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## Affect Identification and Interpersonal Skills: An In-Depth Evaluation of Social Cognition in Schizophrenia

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**AFFECT IDENTIFICATION AND INTERPERSONAL SKILLS: AN IN-DEPTH  
EVALUATION OF SOCIAL COGNITION IN SCHIZOPHRENIA**

by

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A dissertation submitted in partial fulfillment  
of the requirements for the

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**Griffin Pollock Sutton**

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**August 2012**

## **Abstract**

# **Affect Identification and Interpersonal Skills: An In-Depth Evaluation of Social Cognition and Clinical Correlates within Schizophrenia**

by

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The presence of deficits in various sub-domains of social cognition has been investigated to a degree in individuals with schizophrenia. Some of the most commonly researched and documented deficits have included impairments in the identification of affect portrayed in faces. Research has indicated that the performance of individuals with schizophrenia on such tasks is generally impaired as compared to normal controls. However, some have questioned the generalizability of such findings to real-world situations, as day-to-day interactions generally necessitate a constant, fluid assessment of the thoughts and feelings of others and are rarely, if ever, limited to still images of others. Furthermore, the commonly observed deficits in social functioning in individuals with schizophrenia are likely related to impairments in multiple sub-constructs related to social cognition in general, and not solely to deficits in affect identification.

The primary purpose of this study was to evaluate individuals with schizophrenia on a number of increasingly complex social cognitive tasks across multiple sub-domains of social cognition, namely affect identification, perception and interpretation of complex social situations, and theory of mind. Unique contributions of these sub-domains to one

another were systematically examined, with contributions evaluated including those of basic visual and auditory perception on affect perception, of affect perception on perception and interpretation of complex social situations, and of perception and interpretation of complex social situations on theory of mind. Path analysis was used to conduct such evaluations, allowing for a comparison of goodness of fit of various models depicting the various hypothesized relationships between these variables. It was hypothesized that the simplest, most parsimonious model would be the best fit for the data. In contrast, it was found that a slightly more complex model, which included paths reflecting the predictive relationships of auditory perception and visual perception to auditory/visual affect identification, was found to be the best fit for the data. The findings of the present study warrant further exploration of social cognition in schizophrenia, particularly in the evaluation of the efficacy of treatment strategies which target more basic social cognitive processes in an effort to improve higher-order social cognitive processes in a bottom-up fashion.

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## **Chapter 1:**

### **Introduction**

Schizophrenia is a psychiatric disorder that is estimated to occur in approximately 0.5-1.5% of adults, with annual incidence rates of 0.5-5.0 per 10,000 adults (APA, 1994). Schizophrenia is currently categorized in the DSM-IV-TR as a psychotic disorder frequently characterized by the presence of delusions and hallucinations (APA, 1994). Other symptoms commonly observed in individuals with schizophrenia include disorganized speech, disorganized or catatonic behavior, and such negative symptoms as affective flattening and avolition. The symptoms associated with schizophrenia are often further categorized into positive and negative symptoms. Positive symptoms include the presence of abnormal experiences, namely delusions and/or hallucinations. Conversely, negative symptoms include those which are indicative of the absence of “normal” behavior, including an apparent deficit of emotional experience as evidenced by a decrease in the frequency of facial expressions, paucity of thoughts, and a clinically significant lack of motivation. Social withdrawal, loss of interest in school and/or occupational situations, a decrease in appropriate attention paid to hygiene, and unusual behavior also commonly occur in schizophrenia (APA, 1994), with social withdrawal and inappropriate interactions in social situations often present in such individuals.

Given that social functioning is frequently impaired in schizophrenia, deficits in social interactions have become an increasing focus of recent research, largely within the context of what has been termed “social cognition.” Social cognition refers to those unique cognitive operations that are dedicated to the processing of social information and which allow for adaptive social interactions (Ostrom, 1984). Yager and Ehmann (2006)

similarly define social cognition as a sub-construct which, together with social skills, comprises social functioning. More specifically, the authors describe social functioning as encompassing “overall performance across many everyday domains (e.g., independent living, employment, interpersonal relationships, and recreation)” (p. 48). Within social functioning, social cognition is delineated as “the [collective] cognitive processes involved in the receiving and processing stages”, while social skills are defined as “the cognitive, verbal, and nonverbal behaviors necessary to engage in positive interpersonal interactions...[which] are conceptualized as lying along a continuum, ranging from basic, molecular skills to more complex, molar skills” (Yager & Ehmann, 2006, p. 49). Hence, the processing of social information may require a number of distinct yet integrated cognitive processes such as facial affect perception and processing, social perception, and knowledge of social norms.

Support for a distinction between social and nonsocial cognitive processes comes from a number of areas, including studies demonstrating small to moderate correlations among standard neurocognitive and social cognitive measures, as well as the involvement of unique neural substrates in the processing of social and nonsocial information (for a review, see Penn, Corrigan, Bentall, Racenstein, & Newman, 1997; Couture, Penn, & Roberts, 2006). This specialized processing of social information is also consistent with the more general opinion that the development of specialized information processing symptoms is adaptive, allowing the brain to address specific environmental challenges (Tooby & Cosmides, 1990).

Research has demonstrated deficits in social cognition deficits to be stable over time in both first- and multi-episode schizophrenia patients, regardless of fluctuations in

symptomatology (Meyer & Kurtz, 2009), and to be comprised of multiple contributing sub-constructs which may be moderately inter-related (Cohen, Forbes, Mann, & Blanchard, 2006). Social functioning and skills have also been found in individuals with schizophrenia, including such odd behaviors as smiling in response to seeing a frowning face (Falkenberg, Bartels, & Wild, 2008), behaviors and mannerisms which likely interfere with daily social interactions. Although an ever-growing body of research is continuing to shed light on the presence and severity of social cognitive deficits in schizophrenia, recent reviews indicate that a weakness in the literature is an evaluation of social cognition specifically in terms of its sub-domains, as well as how those sub-domains relate to such other variables as functional outcome (e.g., Couture et al., 2006).

The processing of social information, or social cognition, has been posited to be related to the symptomatology associated with schizophrenia and the interpretations individuals with schizophrenia make about their worlds (Penn et al., 1997). Based on these considerations, the current study examined social cognition in schizophrenia, with a general goal of providing a more comprehensive evaluation of deficits in these patients than has been previously conducted. The goal of this approach was not only to allow for the identification of discrete social cognitive deficits in schizophrenia, but also for an evaluation of the relative contributions of various simple social cognitive tasks to more complex social cognitive measures. The potential influence of more basic processes on more complex social cognitive functioning in individuals with schizophrenia has been suggested by others (e.g., Wynn, Sugar, Horan, Kern, & Green, 2010), but has yet to be systematically evaluated.

The following sections review social deficits reported to date in individuals with schizophrenia as they pertain to the identification of affect portrayed in isolation and within the context of social situations, to the accurate perception and interpretation of and participation in complex interpersonal situations, and to appropriate judgments related to theory of mind.

## **Chapter 2:**

### **Literature Review**

#### **Auditory Perception**

Research has found that deficits in accurate perception of pitch and prosody and frequency discrimination may be demonstrated by individuals with schizophrenia as compared to healthy controls (e.g., Holcomb et al., 1995; Leitman et al., 2005), including as early as the prodromal phase in such individuals (Valkonen-Korhonen, Laukkanen, Tarkka, Partanen, & Lehtonen, 2003) and in unaffected first-degree relatives of such individuals (Force, Venables, & Sponheim, 2008; Kee, Horan, Mintz, & Green, 2004).

Leitman and colleagues (2005), for example, compared a group of individuals with schizophrenia or schizoaffective disorder ( $n = 43$ ) to a group of normal controls ( $n = 34$ ) on several auditory perception tasks. Basic auditory processing was evaluated via a tone matching task, for which participants were asked to determine whether briefly presented tones were the same or different, as well as a distorted tunes task, for which participants were asked to determine whether commonly known tunes were presented correctly or if the pitch of several notes had been altered. More complex auditory tasks administered included a voice emotion identification task, for which participants were asked to identify the emotion being portrayed (i.e., happiness, anger, fear, sadness, surprise, or shame) in a content-neutral statement, as well as a voice emotion discrimination task, on which participants were asked to determine whether pairs of content-neutral sentences were portraying the same or different emotional categories. Measures of facial affect identification and facial affect discrimination were also administered to the participants. Results indicated that the psychiatric group performed

significantly worse than the normal control group on all tasks, suggesting impairments in auditory affect identification, as well as in more basic auditory perception. Furthermore, a principal components analysis of the data yielded separate factors for the auditory and visual tasks, suggesting the presence of separate auditory and visual sensory and affect identification processes.

Structural differences in individuals with schizophrenia as compared to healthy controls have also been found in relation to frequency discrimination, in that the anterior-posterior asymmetry of the auditory cortex was found to be reduced in a group of individuals with schizophrenia ( $n = 19$ ) as compared to a group of healthy controls ( $n = 22$ ), thus suggesting abnormal tonotopic organization in individuals with schizophrenia (Rojas et al., 2002). Additionally, no significant relationships were found between tonotopic organization or degree of asymmetry and ratings of psychiatric symptomatology as measured via the Positive and Negative Syndrome Scale. Research evaluating event-related brain potentials has also demonstrated evidence of impaired tone discrimination in individuals with schizophrenia ( $n = 50$ ) as compared to healthy controls ( $n = 21$ ), thus suggesting impaired basic auditory processing in individuals with schizophrenia (Leitman et al., 2010; Rojas et al., 2002).

