the BTSCA score with symptoms and functional outcomes.

Additionally, this study only evaluated the performance of the BTSCA in a SZ group. However, there are a wide variety of neurological, psychiatric, and developmental disorders that display social cognitive deficits, including disorders such as traumatic brain injury (McDonald, 2013), dementia (Cosentino et al., 2015), Parkinsons's disease (Narme, Mouras, Roussel, Dura, Krystkowiak, & Godefroy, 2013), Huntington's Disease (Bora et al., 2017), Autism and Attention Deficit Hyperactivity Disorder (Bora & Pantelis, 2016). Though a review of the social cognitive abilities in these disorders is beyond the scope of this paper, social cognition deficits in some disorders are just beginning to receive attention. Thus it has been recommended that social cognitive assessment should be part of standard neurological examinations and tracked throughout disease progression (Henry et al., 2016). Future research may wish to examine the usefulness of the BTSCA when applied with those populations. For example, a meta-analysis by Bora et al. (2017) found that individuals with Huntington's disease displayed significant

impairments in ER and ToM. The authors pointed out that if social cognitive deficits were found to exist in the disease before motor symptoms are present, they may be useful to track disease progression or treatment. However, they also pointed out that there are a lack of studies investigating these deficits and the relationships to symptoms or behavioral correlations in the disease (Bora et al., 2017). Additionally, a meta-analysis by Cotter et al. (2016) also found consistent ER and ToM deficits in Multiple Sclerosis that in some cases were higher in magnitude than neurocognitive deficits and were present even in individuals with short disease duration. Again, the authors emphasized a need for more research in this area and a greater need for physicians to be aware of these deficits. In populations where these deficits are being increasingly recognized as areas to pay attention to, the BTSCA could provide a useful method to determine overall patterns of social cognitive deficits in the disorders, which could be followed up by more extensive evaluations.

Lastly, since the current study used a normal control group as a comparison sample, the ability of the BTSCA to distinguish between various clinical groups was not examined. It is often the case in clinical practice, where differential diagnosis is a primary focus of evaluation, that differentiating between various clinical disorders is more important than simply documenting the presence and severity of impairment relative to controls. Future research could advance understanding regarding usefulness of the BTSCA when differential diagnosis is a consideration by examining classification indices between various groups where the presence of social cognitive deficits might help clarify diagnosis, as would be the case for example in distinguishing between frontotemporal dementia and Alzheimer's disease. Results generally reflect that the BTSCA subscales may have some utility in this regard, given the differential

pattern of impairment of the social cognitive domains in the SZ group, although additional research is needed to establish this utility.

In conclusion, findings from the current study demonstrated that the BTSCA shows promising psychometric properties and clinical utility as a brief screening measure of social cognition in individuals with SZ. A brief social cognitive measure, such as the BTSCA, has the potential to assess social cognition in schizophrenia and other clinical disorders by both clinicians and researchers. For example, the BTSCA could be used to quickly and efficiently screen individuals for social cognitive deficits that may be indicative of SZ or another clinical process. From a research perspective, the BTSCA may provide a useful and quick means to investigate the mechanisms that underlie different social cognitive domains in various disorders. Further, if the BTSCA is found to have good test-retest reliability, it could be used to assess potential changes in social cognitive functioning results from disease progression, rehabilitation, or intervention. Overall, the BTSCA provides an efficient measure to screen for social cognitive abilities in SZ, the importance of which is becoming increasingly recognized in the field given the relationship between social cognition and functional outcome.

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CURRICULUM VITAE

RyAnna Zenisek
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EDUCATION

Doctor of Philosophy in Clinical Psychology, anticipated graduation December 2018
University of Nevada, Las Vegas
APA-Accredited Clinical Psychology Program, Neuropsychology Track
Advisor: Daniel N. Allen, Ph.D.

Dissertation: Development and Validation of a Brief Measure of Social Cognitive Abilities, anticipated defense May 2017

Master of Arts in Clinical Psychology, August 2014
University of Nevada, Las Vegas
APA-Accredited Clinical Psychology Program, Neuropsychology Track
Advisor: Daniel N. Allen, Ph.D.

Thesis: Auditory Processing Deficits in Bipolar Disorder with and without a history of psychotic features

Bachelor of Arts, December 2008
Indiana University of Pennsylvania

Honors Thesis: An Examination of Pseudo-stalking in the Absence of Threat
Advisor: David Laporte, Ph.D.