In addition to the aforementioned identified relationship between tone frequency discrimination and affect identification, performance on tone frequency discrimination tasks has been linked to such higher order cognitive processing domains as executive functioning, such that impaired tone frequency discrimination performance was determined to be associated with altered dorsolateral prefrontal cortex functioning and negative symptomatology (Merrin, Floyd, Deicken, & Lane, 2006).

## Visual Perception

Regarding visual processing in individuals with schizophrenia, a number of studies have identified deficits in basic visual processing independent of deficits in visual affect identification in such individuals. Feinberg, Rifkin, Schaffer, and Walker (1986), for example, compared the performance of groups of individuals with schizophrenia ( $n = 20$ ), major depressive disorder ( $n = 20$ ), and normal controls ( $n = 20$ ) on facial identity and affect matching tasks. Participants were asked to match faces independent of affective state with faces presented both as “normal” and inverted, and to match affective states independent of facial identity, again with faces presented both as “normal” and inverted. While the major depressive disorder group was impaired only on the matching of affect task, the schizophrenia group was found to perform significantly worse than the normal control group on all four tasks, regardless of whether task requirements included matching of identity independent of affective state or matching of affective state independent of identity. Similar findings reported by Salem, Kring, and Kerr (1996) and Nelson, Combs, Penn, and Basso (2007) further suggest that individuals with schizophrenia may demonstrate a generalized deficit in visual information processing which may account for higher order deficits in visual affect identification.

Kosmidis and colleagues (2007) similarly compared the performance of a group of individuals with schizophrenia ( $n = 37$ ) to that of a group of normal controls ( $n = 32$ ) on identity matching, affect discrimination, and affect identification tasks. While the patient group performed similarly to the normal control group on tasks of facial identity matching and affect discrimination (i.e., discriminating between two intensities of the same emotion), performance was significantly below that of normal controls on a

measure of affect identification (i.e., identifying whether faces are portraying happiness, sadness, fear, anger, disgust, or surprise). Findings thus suggest the presence of facial processing deficits, though only in terms of affect identification, in individuals with schizophrenia. Similar results have been reported by others (e.g., Schneider et al., 2006), while some have found evidence of deficits in facial recognition in individuals with schizophrenia, albeit to a significantly lesser degree than deficits in facial affect identification in such individuals (Martin, Baudouin, Tiberghien, & Franck, 2005).

At a more basic level of visual processing, some research has suggested the presence of deficits in facial identification when only basic configural information is presented. McBain, Norton, and Chen (2010), for example, compared the performance of a group of individuals with schizophrenia ( $n = 41$ ) to that of a group of normal controls ( $n = 62$ ) on facial detection and discrimination tasks. The facial detection task was comprised of a series of line drawings depicting basic, configural images of faces and trees, with stimuli presented both right side up and inverted. The facial discrimination task was comprised of a series of unaltered photographs of faces which were presented to the participants in pairs. For each pair of stimuli, participants were asked to select which face they had seen previously. Results indicated that the schizophrenia group performed significantly worse than the normal control group on both tasks, thus suggesting that individuals with schizophrenia may exhibit deficits in the processing of visual information, even at the level of very basic facial processing, regardless of whether or not emotional content is also present.

Studies employing eye tracking software have also been used to evaluate for differences in eye movement and fixation patterns in individuals with schizophrenia.

Manor and colleagues (1999) compared the eye movements of a group of individuals with schizophrenia ( $n = 25$ ) to a group of normal controls ( $n = 25$ ) while viewing a face of neutral emotional state and a figure of somewhat comparable complexity (namely, the Rey-Ostierrieth Complex Figure). The schizophrenia group exhibited significantly fewer fixations on different parts of the face than did the normal control group. Additionally, the patient group had shorter scanpath lengths than did the normal control group, indicating that restricted eye movement and fixation patterns of the schizophrenia group as a whole may have limited the amount of information which could be accurately perceived. These findings are overall somewhat in agreement with reports of impaired processing of the gestalt of faces by individuals with schizophrenia, who seem to demonstrate an over-reliance on the processing of individual facial features in isolation (Joshua & Rossell, 2009; Schwartz, Rosse, Iohri, & Deutsch, 1999), which likely interferes with the processing of faces both with and without emotional content. Notably, training with the goal of focusing more on salient facial features has been found to improve accuracy of affect identification in individuals with schizophrenia (Russell, Green, Simpson, & Coltheart, 2008).

While research findings to date overall suggest that individuals with schizophrenia may exhibit deficits in the processing of visual information at a basic level, it remains unclear whether such deficits may account for higher order deficits in affect identification or if deficits in affect identification may be impaired at a level of severity which is beyond that which may be accounted for by basic visual processing deficits.

### **Identification of Affect**

**Perception of visual information in affect identification.** Accurate

identification of facial affect is critical for normal human interactions. Deficits in the identification of affect portrayed in faces have been frequently reported in individuals with schizophrenia (e.g., Mueser et al., 1997), and have been found to be significantly related to social functioning (Hooker & Park, 2002). Deficits have been reported as early as during the first episode of the disorder (Edwards, Pattison, Jackson, & Wales, 2001; Williams et al., 2009) to persist over time periods of up to 3 months and during both the active phase of the disorder and periods of clinical remission (Addington & Addington, 1998; Exner, Boucsein, Degner, Irle, & Weniger, 2004; Gaebel & Wolwer, 1992; Streit, Wolwer, & Gaebel, 1997; Wolwer, Streit, Polzer, & Gaebel, 1996), to be present regardless of medication status and dosage (Gaebel & Wolwer, 1992), and to be demonstrated by individuals with schizophrenia regardless of racial/ethnic or cultural background (e.g., Edwards et al., 2001; Habel et al., 2000; Hofer et al., 2009; Huang, Chan, Lu, & Tong, 2009; Leppanen, Niehaus, Koen, Schoeman, & Emsley, 2008; Minoshita et al., 2005; Pan, Chen, Chen, & Liu, 2009; Pinkham, Sasson, et al., 2008).

Edwards and colleagues (2001) also found evidence that deficits in affect recognition in individuals with schizophrenia are present regardless of and independent from impairments in overall intellectual functioning. Participants included a group of individuals with first-episode schizophrenia ( $n = 29$ ) and a group of normal controls ( $n = 24$ ) who were administered a battery comprised of facial and vocal affect identification measures, as well as overall intellectual functioning as estimated via the WAIS-R. Results indicated that the schizophrenia group, as expected, exhibited significantly poorer accuracy in the identification of affect portrayed via visual (i.e., facial) or auditory (i.e.,

vocal) stimuli, a difference which maintained statistical significance after controlling for intelligence.

The etiology of these deficits, however, remains debated. Some have hypothesized that they result from abnormalities in the early stages of visual processing of faces, particularly given that deficits are found even when such stimuli are presented very briefly (e.g., Suslow, Droste, Roestel, & Arolt, 2005; Suslow, Roestel, & Arolt, 2003), and that deficits in the identification and recognition of neutral faces have been reported (Rocca et al., 2009). Others, however, have reported evidence of a specific deficit in the processing of faces portraying various emotional states with relatively unimpaired facial recognition and identification (Gooding, Luh, & Tallent, 2001; Gooding & Tallent, 2002; Hall et al., 2004; Wynn, Lee, Horan, & Green, 2008), while still others have reported evidence of deficits in both recognition of identity and facial affect identification (e.g., Hooker & Park, 2002; Kerr & Neale, 1993; Silver, Bilker, & Goodman, 2009).

Thus, a great deal of research has thus focused on the processing of emotional cues portrayed in faces within this population in an effort to evaluate the severity of and etiology underlying these deficits. The following sections discuss research to date which explores generalized versus emotion-specific deficits in facial identification, differential deficits according to emotional category, findings regarding facial affect identification deficits in schizophrenia, and the generalizability of facial affect identification tasks to real-world situations.

*Differential deficits according to emotional category.* Research has also investigated whether there is a differential level of impairment in affect identification in

individuals with schizophrenia according to emotional category, such that negative emotions may be identified with less accuracy than positive emotions, suggesting an abnormality of the activation and/or structure of the amygdala in such individuals (e.g., Edwards et al., 2001; Johnston, Devir, & Karayanidis, 2006).

In support of a deficit specific to negative emotions, Bediou, Krolak-Salmon, and colleagues (2005) compared the performance of a group of individuals with schizophrenia ( $n = 29$ ) to that of a group of individuals with major depressive disorder ( $n = 20$ ) and normal controls ( $n = 20$ ) on a task requiring participants to identify whether photographs of individuals were portraying happiness, fear, disgust, or neutrality in varying degrees of emotional intensity. Overall, the schizophrenia group was found to exhibit significantly lower accuracy in emotion identification than both the major depressive and normal control groups, who in turn performed similarly to one another. Further analyses indicated that the schizophrenia group demonstrated significantly lower accuracy than the normal control group when identifying disgust, and than both the major depressive disorder and normal control groups when identifying fear. No significant group differences in accuracy were found between the major depressive disorder and normal control groups when identifying disgust or fear, or among all three groups when identifying happiness. These results therefore suggest that individuals with schizophrenia may have a selective deficit in the recognition and accurate identification of negative emotions, in this case fear and disgust, with relatively spared recognition of such positive emotions as happiness. Other researchers have reported similar findings, especially for faces depicting fear, anger, and disgust (e.g., Chambon, Baudouin, & Franck, 2006; Green, Waldron, & Coltheart, 2007; Evangelii & Broks, 2000; Leppanen, Niehaus, Koen,

du Toit, et al., 2008; Mandal, Pandey, & Prasad, 1998), and have also hypothesized that such deficits may be associated with the negative symptoms observed and reported in many individuals with schizophrenia (e.g., Kohler et al., 2003; Premkumar et al., 2008; Schneider, Gur, Gur, & Shtasel, 1995; van 't Wout et al., 2007), or may perhaps even be indicative of a negative response bias and a tendency to attribute negative emotions (such as fear or sadness) to otherwise neutral or happy faces (e.g., Tsoi et al., 2008).

Some research has suggested, however, that deficits in affect recognition specific to negative emotional categories may not be unique to schizophrenia. Johnston and colleagues (2006), for example, found that both a group of individuals with schizophrenia ( $n = 23$ ) and a normal control group ( $n = 18$ ) demonstrated significantly poorer recognition accuracy for negative emotions (i.e., fear, disgust, anger, and sadness) than for positive emotions (i.e., happiness and surprise). However, this differential performance according to level of category was found to be significantly more pronounced in the schizophrenia group than in the normal control group, suggesting that the oft observed differential impairment in the accuracy of negative emotions as compared to positive emotions in individuals with schizophrenia may not be due to a negative emotion specific deficit in schizophrenia per se, but instead may be a pattern which is mirrored in normal controls, but which is typically significantly more pronounced in individuals with schizophrenia due to their overarching struggle with affect identification and purported amygdalar dysfunction.

Further evidence of differential identification of affect according to emotional category comes from studies comparing the event-related potentials (ERPs) of individuals with and without schizophrenia, which have found abnormal amplitude patterns in patient

groups when viewing faces portraying negative emotions, including disgust, as well as when viewing neutral faces (e.g., An et al., 2003; Caharel et al., 2007; Horley et al., 2001; Kuperberg, Kreher, Swain, Goff, & Holt, 2011). However, some have reported such abnormalities when viewing both positive (i.e., happy) and negative (e.g., fear) faces in individuals with paranoid schizophrenia (e.g., Ramos-Loyo, Gonzalez-Garrido, Sanchez-Loyo, Medina, & Basar-Eroglu, 2009; Yamamoto, Morita, Waseda, Ueno, & Maeda, 2001), although abnormalities may be limited to only negative faces during periods of remission as compared to during acute phases of the disorder (Yamamoto et al., 2001).

In contrast, some research has indicated differential performance on facial affect identification tasks according to emotional category, although in a differing pattern. Specifically, Sachs, Steger-Wuchse, Kryspin-Exner, Gur, and Katschnig (2004) compared the performance of individuals with schizophrenia ( $n = 40$ ) to that of normal controls ( $n = 43$ ) on a measure of facial affect identification. While the schizophrenia group was found, as expected, to exhibit significantly poorer accuracy in affect identification as compared to the normal control group, there was evidence of differential performance within the schizophrenia group according to emotional category presented. However, contrary to multiple reports of relatively greater impairment of identification of negative emotions, the participants included in this sample demonstrated relatively poorer performance on stimuli of faces depicting happiness than those portraying sadness. This finding suggests the presence of subgroups of individuals with schizophrenia who may be differentially impaired on such tasks. Similar findings were reported by Schneider and colleagues (1995).

Still others have found evidence of impaired affect identification by individuals with schizophrenia for faces depicting anger and sadness, with relative sparing of identification for those portraying happiness, fear, and disgust (Bediou, Franck, et al., 2005). To further complicate the issue, some researchers have found evidence that only the identification of faces depicting neutrality of emotional state have been especially impaired in individuals with schizophrenia (Heimberg, Gur, Erwin, Shtasel, & Gur, 1992; Kucharska-Pietura & Klimkowski, 2002), while others have found evidence of a global impairment in affect identification, with no evidence of differential impairment according to emotional valence or in category, in individuals with schizophrenia (Norton, McBain, Holt, Ongur, & Chen, 2009; Silver, Shlomo, Turner, & Gur, 2002).

As indicated via a review of the literature to date, research evaluating the presence and nature of differential deficits in facial affect identification according to emotional category and/or valence of emotion has yielded mixed results, thus impacting the field's ability to formulate an overall conclusion in the matter.

*Evidence against facial affect identification deficits in schizophrenia.* Although uncommon and infrequent, some researchers have notably found no evidence of impairment of facial affect identification by individuals with schizophrenia. Vaskinn and colleagues (2007), for example, compared the performance of a group of individuals with schizophrenia ( $n = 31$ ) to that of groups of individuals with bipolar disorder ( $n = 21$ ) and normal controls ( $n = 31$ ) on facial and auditory affect identification tasks. Notably, there were no significant differences found amongst the groups in accuracy of facial affect identification. Bellack, Blanchard, and Mueser (1996) similarly found that neither a group of individuals with schizoaffective disorder or schizophrenia ( $n = 35$ ) nor a group

of individuals with bipolar disorder ( $n = 11$ ) exhibited significantly poorer performance on a facial affect identification task as compared to a group of normal controls ( $n = 19$ ).

Similarly, Bigelow and colleagues (2006) evaluated a group of individuals with schizoaffective disorder, a brief psychotic disorder, or schizophrenia ( $n = 20$ ), as well as a group of normal controls ( $n = 14$ ) on a number of emotion identification tasks.

Interestingly, the accuracy of the patient group was not significantly different than that of the normal control group when participants were asked to identify the affect portrayed in photographs of scenes and objects without people or photographs of faces portraying various emotions. The patient group, however, did perform significantly worse than the normal control group on measures of affect identification in still scenes from movies, both when the scenes included the facial expressions of the actors and when the facial expressions had been blurred out. The results therefore suggest that the presentation of affect in more simple formats (e.g., in photographs of faces) may not be impaired in individuals with schizophrenia, while more complex presentations (e.g., in photographs of scenes) may be more difficult for such individuals. However, the mixed diagnostic nature of the patient group may have confounded the results somewhat.

Thus, while the majority of research indicates the presence of deficits in facial affect identification in individuals with schizophrenia, reports of some conflicting findings suggest that there may be some variation in performance in some aspect of this sub-domain.

***Generalizability of facial affect identification tasks to real-world situations.***

One criticism of facial affect identification research is its potential lack of generalizability to real-world situations, especially given that real-world situations are rarely, if ever,

comprised of still-life images. Kee, Horan, Wynn, Mintz, and Green (2006) compared the recognition accuracy of affect in faces of a group of individuals with schizophrenia ( $n = 47$ ) to that of a group of normal controls ( $n = 31$ ), with affective states portrayed varying in intensity in an effort to increase generalizability of facial affect identification tasks to real-world situations. Results indicated that the schizophrenia group performed significantly worse than the control group overall, but also that the schizophrenia group had the most difficulty with the relatively ambiguous (i.e., less extreme) affective states. This is in agreement with findings reported by Vernet, Baudouin, and Franck (2008), and may reflect an overall blurring of distinctions between emotional categories by individuals with schizophrenia, which in turn may lead to erroneous perception of ambiguous emotional states by such individuals in day-to-day situations. Similar findings were reported by Tomlinson, Jones, Johnston, Meaden, and Wink (2006), in that individuals with schizophrenia were relatively less accurate in affect identification when stimuli were presented in still photographs than when presented in moving images. The authors suggest that such an improvement may indicate that individuals with schizophrenia notice and consider movements of the face when making judgments regarding the individual's current emotional state.

Overall, research to date has indicated that facial affect identification is generally impaired to some degree in individuals with schizophrenia. However, the specific nature of these deficits and whether there are any differences in level of impairment according to subtype of schizophrenia remains to be determined. Additionally, multiple studies have found evidence of differential impairment according to emotional category in such individuals, although research has yielded mixed findings regarding which categories in

particular may be spared. Again, further research in this domain may help to shed light onto these issues.

**Perception of auditory information in affect identification.** Although less consistently evaluated and demonstrated than deficits in facial affect identification, impairments in auditory affect identification have been found in individuals with schizophrenia as compared to normal controls, including those with first-episode schizophrenia (Hoekert, Kahn, Pijnenborg, & Aleman, 2007). Furthermore, these impairments have been found to be significantly greater in severity in individuals with schizophrenia as compared to individuals with such other psychiatric diagnoses as bipolar disorder (Vaskinn et al., 2007). As with the facial affect identification literature, however, it is unclear whether these deficits result from low level sensory deficits, higher order processing, or some combination of the two, although some evidence in favor of a relationship between basic auditory processing and auditory affect identification has been demonstrated (e.g., Leitman et al., 2005).