CLINICAL INTERNSHIP

Psychology Pre-doctoral Intern, August 2016 - Present
VA Ann Arbor Healthcare System
APA-Accredited Clinical Internship

- *Geriatric Neuropsychology*, August 2016 - Present
  Major Rotation: 24 hours per week
  Supervisors: Robert J. Spencer, Ph.D. and Linas A. Bieliauskas, Ph.D., ABPP
  - Responsible for completion of neuropsychological screening battery for all patients admitted to the Community Living Center (CLC). Responsibilities included test administration for approximately 1-2 patients per week and scoring, interpretation, and report writing for 4-6 patients per week.
  - Completed full neuropsychological assessments at provider's request to aid in treatment planning and discharge. Responsibilities included test administration, scoring, interpretation, and report writing.

- Provided brief intervention to CLC inpatients using primarily motivational interviewing and CBT.
- Attended weekly interdisciplinary staff meetings to provide feedback to the treatment team and consultation for mental health services.
- Trained and supervised research assistants in test administration and scoring. Co-led weekly training and didactic meetings with research assistants.
- Participated in weekly geriatric neuropsychology didactics.

- *Compensation & Pension*, August 2016 – Present
  Minor Rotation: 12 hours per week
  Supervisor: Steven H. Putnam, Ph.D.
  - Completed comprehensive compensation and pension evaluations of veterans seeking financial compensation for psychological disorders. These evaluations required rendering a diagnosis and medicolegal opinion based on integrating data obtained via a clinical interview, administration of a battery of psychometric/psychological testing that included the MMPI-2, and a thorough record review of veteran's service and medical records.

- *Traumatic Brain Injury Clinic*, October 2016 – Present
  Elective Training Opportunity
  Supervisor: Robert J. Spencer, Ph.D. and Percival H. Pangilinan Jr, MD
  - Interpreted and supervised weekly neuropsychological assessments of veterans with traumatic brain injuries and provided feedback to the polytrauma team.

- *Neuropsychological Assessment*, March 2017 – August 2017
  Major Rotation: 24 hours per week
  Supervisor: Robert J. Spencer, Ph.D.
  - Conducted comprehensive outpatient evaluations for veterans with dementia, ADHD, traumatic brain injury, and other disorders with the purpose of providing usable feedback to veterans, their families, and their treating providers. Duties will also include academic and scholarly activities.

- *Psychosocial Rehabilitation & Recovery*, March 2017 – August 2017
  Minor Rotation: 12 hours per week
  Supervisor: Nicholas Bowersox, Ph.D.
  - Conducted individual and group psychotherapy with veterans with a history of serious mental illness and significant functional impairment to improve and maintain functional abilities and aid individuals in mental health recovery.

CLINICAL PRACTICUM EXPERIENCES

Center for Applied Neuroscience, June 2013 – July 2016

Las Vegas, NV
Supervisors: Thomas Kinsora, Ph.D. and Sharon Jones-Forrester, Ph.D.

- Conducted neuropsychological and forensic assessments with individuals ranging in age from 6 to 90 in an outpatient private practice setting or the Clark County Detention Center. Further responsibilities included scoring, interpretation, and integrative report writing. Commonly presented patient diagnoses included cognitive disorders of varying etiologies, affective disorders, pervasive developmental disorders, learning disabilities, and TBI.
- Attended weekly individual and group supervision, didactics, and case conferences.
- After formal practicum training, I was hired as a testing assistant to conduct all aspects of neuropsychological assessment, including test administration, scoring, and report writing.

Cleveland Clinic Lou Ruvo Center for Brain Health, July 2014 - August 2015
Las Vegas, NV
Supervisors: Justin B. Miller, Ph.D., ABPP-CN and Sarah Banks, Ph.D., ABPP-CN

- Conducted neuropsychological assessments with individuals ranging in age from 20-95 in an outpatient specialized medical clinic. Further responsibilities include scoring, interpretation, and integrative report writing. Commonly presented patient diagnoses included individuals suspected of having neurodegenerative disease, most commonly dementia and movement disorders, referred from neurology and psychiatry.
- Co-facilitated a weekly support group for caregivers of individuals with frontotemporal dementia under the supervision of Dr. Banks and a weekly support group for caregivers of individuals with memory problems with Donna Munic-Miller, Ph.D.
- Attended weekly individual and group supervision and didactics, as well as weekly case conferences with neurology, psychiatry, nursing, physical therapy, and social work.
- After the formal practicum training, I was hired to continue conducting neuropsychological assessments, scoring, and report writing on an as-needed basis, with a report turn-around time of two days.