***Differential deficits according to emotional category.*** Although research to date evaluating the presence and nature of emotion-specific deficits in the perception of auditory information is somewhat limited, reported findings have generally been consistent with such a hypothesis, which is concordant with reports of temporal lobe abnormalities in individuals with schizophrenia. Kucharska-Pietura, David, Masiak, and Phillips (2005), for example, compared the performance of a group of individuals with schizophrenia ( $n = 100$ ) to that of a group of normal controls ( $n = 50$ ) on measures of auditory and visual affect identification, as well as on a measure of facial identity recognition. The schizophrenia group, which included only individuals who were

determined to be in clinical remission at time of testing, was comprised of two sub-groups based on length of illness ( $n = 50$  first- or second-episode participants;  $n = 50$  chronically ill participants). Emotional categories included on the Facial Emotion Recognition Test were interest/excitement, enjoyment/joy, surprise/startle, distress/anguish, disgust, contempt, anger/rage, shame/humiliation, and fear/terror, while those included on the Voice Emotion Recognition Test were happy, sad, fear, anger, surprise, disgust, and neutral. Results indicated that the first-/second- episode schizophrenia group performed significantly worse than the normal control group on all tasks, and that the chronic schizophrenia group in turn performed significantly worse than both the first-/second-episode schizophrenia and normal control groups across all tasks. These results suggest impairments in both visual and auditory affect identification in individuals with schizophrenia. Furthermore, the present study indicates that such deficits may be present very early on in the course of the disorder and may worsen over the course of the disorder, suggesting that impairments in these abilities are perhaps associated with both etiology and disease course. Similar findings regarding impairment in both visual and auditory affect identification were reported by Edwards and colleagues (2001), who also found no evidence of differential performance within the schizophrenia group according to emotional category despite significant overall impairment of the group in both domains as compared to normal controls.

Bach, Buxtorf, Grandjean, and Strik (2009) performed a similar study in which a group of individuals diagnosed with paranoid schizophrenia ( $n = 25$ ), a group of normal controls ( $n = 25$ ), and a group of clinically depressed individuals ( $n = 25$ ) were compared on measures of both visual and auditory affect identification. Emotional categories

included happiness, sadness, anger, fear, disgust, and neutrality. Visual stimuli were presented via photographs of faces, while auditory stimuli were presented in the form of non-words which were clustered into sentence-like phrases and were read in various tones of voice to depict the various emotional categories. Results indicated that the schizophrenia group performed significantly worse than both the normal control and clinically depressed groups on both the visual and auditory affect identification tasks, with relatively poorer performance within the schizophrenia group on items portraying anger. Overall, these results suggest that auditory affect identification is impaired in such individuals, and also that this impairment may be relatively unique to schizophrenia within the realm of psychiatric disorders. Similar findings were reported by Hooker and Park (2002), who found a group of individuals with schizophrenia ( $n = 20$ ) to perform significantly worse than a group of normal controls ( $n = 27$ ) on measures of both visual and auditory affect identification.

Interestingly, as previously reported, Vaskinn and colleagues (2007) found no evidence of impaired facial affect identification in a group of individuals with schizophrenia ( $n = 31$ ) as compared to both a group of individuals with bipolar disorder ( $n = 21$ ) and a group of normal controls ( $n = 31$ ). The schizophrenia group did, however, perform significantly worse than both the bipolar disorder and normal control groups on a measure of auditory affect identification, thus suggesting the presence of auditory affect identification independent of facial affect identification in individuals with schizophrenia. However, given that this study did not include a measure of affect identification when stimuli were presented both auditorily and visually, its results shed no light onto the

question of whether the integration of auditory and visual stimuli is also and/or differentially impaired in individuals with schizophrenia.

Research to date, although limited, thus suggests that both visual and auditory affect identification may be impaired in individuals with schizophrenia. In terms of ecological validity, however, research evaluating affect identification and accurate perception of social cues on tasks of concurrently presented visual and auditory information seem to better mirror real-world interpersonal interactions for which such skills are often necessitated.

**Integration of visual and auditory emotional information.** Some research has also evaluated affect identification in individuals with schizophrenia in response to stimuli portraying both visual and auditory information (i.e., via moving images). Such research is aimed at evaluating whether deficits in visual-auditory affect identification are present in such individuals in addition to previously described deficits in visual and affect identification independent of one another (e.g., Kee, Kern, & Green, 1998; Kerr & Neale, 1993).

Bryson, Bell, and Lysaker (1997) evaluated the performance of a group of individuals with either schizophrenia or schizoaffective disorder ( $N = 63$ ) on such a task to their performance on a number of neurocognitive measures. No normal control group was included for comparison. The neurocognitive battery included the Wisconsin Card Sorting Test as a measure of executive functioning and abstract reasoning, the Wechsler Adult Intelligence Scale – Revised as a measure of general intelligence, the Continuous Performance Task as a measure of sustained attention, the Wechsler Memory Scale – Revised as measures of auditory and visual memory, the Hopkins Verbal Learning Test

as a measure of verbal learning and memory, and Horham's Proverbs as a measure of severity of thought disorder. The ability of the participants to recognize and identify the emotions portrayed in interpersonal situations was measured via the Bell-Lysaker Emotion Recognition Task (BLERT), which is comprised of an actor reciting brief monologues with facial expressions and vocal tones manipulated to indicate various emotional states. The content of the monologues is otherwise emotionally neutral. Emotional states portrayed include happiness, sadness, fear, disgust, surprise, anger, and neutral. Results indicated that the group exhibited moderate impairment on the BLERT as determined via a previously delineated method of rating of severity according to BLERT total scores. Furthermore, performance on the BLERT was found to be significantly correlated with and predicted by performance on measures of executive functioning and sustained attention, but not by a measure of general intelligence. The study therefore demonstrated not only the utility of the BLERT in identifying deficits in social cognition when utilizing visual and auditory social cues, but also provided support to the previously explored hypothesis that impairments in social cognition in individuals with schizophrenia are independent of general deficits in intellectual functioning.

Fiszdon, Richardson, Greig, and Bell (2007) reported similar findings, in that groups of individuals with schizophrenia ( $n = 199$ ) and schizoaffective disorder ( $n = 73$ ) were evaluated on a number of neurocognitive domains, including verbal and nonverbal memory as measured via the Wechsler Memory Scale – Revised, working memory as measured via the WAIS-III Digit Span subtest, information processing speed as measured via the WAIS-III Coding subtest, verbal learning and memory as measured via the Hopkins Verbal Learning Test – Revised, and executive functioning as measured via the

Wisconsin Card Sorting Test. Social cognition was also evaluated via the Hinting Task as a measure of theory of mind, and the Bell-Lysaker Emotion Recognition Test as a measure of visual-auditory affect identification. Both groups were found to have performed worse than the general population as determined by standard scores derived from the norms reported in the respective manuals of the neurocognitive tasks, and a set of unpublished norms regarding performance on the social cognition tasks. The findings therefore suggest some degree of impaired affect identification by individuals with schizophrenia and schizoaffective disorder when such identification necessitates the utilization and integration of both visual and auditory information. Impaired theory of mind is also indicated. The absence of a normal control group for purposes of direct comparison, however, limits the implications of the findings.

Consistent with research examining auditory and visual modalities alone, research has also indicated differential impairment according to the emotional category portrayed on such visual-auditory affect identification tasks, in that negative emotions have been found to be recognized with less accuracy than positive emotions in groups of individuals with schizophrenia. Bell, Bryson, and Lysaker (1997) reported such evidence upon comparison of performance of a group of individuals with either schizophrenia or schizoaffective disorder ( $n = 50$ ), a group of individuals with current substance abuse diagnoses ( $n = 25$ ), and a group of normal controls ( $n = 81$ ), on the Bell-Lysaker Emotion Recognition Task (BLERT). Results indicated that the normal control group performed best, followed by mild to moderate impairment in the substance abuse group. The schizophrenia group exhibited the poorest performance, which fell in the moderate to severe range of impairment range. The schizophrenia group was also found to

demonstrate significantly poorer recognition accuracy when presented with negative emotions (i.e., sadness, fear, anger, and disgust) than with positive emotions (i.e., happiness and surprise). This is concordant with previously reported findings that individuals with schizophrenia may demonstrate relatively poorer accuracy on tasks of facial affect identification for negative than for positive emotions (e.g., Premkumar et al., 2008).

Abnormal perception of visually and auditorily incongruent cues may also be present in individuals with schizophrenia, as suggested by de Jong, Hodiamont, van den Stock, and de Gelder (2009) subsequent to a comparison of a group of individuals with schizophrenia ( $n = 55$ ) to that of a group of individuals with non-schizophrenia psychosis ( $n = 46$ ), as well as to a group of normal controls ( $n = 50$ ). Participants were administered measures of affect recognition, with each stimulus comprised of a photograph depicting an emotion and a voice simultaneously reading an otherwise neutral sentence in an “emotional” tone. The emotional states portrayed visually and auditorily were congruent for some items (i.e., a “happy” face paired with a “happy” voice), and incongruent for others (i.e., a “happy” face paired with a “fearful” voice). Identification of affect was more accurate for all groups for congruent (as compared to incongruent) stimuli. This differential performance, however, was significantly less pronounced in the schizophrenia group than in either the non-schizophrenia psychotic or healthy control groups, suggesting a breakdown in the integration of visual and auditory information in individuals with schizophrenia, which could lead to a decrease in performance accuracy when those stimuli are discordant with one another.

Huang and colleagues (2009) also found evidence of misperception of an impairment in visual-auditory affect identification presented via particularly ambiguous stimuli in individuals with schizophrenia ( $n = 18$ ) as compared to a group of normal controls ( $n = 16$ ). The task was comprised of a series of audio recordings of interpersonal interactions with concurrently presented photographs of individuals portraying various affective states. Emotions depicted in the photographs were either “happy” or “angry”, but were altered in order to increase the ambiguity of the photograph and thus evaluate the point at which faces began to be perceived as “angry” rather than “happy” in the groups. Results indicated that the schizophrenia group began to perceive faces as “angry” earlier in the continuum of ambiguity than did the normal control group. Furthermore, the schizophrenia group seemed to disregard the context cues presented in the auditory stimuli when determining the emotion portrayed. These findings are similar to those of Vernet and colleagues (2008) and Kee and colleagues (2006), in that greater ambiguity seemingly leads to greater difficulty in affect discrimination by individuals with schizophrenia, and also to those of Green and colleagues (2007), in that individuals with schizophrenia may be more prone to misinterpret a signal as being threatening, regardless of conflicting context evidence.

Bellack and colleagues (1996), however, found no evidence of impaired affect identification by a group of individuals with either schizophrenia or schizoaffective disorder ( $n = 35$ ) as compared to a group of normal controls ( $n = 19$ ) when participants were shown silent videos and videos paired with auditory stimuli and asked to identify the emotion of a character in a scene. Interestingly, however, there were also no significant between-group differences in accuracy of facial affect identification as

measured via photographs of actors portraying various emotional states, perhaps suggesting an anomalous finding, especially given the overwhelming evidence in the literature in support of facial affect identification deficits in such individuals.

Overall, research conducted to date has generally indicated that individuals with schizophrenia exhibit deficits in identification of affect for combined visual and auditory information. The exact nature of these deficits, however, remains unclear. Research has yet to demonstrate, however, whether such deficits are reflective of impaired visual processing, impaired auditory processing, a combination of the two, or due to the need to integrate information from multiple modalities of stimulus presentation. Furthermore, as with visual and auditory affect identification, it remains unclear whether there are differential impairments in visual-auditory affect identification according to emotional valence (i.e., positive versus negative) and/or to specific emotional category (i.e., happy, sad, anger, disgust, etc.).

**Neurocognitive correlates of affect identification.** Multiple neurocognitive deficits have been found to be associated with deficits in facial affect identification in individuals with schizophrenia, with the most pronounced of these deficits being in executive function (e.g., Premkumar et al., 2008; Sachs et al., 2004). Although some studies have found no evidence of such relationships (e.g., Gur et al., 2006), other authors have postulated that deficits in such social cognitive tasks as facial affect identification may be due to an overloading of working memory capacity in individuals with schizophrenia, rather than to impaired processing of social or emotional information per se, such that emotional information overloads an already weaker than normal working memory system (e.g., Hoschel & Irle, 2001). Nevertheless, recent research has attempted

to elucidate the relationship, if any, between affect identification and neurocognitive functioning.

Premkumar and colleagues (2008), for example, compared the performance of a group of individuals with either schizophrenia or schizoaffective disorder ( $n = 73$ ) to that of a group of normal controls ( $n = 30$ ) on a facial affect identification task, as well as on a task of executive function, namely the Wisconsin Card Sorting Test. Greater impairments on the facial identification task in the patient group were significantly correlated with more perseverative errors on the Wisconsin Card Sorting Test, suggesting a degree of cognitive inflexibility in such individuals, which may at least partially account for the observed misattribution of affect. Similar results have been reported by others, such that deficits in affect identification have been found to be associated with impairments in verbal processing, verbal processing, visual memory, fine motor skills, visual processing, visual scanning, sustained attention, and verbal memory (Bozikas, Kosmidis, Anezoulaki, Giannakou, & Karavatos, 2004; Kee, Kern, & Green, 1998; Kohler, Bilker, Hagendoorn, Gur, & Gur, 2000; Sachs et al., 2004; Silver & Schlomo, 2001; Williams, Loughland, Gordon, & Davidson, 1999). Deficits in executive functioning have also been demonstrated (e.g., Bozikas et al., 2004; Kohler et al., 2000; Sachs et al., 2004), although such evidence has been conflicting (e.g., Silver et al., 2003).

Further research has attempted to determine whether deficits in affect recognition may be accounted for by impairments in overall cognitive functioning, or if the two are independent domains which may be differentially impaired. Kerr and colleagues (1993), for example, compared the performance of a group of individuals with schizophrenia ( $n = 29$ ) to a group of normal controls ( $n = 23$ ) on several affect identification and

discrimination tasks, as well as on a number of neuropsychological measures. Specifically, participants were asked to identify the emotion (i.e., happiness, sadness, anger, fear, surprise, and shame) portrayed in photographs. Participants were also asked to identify whether two faces or voices were depicting the same or different emotional states. Measures of facial recognition and perception of sounds were administered to ensure that no underlying deficits were present in the recognition of faces or sounds. Interestingly, results indicated that the schizophrenia group performed significantly worse than the normal control group on all of the tasks, including those with no emotional content (i.e., the facial recognition and perception of sounds tasks). The authors purport that these findings suggest that deficits in the identification of emotions, as well as in discrimination between different emotional categories, may be due to a general cognitive deficit in individuals with schizophrenia, rather than to a specific deficit due to the emotional content of the stimuli. However, it should be noted that these individuals were all unmedicated at time of testing, which is in stark contrast to the majority of the other literature. It may therefore be that antipsychotic medications improve cognitive functioning and/or basic perception in general, but do not remedy deficits in the identification of and discrimination between emotionally-laden stimuli. Other studies, however, have found no such evidence of a meaningful relationship between overall intellectual functioning and facial affect identification (e.g., Schneider et al., 1995).

Pan and colleagues (2009) reported further evidence to support the hypothesis that deficits in affect identification in individuals with schizophrenia may be related to, if not at least partially accounted for by, deficits in overall intellectual functioning upon comparison of a group of individuals with chronic, stabilized schizophrenia ( $n = 33$ ) to

that of a group of acute patients ( $n = 40$ ) and a normal control group ( $n = 40$ ) on measures of social functioning, facial affect identification, selective and sustained attention, visuospatial working memory, processing speed, executive functioning, and overall intelligence. As expected, both schizophrenia groups performed significantly worse than the normal controls across all neurocognitive domains measured.

Additionally, the chronic but stable schizophrenia group exhibited intermediate levels of performance on several neurocognitive variables, as they performed significantly better than the acute patients but worse than the normal control participants on measures of selective and sustained attention, as well as processing speed. Further results indicated differential relationships amongst the variables according to patient group membership. Specifically, the performance of the chronic schizophrenia group on the facial affect identification task was related to several sub-domains of social functioning, namely social role performance and self-care, as measured via the Personal and Social Performance Scale, but not to other neurocognitive variables. Conversely, the performance of the acute schizophrenia group on the affect identification task was significantly related to neurocognitive impairment, specifically in overall intellectual functioning, as well as in the domains of visuo-spatial working memory and selective attention. Interestingly, performance on the affect identification task was also significantly related to visuo-spatial working memory in the normal control group. Overall, these results shed little light onto the debate over whether deficits in social cognition are independent from intellectual functioning in general, or whether they are subsumed by deficits in this domain. However, the results suggest that acutely ill patients with schizophrenia may experience deficits in affect recognition and identification that are secondary to overall

intellectual impairment and that are also related to deficits in visuo-spatial working memory, similar to normal controls. However, the long-lasting deficits that are, for many individuals with schizophrenia, observed throughout the lifetime and disease course may be present regardless of intellectual functioning.

### **Perception and Interpretation of Complex Social Situations**

As already discussed in depth, multiple domains related to social cognition have been found to be significantly impaired in individuals with schizophrenia. It is apparent that deficits in visual and auditory perception, visual affect identification, auditory affect identification, and visual-auditory affect identification may all contribute to the impaired social cognition and social functioning in individuals with schizophrenia. However, many of the tasks previously discussed do not emulate real life situations, as judgments are often confined to single static stimuli (e.g., identification of affect on a specific face). To address this consideration, studies have also evaluated the ability of patients with schizophrenia to interpret more complex situations. Research to date has suggested that deficits in the processing of social cues may contribute to overall deficits in social functioning in individuals with schizophrenia and may be present early on in the course of the disorder at a level of impairment which is similar to that of individuals with multi-episode schizophrenia (Addington, Saeedi, & Addington, 2006; Grant, Addington, Addington, & Konnert, 2001), although differential levels of impairment in complex social skills may be associated with differential levels of course severity (Corrigan, Garman, & Nelson, 1996). Studies of these more complex abilities have generally examined interpersonal problem solving, perception of social cues, and ability to role play appropriate social interactions.