Partnership for Research, Assessment, Counseling, Therapy, and Innovative Clinical Education (PRACTICE), August 2012 – August 2013
University of Nevada, Las Vegas
Supervisors: Noelle Lefforge, Ph.D. and Michelle Paul, Ph.D.

- Conducted comprehensive neuropsychological and psychoeducational assessments for adult clients referred from the community and the university disability resource center. Further responsibilities included scoring, interpretation, integrative report writing, and provision of tailored feedback to clients.

PUBLICATIONS AND PRESENTATIONS

Manuscripts Published

Mayfield, A.R., Parke, E.M., Barchard, K.A., **Zenisek, R. P.**, Thaler N.S., Etcoff, L.M., & Allen, D.N. (2016). Equivalence of mother and father ratings of ADHD in children. *Child Neuropsychology*. doi: 10.1080/09297049.2016.1236186

Zenisek, R., Millis, S. R., Banks, S. J., & Miller, J. B. (2016). Prevalence of below-criterion Reliable Digit Span scores in a clinical sample of older adults. *Archives of Clinical Neuropsychology*. doi: 10.1093/arclin/acw025

Zenisek, R., Thaler, N. S., Sutton, G. P., Ringdahl, E. N., Snyder, J. S., & Allen, D. N. (2015). Auditory processing deficits in bipolar disorder with and without a history of psychotic features. *Bipolar Disorders*. doi:10.1111/bdi.12333

Presentations and Abstracts

***** Denotes corresponding published abstract

Becker, M. L., **Zenisek, R.**, Paul, N.B., Vertinski, M., Frantom, M.B., Call, E.T., & Allen, D. (2017). Performance on a Novel Brief Measure for Social Cognition in Schizophrenia. The 37th Annual Conference of the National Academy of Neuropsychology, October 25-28, Boston, MA.

Paul, N.B., **Zenisek, R.**, Becker, M. L., Gomez, R. I., Strong, M., Chaleunsouck, R.A., & Allen, D.N.A. (2017). Psychometric Evaluation of a New Brief Test of Social Cognitive Abilities (BTSCA). The 37th Annual Conference of the National Academy of Neuropsychology, October 25-28, Boston, MA.

***Zenisek, R.**, Thaler, N. S., Sutton, G. P., & Allen D. N. (2015). Basic visual perception deficits are related to impaired functional outcome in schizophrenia and bipolar disorder. The 35th Annual Conference of the National Academy of Neuropsychology, November 4-7, Austin, TX.

Zenisek, R. & Miller, J. (2015). Reliable Digit Span as a Measure of Effort in Dementia. The 43rd Annual Meeting of the International Neuropsychological Society, February 4-7, Denver, CO.

***Zenisek, R.**, Thaler N. S, Ringdahl E. N, Vogel S. J, Sutton, G. P, Bello, D. T, & Allen D. N (2014). Intellectual ability and functional outcome in bipolar disorder and schizophrenia. The 34th Annual Conference of the National Academy of Neuropsychology, November 12-15, Fajardo, PR.

*Palisoc, B. M, Vogel, S. J, Ringdahl E. N, **Zenisek, R.**, & Allen D. N (2014). The relationship between negative symptoms and functional outcome in schizophrenia and bipolar disorder. The 34th Annual Conference of the National Academy of Neuropsychology, November 12-15, Fajardo, PR.

***Verbiest, R**., Ringdahl, E. N., Thaler, N. S., Sutton, G. P., Vogel, S. J., Reyes, A. & Allen, D. N. (2013). Basic auditory perception deficits are related to impaired perception of

sarcasm. The 33rd Annual Conference of the National Academy of Neuropsychology, October 16-19, San Diego, CA.

***Verbiest, R**., Thaler, N., Snyder, J., Kinney, J., & Allen, D. N. (2012). Auditory perception deficits are present in patients with bipolar disorder with psychotic features. Poster and Platform session presented at the Annual Conference of the National Academy of Neuropsychology, November 7-10, Nashville, TN.