Regarding interpersonal skills in particular, a review conducted by Green, Uhlhaas, and Coltheart (2005) led the authors to conclude that non-impaired complex social skills and social functioning may necessitate an accurate consideration and interpretation of contextual cues within interpersonal situations, the breakdown of which would in turn negatively impact overall complex social skills and social functioning. Furthermore, eye tracking studies have suggested that, similar to those observed on facial affect identification tasks, abnormalities in patterns of eye movements and gaze by individuals with schizophrenia have been found during tasks requiring the perception and utilization of social cues within the context of various social situations (Green, Waldron, Simpson, & Coltheart, 2008). Further evaluation of this domain has included tasks assessing perception of social cues and performance on role-playing measures in response to such cues.

Stalberg, Lichtenstein, Sandin, and Hultman (2008), for example, compared the performance of a group of individuals with a psychotic disorder ( $n = 25$ ), the majority of whom (23 of 25, or 92%) had been diagnosed with schizophrenia, a group of unaffected siblings of individuals with schizophrenia ( $n = 20$ ), and a group of normal controls ( $n = 25$ ) on a measure of interpersonal problem solving skills. The purpose of the study was to measure interpersonal problem solving skills in individuals with schizophrenia, and to see if deficits in such skills were also present in first-degree relatives of such individuals, which would suggest a genetic component to the domain and potentially an endophenotypic marker for the disorder. The measure utilized was a Swedish version of the Assessment of Interpersonal Problem Solving Skills (AIPSS), which was created for use specifically with individuals with schizophrenia and which has been used with such

samples in the United States. Results indicated that the schizophrenia group exhibited significantly poorer overall problem solving skills in interpersonal situations than both the first-degree relatives and normal control groups, although differences in perception of social problems and generation of verbally-mediated solutions were no longer statistically significant once presence and severity of positive and negative symptomatology of the schizophrenia participants at time of testing was controlled for. The first-degree relative group in turn performed worse than the normal control group, although this difference was statistically significant only for a measure of nonverbal interpersonal skills, including appropriateness (versus inappropriateness) of eye contact, vocal volume, and affect. Correlational analyses regarding the relationships between psychiatric symptomatology and performance on the AIPSS indicated statistically significant negative relationships between overall psychiatric symptoms and performance on the Performance scale in the schizophrenia group, and between presence and severity of positive symptoms and the Sending Skills scale, which is a reflection of the ability to recognize and choose the “right thing” to say or do in a situation, in the first-degree relative group. Although these results therefore provide inconclusive evidence regarding whether deficits in interpersonal problem solving skills are present in first-degree relatives of individuals with schizophrenia and thus may function as an endophenotypic marker for vulnerability to the disorder, the present findings do provide support for the hypothesis that social cognition is impaired at the interpersonal problem solving skills level in individuals with schizophrenia. However, such deficits may be limited to the domain of interpersonal performance once the effects of psychiatric symptomatology (i.e., positive and negative symptoms) are controlled.

Ucok and colleagues (2006) also evaluated interpersonal problem solving skills in a group of individuals with schizophrenia ( $N = 63$ ) as an evaluation of which neurocognitive domains, if any, may be related to such impairments. The test battery was comprised of the AIPSS as a measure of interpersonal problem solving skills, Wisconsin Card Sorting Test as a measure of executive functioning and cognitive flexibility, the WAIS-R Digit Span subtest as a measure of short-term memory for auditory information, and the Continuous Performance Test as a measure of sustained attention. Subsequent to the administration of the battery, a subgroup of the participants was provided a 6-week-long series of training exercises targeted at improving their interpersonal and problem solving skills. Following the 6 weeks, the training group ( $n = 32$ ) was found to have demonstrated statistically significant improvement in their overall interpersonal problem solving skills, as well as their abilities to recognize, identify and describe interpersonal problems and to consider and choose appropriate responses to such problems. The non-training group ( $n = 31$ ), in turn, exhibited no statistically significant changes in performance on any of the scales of the AIPSS. Furthermore, a consideration of neurocognitive performance indicated that, within the training group, cognitive flexibility and sustained attention as measured prior to the training were significant predictors of post-training performance on the AIPSS. The findings therefore indicate the presence of impairments in interpersonal problem solving skills in individuals with schizophrenia, particularly in the absence of training focused on ameliorating such impairments.

Zanello, Perrig, and Huguelet (2006), conversely, reported evidence which could be considered to suggest that social skills deficits can be explained by impairments in overall intellectual functioning in individuals with schizophrenia. Specifically, the

authors compared the performance of a group of individuals with schizophrenia ( $n = 20$ ) to that of a group of normal controls ( $n = 20$ ) on a number of neurocognitive variables, as well as on a measure of interpersonal skills, namely the AIPSS. Neurocognitive domains evaluated included verbal memory as measured via the Rey Auditory Verbal Learning Test, visuospatial organization and memory via the copy and memory portions of the Rey-Osterrieth Complex Figure Task, executive functioning via the Verbal and Design Fluency tests and the Wisconsin Card Sorting Test, attention via the d 2 cancellation test, and overall intellectual functioning via the Standard Progressive Matrices of Raven. Results indicated that the schizophrenia group performed significantly worse than did the control group on all neurocognitive measures, as well as on all scales of the AIPSS. No statistically significant correlations between performance on any of the AIPSS scales and any of the neurocognitive variables were found in the normal control group. Correlational analyses conducted within the schizophrenia group, however, yielded significant correlations between performance on the AIPSS Processing and Sending scales (i.e., those measuring perception of social problems and the selection of and skill in performing appropriate responses, respectively) and attention, as well as between the AIPSS Sending scale and both executive functioning and overall intellectual functioning, although none of these correlations remained statistically significant once the Bonferroni correction was applied to control for increased risk of Type I errors in multiple correlations. Regression analyses also indicated that overall intellectual functioning was a significant predictor for performance on all scales of the AIPSS in the schizophrenia group, including when controlling for age, gender, and education, with none of the other neurocognitive domains providing any further prediction value. Regression analyses in

the normal control group yielded no such significant predictors of interpersonal problem solving skills. Overall, these results suggest that social functioning and interpersonal skills are impaired in individuals with schizophrenia in relation to normal controls. Furthermore, there may exist a relationship between such impairments and overall intellectual functioning which (a) suggests that deficits in interpersonal skills in individuals with schizophrenia may be accounted for by overall impairments in intellectual functioning, and (b) that this relationship is unique to those with schizophrenia and is not mirrored in normal controls.

Addington, McCleary, and Munroe-Blum (1998), however, found evidence to suggest that interpersonal skills may be related to neurocognitive performance in more specific domains. A group of individuals with schizophrenia or schizoaffective disorder ( $N = 30$ ) was evaluated on measures of neurocognition, social functioning, and interpersonal problem solving skills. Neurocognitive domains assessed included overall verbal ability as measured via the Comprehension, Similarities, and Information subtests of the WAIS-R, overall nonverbal ability as measured via the Picture Arrangement, Digit Symbol, and Object Assembly subtests of the WAIS-R, verbal memory as measured via selected subtests of the WMS-R, visual memory as measured via the memory portion of the Rey-Osterrieth Complex Figure, executive functioning and cognitive flexibility as measured via the Wisconsin Card Sorting Test and the Verbal Fluency Test, and sustained attention as measured via the Continuous Performance Test. Additionally, social functioning was evaluated via the Social Dysfunction Index and the Social Adjustment Scale-II, while interpersonal problem solving skills were evaluated via the Assessment of Interpersonal Problem Solving Skills (AIPSS). Results indicated that

none of the neurocognitive measures significantly predicted participants' scores on the measures of social functioning, suggesting unrelated constructs. However, performance on measures of one's perception of the social aspects of situations (i.e., the AIPSS Processing Skills scale) and his/her knowledge and appropriateness of responses to such situations (i.e., the AIPSS Sending Skills scale) was significantly predicted by sustained attention. Although no overall measure of general intellectual ability was included in this study, an average of the scaled scores of two of the subtests from the Verbal IQ portion of the WAIS, namely the Vocabulary and Information subtests, is often considered to be a good estimate of premorbid intellectual functioning. Therefore, given that the participants' performance on several WAIS-R Verbal IQ subtests did not provide significant predictive value to their respective performance on any of the scales of the AIPSS, the current findings can be considered to suggest that deficits in interpersonal problem solving skills as measured via the AIPSS may be present in individuals in schizophrenia independent of impairments in overall intellectual functioning.

In a comparison of the relative utilization of facial affect and complex social cues in determining the likely emotional state of an individual, Green and colleagues (2007) evaluated groups of individuals with schizophrenia ( $n = 20$ ) and normal controls ( $n = 22$ ) on facial affect recognition and vignette-face tasks. Short written vignettes were presented to the participants prior to the presentation of a photograph of an individual portraying an emotion, with the goal of introducing a more complex element into the task of affect recognition. For each of the stimuli, however, the emotion which would be expected to be portrayed given the social and context cues included in the vignette was discordant with the emotion which was actually depicted in the photograph of the face.

The task therefore allowed for a determination regarding whether social and context cues influenced the determination of affect in individuals with schizophrenia as compared to normal controls. Results indicated that, in addition to the expected impaired performance on the facial affect identification task, the schizophrenia group performed significantly worse than the control group on the face-vignette task, with significantly less apparent consideration of the context cues presented in the vignettes. This effect was especially notable for facial expressions which could be perceived as communicating threat, indicating that individuals with schizophrenia are especially likely to misconstrue otherwise neutral or positive situations as threatening. Similar findings were reported by Penn, Ritchie, Francis, Combs, and Martin (2002).

Overall, deficits in complex social skills in a broad sense have been found in individuals with schizophrenia. However, the complex nature of social cognition as a construct necessitates a consideration of the sub-constructs which contribute to the domain. Multiple studies have, in isolation, found evidence of deficits in such sub-constructs of social cognition as affect identification (especially facial affect identification), theory of mind, and interpersonal interaction and problem solving skills. However, studies have generally neglected to compare the performance of one group of individuals with schizophrenia to that of one group of normal controls across all of these domains, thus precluding an evaluation of whether deficits may be present across these sub-domains, and/or may vary in degree of severity.

**Neurocognitive correlates of deficits in perception and interpretation of complex social situations.** As with deficits in affect identification, research regarding deficits in perception and interpretation of complex social situations has attempted to

evaluate (1) to what extent neurocognitive deficits and social skills impairments may be related, and (2) whether observed impairments in complex social skills in individuals with schizophrenia may be due to impairments in social cognition as a separate neurocognitive domain, or instead to overall neurocognitive impairments.

Sergi, Rassovsky and colleagues (2007), for example, utilized structural equation modeling to compare how well a one-factor model (i.e., neurocognition and social cognition as one factor) versus a two-factor model (i.e., neurocognition and social cognition as separate factors) fit the performance data of a group of individuals diagnosed with either schizophrenia or schizoaffective disorder ( $n = 100$ ). The neurocognitive domains measured included verbal episodic memory via the California Verbal Learning Test, executive functioning via the Wisconsin Card Sorting Test, sustained attention via the Degraded-Stimulus Continuous Performance Test, verbal working memory via a Letter-Number Span Test, information processing speed via the Digit Symbol-Coding subtest of the Wechsler Adult Intelligence Scale – Third Version, fine motor skills via the Grooved Pegboard Test, and verbal fluency via the Controlled Oral Word Association Test. Likewise, two sub-domains were used to evaluate social cognition – emotion perception and social perception. Emotion perception was measured via the Face and Verbal Emotion Identification Tasks, while social perception was measured via the Half-Profile of Nonverbal Sensitivity and the Interpersonal Perception Task-15. Notably, both the one- and two-factor models yielded nonsignificant chi-square coefficients and had moderate to high factor loadings from each of the variables, indicating that both models fit the data relatively well. However, a comparison of the chi-square coefficients for each of the models evidenced that the two-factor model was a significantly better fit for the

data than was the one-factor model. In other words, the findings suggested that the construct of social cognition may be independent from that of neurocognition in general, and that impairments in complex social situation perception and interpretation by individuals with schizophrenia may not be accounted for solely by overall deficits in neurocognition.

Addington and Addington (1999) similarly evaluated a group of such individuals ( $N = 80$ ) on two self-report measures, namely the Social Functioning Scale and the Quality of Life Scale, as well as with the Assessment of Interpersonal Problem Solving Skills (AIPSS), which served to evaluate complex social skills. Neurocognitive domains assessed included verbal ability as measured via the Vocabulary subtest of the WAIS-R, visual-spatial ability as measured via the Block Design subtest of the WAIS-R, verbal memory as measured via the Logical Memory and Paired Associates subtests of the WMS-R, visual memory as measured via the Rey-Osterrieth Complex Figure, visual attention as measured via the Continuous Performance Test and the SPAN, and executive functioning as measured via the Wisconsin Card Sorting Test, the Chicago Word Fluency Test, and the Jones-Gotman Design Fluency Test. Results indicated that performance in the neurocognitive domains of executive functioning, verbal ability, and verbal memory significantly predicted complex social skills. Visual-spatial functioning and visual attention were also related to performance on the social skills portion of the AIPSS. Overall, these findings suggest that deficits in both neurocognition and complex social skills are common in individuals with schizophrenia and that the degree of impairment in neurocognition may impact the severity of deficits in social cognition, but also that such deficits may be differentially impaired in such individuals.

Research to date has thus generally found that, while complex social skills impairments may tend to co-occur with deficits in multiple other neurocognitive domains, including overall intellectual functioning, such impairments may be independent from these other deficits and may persist outside of the generalized cognitive deficit commonly thought to be associated with schizophrenia. This finding lends further support to the hypothesis that individuals with schizophrenia may exhibit differential impairments across sub-domains of social cognition. Further research into the exact nature of these potentially various levels of impairment, however, is needed.

### **Theory of Mind**

Theory of mind as a construct can be described as the ability to formulate working hypotheses regarding the thoughts, feelings, and goals of another individual given context and interpersonal cues. This ability to “place oneself into another’s shoes” has been hypothesized and subsequently found to be impaired in individuals with schizophrenia, both immediately (e.g., Couture, Penn, Addington, Woods, & Perkins, 2008; Lysaker, Shea, et al., 2010; Schimansky, David, Rossler, & Haker, 2010) and longitudinally (e.g., Lysaker et al., 2011), although some findings have suggested that such deficits may be present in individuals with disorganized, but not in non-disorganized, schizophrenia (Brune, 2003; Sarfati, Hardy-Bayle, Brunet, & Widlocher, 1999). Nevertheless, such deficits likely interfere with the ability of such individuals to behave appropriately in day-to-day social interactions, resulting in increasingly greater social withdrawal and isolation, and may be associated with the etiology of paranoia in individuals with schizophrenia (Lysaker, Salvatore, et al., 2010).

The origin of theory of mind as it applies to individuals with schizophrenia is characterized by an overlap with theory of mind in autism, particularly given that a marked deficit in social interaction is a hallmark feature of autism (APA, 1994). In fact, autism was historically considered by some to be a form of schizophrenia characterized primarily by negative symptoms, in the absence of positive symptoms. As described by Frith (2004), children diagnosed with autism have repeatedly been found to perform poorly on theory of mind tasks, which has been postulated to account for their frequently relatively poor social skills. Early research into the domain of theory of mind focused on the construct within autism specifically, with studies indicating its uniqueness to autism as compared to such other disorders as Down's Syndrome (e.g., Baron-Cohen, Leslie, & Frith, 1985), while more recent directions of research have begun to include a comparison of social cognition between individuals with these disorders in order to further elucidate social cognition (e.g., Sasson, Pinkham, Carpenter, & Belger, 2011).

In his overview of theory of mind, both in general and as it relates to schizophrenia, Frith (2004) holds that theory of mind is not necessarily synonymous with social cognition, as social cognition is multi-dimensional and does not solely include theory of mind. Theory of mind can instead be conceptualized as a sub-domain of social cognition, for while social cognition can theoretically be present in the absence of theory of mind abilities, social cognition is very likely to be impaired in such cases, leading to impairments in overall social functioning. In other words, theory of mind is a construct that is independent from social cognition, but also a domain in which impairments generally co-occur, if not contribute to, impairments in social cognition. Frith (2004) also posits that theory of mind may not be impaired in individuals with schizophrenia per

se, as many individuals with schizophrenia are able to consider the thoughts and motives of others. Rather, that this ability is just often flawed in these individuals. Instead the performance of individuals with schizophrenia on theory of mind tasks is, according to Frith (2004), characterized by an “over-mentalization,” in which inaccurate hypotheses are made regarding the thoughts and beliefs of others. The performance of such individuals on theory of mind tasks thus suggests an overreliance on the “state of the world,” with relatively little or inefficient consideration of the belief systems, motivations, and thoughts of others, leading to erroneous or inappropriate social responses and ineffective communication with others. Interestingly, however, some research has indicated that “over-mentalization” may be associated with prominent positive symptoms, and “under-mentalization” may in turn be associated with prominent negative symptoms, with each sub-group demonstrating similarly impaired theory of mind (Montag et al., 2011). Other research has similarly identified a relationship between severity of positive symptomatology and impaired theory of mind (Koelkebeck et al., 2010). Regardless of the specific mechanism or etiology of impairment, however, these deficits overall likely in turn contribute to the impairments in social functioning so often apparent in individuals with schizophrenia.

The assessment of theory of mind is often broken down into first- and second-order theory of mind tasks, with first-order tasks requiring participants to identify the thoughts and/or emotional state of another (Kleinman, Marciano, & Ault, 2001), as opposed to second-order theory of mind tasks, which evaluate what participants think another individual’s thoughts are about the thoughts of others or of the participant (Bauminger & Kasari, 1999). One first-order theory of mind task frequently used is

comprised of variations of what is known as the “Eyes Task.” The Eyes Task includes a series of photographs of individuals portraying various emotional states, with only the portions of the photographs in which the eyes are depicted presented as stimuli. Participants are asked to determine the emotional state of the individual in each photograph. Although this task is reminiscent of facial affect identification tasks, the primary difference between these two types of measures is the lack of salient facial features in the Eyes Tasks, other than the eyes themselves. Such first-order theory of mind tasks as the Eyes Task therefore allow for a measure of one’s ability to consider the thoughts and feelings of others without having the convenience of facial features.