***Verbiest, R**., Thaler, N. S., Ringdahl, E. N., Vertinski, M., & Allen, D. N. (2012). Tone discrimination is uniquely linked to bipolar disorder with psychotic features. The 4th Annual Meeting of the American College of Professional Neuropsychology, March 8-11, Las Vegas, NV.

*Bangalore, S. S., Walker, C., **Verbiest, R.**, Montrose, D., Carl, M., Thomas, A., & Cho, R. (2012). Effect of Cannabis on Cortical Gamma Oscillations. Annual Meeting of the Society of Biological Psychiatry, Philadelphia, PA.

***Verbiest, R.,** Thaler, N. S, Strauss, G. P., Allen, D. N. (2011). Slowed Processing Speed Influences Neurocognitive Impairments In Patients with Deficit Syndrome Schizophrenia. Annual Meeting of National Academy of Neuropsychology, Marco Island, FL.

Cho, R. Y., Walker, C., **Verbiest, R**., Frankle, W. G., Lewis, D. A. (2011). Effects of Dextro-amphetamine on cortical oscillations in schizophrenia vs. healthy control subjects. Annual Meeting of NCDEU, Boca Raton, FL.

*Cho, R. Y., Walker, C., **Verbiest, R**., Frankle, W. G., Lewis, D. A. (2010). Differential Effects of Dextro-Amphetamine Administration In Schizophrenia Vs. Healthy Control Subjects. Annual Meeting of Society of Biological Psychiatry, New Orleans, LA.

*Polizzotto, N. R., Hill-Jarrett, T., **Verbiest, R.,** Carl, M., Radchenkova, P., Walker, C., & Cho, R. Y. (2010). Developmental Trajectory of Context Processing Using the AX-CPT Paradigm. Annual Meeting of the Society of Biological Psychiatry, New Orleans, LA.

*Takahashi, T., Walker, C., **Verbiest, R.,** Ueno, K., Wada, Y., & Cho., R. (2010). Effect of Amphetamine on Neural Complexity in Schizophrenia. Annual Meeting of the Society of Biological Psychiatry, New Orleans, LA.

*Walker, C. P., **Verbiest, R**., Polizzotto, N. R., Carl, M., Radchenkova, P., Hill-Jarrett, T., & Cho, R. Y. (2010). Development of Sensory Cortical Gamma Using Steady State Auditory Evoked Potentials. Annual Meeting of the Society of Biological Psychiatry, New Orleans, LA.

Bangalore, S. S., Ramaswamy, R., Carter, C. S., Cohen, J., Cutler, V., **Verbiest, R**., Cho, R. Y. (2009). Selective DLPFC Deficits in Cognitive Control Network in Relatives of Individuals with Schizophrenia using a Functional Imaging Paradigm. Annual Meeting of Society of Biological Psychiatry, Vancouver, BC

Verbiest, R. & LaPorte, D. (2008). An examination of pseudo-stalking in the absence of threat. Presented at the Mid-America Undergraduate Psychology Research Conference, Crestview Hills, KY.

RESEARCH EXPERIENCE

Neuropsychology Research Program, August 2012 – Present
University of Nevada, Las Vegas
Supervisor: Daniel N. Allen, Ph.D.

- *Study (dissertation): Development and Validation of a Brief Measure of Social Cognitive Abilities.*
    - Project development, including selection of test battery, proposal presentation, IRB approval preparation, and database creation.
    - Screening and assessment of healthy controls and individuals with schizophrenia using an extensive psychiatric and neuropsychological battery in order to develop a brief measure of social cognition.

- *Study: Standardization of the Wechsler Intelligence Scale for Children, Fifth Edition.*
    - Recruitment, screening, and assessment of children with traumatic brain injury, intellectual disability, and attention-deficit/hyperactivity disorder on a standardization version of the WISC-V for Pearson

- *Study (thesis): Auditory Processing Deficits in Bipolar Disorder with and without a History of Psychotic Features*
    - Screening and assessment of healthy controls and individuals with schizophrenia using an extensive psychiatric and neuropsychological battery to combine with an archival database in order to address the degree to which psychosis affected tone discrimination.

- *Study: Social Cognition in Individuals with Schizophrenia and Bipolar Disorder*
    - Screening and assessment of healthy controls and individuals with schizophrenia or bipolar disorder using an extensive psychiatric and neuropsychological battery to assess social cognitive functioning.

- *Study: Standardization of Halstead Category Test, Computer Version.*
    - Assessment of individuals from the UNLV Psychology subject pool in a 2-part neuropsychological battery in order to compare psychometric properties of the computerized and original version of the Halstead Category Test.

Clinical Cognitive Neuroscience Laboratory, December 2008 – July 2011
University of Pittsburgh
Supervisor: Raymond Cho, M.D., M.Sc.

- Research Specialist: Conducted behavioral, EEG, and fMRI experiments with healthy controls and clinical populations, including first-break medication naïve individuals with schizophrenia and bipolar disorder, to study the mechanisms of cognitive control and their disturbances in psychiatric illness. Responsibilities included recruitment, phone screening, protocol administration, analyzing behavioral, EEG, and fMRI data, and training of research assistants.

TEACHING EXPERIENCE

General Psychology, Fall 2013 – Spring 2015
University of Nevada, Las Vegas
- Independently designed and taught two sections per semester of an undergraduate General Psychology course.

OTHER RELEVANT TRAINING EXPERIENCE

Psychological Assessment and Testing Clinic, Fall 2015 – Spring 2016
University of Nevada, Las Vegas
Supervisors: Michelle Paul, Ph.D. and Andrew Freeman, Ph.D.
- Advanced Graduate Assistant responsible for conducting phone intakes and making case assignments, as well as performing other administrative functions, for staff at the department community psychological assessment training clinic. Additional responsibilities included aiding in psychological assessment supervision for 2 junior graduate students and assisting with the child assessment class.

Symptoms Ratings Training Program, Fall 2013
University of Nevada, Las Vegas
Training Supervisor: Daniel N. Allen, Ph.D.
- Completed a series of training workshops for the administration of a number of clinician administered scales for symptoms of schizophrenia and bipolar disorder. Refresher workshops were held periodically.

Comprehensive Training in Dialectical Behavior Therapy, Fall 2012 – Summer 2013
Las Vegas, NV
Training Supervisor: Alan Fruzzetti, Ph.D.
- Completed a training program for DBT that included didactic training, demonstration, video, and supervised practice over a series of workshops for a total of approximately 36 hours.

SCID Training Program, Spring 2012 – Spring 2013
University of Nevada, Las Vegas
Training Supervisor: Daniel N. Allen, Ph.D.
- Completed a series of training workshops for administration of the Structured Clinical Interview of the DSM-IV-TR Axis I Disorders (SCID-IV). Training culminated in a final mock interview conducted with an advanced graduate student trained in administration in

order to assess proficiency and endorsement to administer the SCID in numerous studies being conducted within Dr. Allen's research lab, as well as other labs within the UNLV Psychology Department.
- Provided training and mock interview assistance in subsequent training workshops.

SERVICE

National Academy of Neuropsychology
Student Volunteer at Annual Conferences

NAN Annual Conference, Fajardo, PR	November 2014
NAN Annual Conference, San Diego, CA	October 2013
NAN Annual Conference, Nashville, TN	November 2012
NAN Annual Conference, Marco Island, FL	November 2011

UNLV Outreach Undergraduate Mentorship Program, Spring 2013 – Spring 2016
- Provide mentorship of undergraduate students from underrepresented populations to prepare them for a career in psychology or a related field. Responsibilities include meetings to discuss educational goals and career aspirations, and aiding in graduate school preparation and applications.

Clinical Student Committee Cohort Representative, Fall 2014
- Responsibilities included assisting with interview weekend activities, organizing student focused events, and serving as a liaison between clinical faculty and graduate students.

PROFESSIONAL AFFILIATIONS

National Academy of Neuropsychology, Student Affiliate	2011-Present
American Psychological Association, Student Affiliate	2011-Present
Nevada Psychological Association, Student Affiliate	2012-2015
International Neuropsychological Society, Student Affiliate	2015-Present
American Academy of Clinical Neuropsychology, Student Affiliate	2016-Present

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HONORS AND AWARDS

Patricia Sastaunak Scholarship ($2,500)	2013
Graduate & Professional Student Association travel funding to attend and present at The National Academy of Neuropsychology Conference in Nashville, TN ($325)	2012
Stanley W. Lore Scholarship ($1000)	2007