Kington, Jones, Watt, Hopkin, and Williams (2000) evaluated performance on a first-order theory of mind task in a group of individuals with schizophrenia ( $n = 16$ ) as compared to that of a group of normal controls ( $n = 16$ ). Participants were administered a task of facial affect identification via photographs of an actress portraying a number of emotional states (i.e., happy, sad, afraid, surprised, distress, disgust, and angry) and “complex mental states” (i.e., arrogant, flirting, scheming, quizzical, bored, interested, admiring, guilty, and thoughtful). Some photographs were presented in their entirety, while others included only the actress’ eyes. As expected, results yielded overall significant between-group differences, in that the schizophrenia group performed significantly worse than the normal control group across all tasks. Further analyses indicated that the schizophrenia group performed similarly to the normal control group in the identification of affect for non-complex mental states for both the face and eyes stimuli, as well as in the identification of complex mental states for the face stimuli, but significantly worse than the normal controls in the identification of complex mental states

for the eyes stimuli. Results therefore interestingly suggest that such individuals struggle primarily when interpreting complex mental states from limited facial cues, but that their identification of affect for non-complex affective states is relatively intact. Although these findings are discordant with those which have reported deficits in facial affect identification in individuals with schizophrenia (e.g., Mueser et al., 1996), the stimuli in this case were presented in a forced choice format (i.e., two choices per photograph), thus increasing chance performance. Stimuli for the complex emotional states were also presented with only two response options, which again may have led to a ceiling effect. The nature of the experimental design in this study may therefore have masked or minimized true impairments in the ability of individuals with schizophrenia to complete complex theory of mind tasks with limited visual/facial cues present.

Corrigan and Nelson (1998) also found evidence of impairment theory of mind in a group of individuals with schizophrenia or schizoaffective disorder ( $n = 48$ ) who were divided into sub-groups based on ratings of the presence and severity of positive, negative, affective, and overall psychiatric symptoms at time of testing, resulting in low ( $n = 24$ ) and high symptom ( $n = 24$ ) groups. No normal control group was included for comparison. All participants were administered the Social Cue Recognition Test (SCRT), which includes measures of perception of both concrete and abstract social cues. Items measuring the perception of concrete social cues included questions about the action and dialogue which took place in a videotaped scene, while items regarding the perception of abstract social cues included questions about the affect, social rules, and goals of the persons portrayed in the scenes. Results indicated that the accuracy of both the low and high symptom groups was significantly lower for abstract items than for

concrete items, with accuracy in performance decreasing according to increasingly greater degrees of abstraction. The results therefore indicate that aspects of social situations that necessitate or tap into theory of mind are more difficult for individuals with schizophrenia to accurately interpret than are social cues which are more concrete in nature. Furthermore, such difficulties with theory of mind tasks are, according to the results of this study, relatively equally difficult for such individuals regardless of the severity of their symptomatology at time of testing, suggesting that theory of mind difficulties are trait rather than state aspects of the disorder.

In other evaluations of theory of mind deficits in individuals with schizophrenia, researchers have attempted to elucidate whether there may be differences in performance by such individuals according to the presence or absence of a verbal component to the task, as well as according to the level of difficulty of the verbal component when present. Champagne-Lavau and colleagues (2009), for example, compared the performance of a group of individuals with schizophrenia ( $n = 31$ ) to that of a group of normal controls ( $n = 29$ ) on several theory of mind tasks. As a measure of nonverbal theory of mind capacities, participants were administered a comic strip task in which comic strip frames were presented in a fixed order and depicted a character performing an action. For each comic strip, participants were asked to select the final strip of the frame based upon their evaluation of the motivations and intentions of the main character. A measure of verbal theory of mind ability was also included, in which participants were given sets of geometric figures in a certain order. For each set of figures, participants were asked to provide verbal descriptions and instructions to a confederate examiner so that the examiner could know in which order the figures were placed. The schizophrenia group

performed significantly worse than the normal control group on both the nonverbal and verbal theory of mind tasks, regardless of the level of complexity of the verbal task. Furthermore, the performance of the schizophrenia group on the verbal task was characterized by a greater number of “turns taken” by the schizophrenia group in order to communicate the order of the figures to the examiner, as well as a more frequent need for clarification regarding what had been verbalized, indicating a weaker ability of the schizophrenia group to accurately communicate to another individual during a give-and-take conversation situation as compared to normal controls. Overall, these findings lend support to the hypothesis that individuals with schizophrenia exhibit deficits in theory of mind at both a nonverbal and verbal level, as well as at varying levels of complexity on verbal tasks. Similar findings were reported by Kern and colleagues (2009), such that performance on theory of mind tasks by individuals with schizophrenia as compared to normal controls was found to decrease as ambiguity of the cues increased.

The potential implications of impairments in abilities such as affect recognition and theory of mind at a real-world level include an inability to recognize and accurately identify the current emotional state of another individual coupled with, or perhaps leading to, an inability to in turn accurately identify that individual’s current mental state, intentions, and/or desires. Despite its potential ecological validity, this hypothesized relationship has been investigated very little. Nonetheless, Langdon, Coltheart, and Ward (2006) compared the performance of a group of individuals with schizophrenia ( $n = 22$ ) to that of a group of normal controls ( $n = 18$ ) on a handful of emotion attribution and theory of mind tasks. Specifically, participants were administered a false-belief comic strip task, for which participants were given a series of comic strip frames and asked to

arrange them in the correct order, with each strip including a false-belief component which had to be considered for correct sequencing. Participants were also administered an emotional attribution comic strip task, for which participants were given a series of comic strip frames depicting a sequence of events with the character's facial expression absent and asked to match a series of cards depicting facial expressions to the likely situations in the comic strip in which the character was feeling each emotion. A facial affect identification task was also included in the battery. The study therefore allowed for a consideration of thought and emotion attribution, as well as affect identification. Contrary to multiple reports of impairments in facial affect identification by individuals with schizophrenia, the present study found that the schizophrenia group performed similarly to the normal control group on the affect identification task. However, the schizophrenia group did demonstrate significantly poorer performance on the two theory of mind tasks, suggesting impairments in the ability to attribute thoughts and emotional states to others within a situational context. Therefore, while the schizophrenia participants as a whole were able to identify emotional states at a basic and situation-independent level, this ability seemed to break down on tasks resembling more real-world situations.

**Neurocognitive correlates of theory of mind.** Similar to the debate regarding the effect of intelligence on social cognition and whether or not the two should be considered independent constructs, there stands the question over whether theory of mind impairments may be due to impairments in overall intellectual functioning. This is an especially relevant issue considering the association of prominent theory of mind deficits in both individuals with schizophrenia and those with autism, both disorders of which are

also commonly associated with lower intellectual functioning (in the case of schizophrenia, generally in terms of both premorbid and current intellectual functioning) as compared to the normal population. In this light, Doody, Gotz, Johnstone, Frith, and Cunningham Owens (1998) compared the performance of a group of individuals with schizophrenia ( $n = 28$ ), an affective disorder ( $n = 24$ ), a mild learning disability as defined by an intellectual quotient (IQ) falling in the 50-70 range ( $n = 19$ ), co-morbid schizophrenia and learning disability ( $n = 18$ ), and normal controls ( $n = 20$ ) on measures of first- and second-order theory of mind. Both the schizophrenia and mild learning disability groups demonstrated significant impairment on the second order theory of mind task. However, once participants who had failed a series of basic reality questions were excluded from the analyses, significant impairments remained only for the schizophrenia group, suggesting the presence of such deficits in individuals with schizophrenia independent of overall intellectual functioning. Concordant findings were reported by Gavilan and Garcia-Albea (2011), in that impairments in theory of mind were found to be present in accordance with severity of impairments in language comprehension, but not with deficits in overall intellectual functioning.

Brune (2005) similarly evaluated groups of individuals with schizophrenia ( $n = 23$ ) and normal controls ( $n = 18$ ) on measures of facial affect identification, theory of mind, event sequencing, executive functioning, and intellectual functioning. As expected, the schizophrenia group performed significantly worse than the normal control group on all measures. Furthermore, no statistically significant correlations were found between performance on the theory of mind and perception tasks with estimated premorbid IQ in the schizophrenia group, suggesting that such deficits are present in

individuals with schizophrenia independent of impairments in overall intellectual functioning. Similar findings were reported by Bailey and Henry (2010), such that individuals with schizophrenia evidenced impairments in both theory of mind and executive functioning as compared to normal controls, although theory of mind deficits were found to be present above and beyond the executive functioning deficits.

The relationship between cognition and social functioning in individuals with schizophrenia has also been found to be mediated by theory of mind. Couture, Granholm, and Fish (2011), for example, evaluated the performance of a group of 178 individuals with schizophrenia or schizoaffective disorder on measures of social cognition and neurocognition. Specifically, the authors administered measures of theory of mind (via the Hinting Task), cognition (via a global neurocognition score derived from performance on measures of processing speed, working memory, verbal learning, visual learning, and executive functioning), and self-reported social functioning (via the Independent Living Skills Survey) in a group of 178 individuals with schizophrenia or schizoaffective disorder. A path analysis of the data yielded theory of mind as a partial mediating variable between neurocognition and self-reported social functioning, suggesting that social functioning cannot be explained by global neurocognitive performance alone, and instead is impacted by theory of mind, in individuals with schizophrenia. Similarly, others have found evidence of impaired theory of mind in individuals with schizophrenia compared to normal controls despite participant matching according to measured overall intellectual functioning (Pinkham & Penn, 2006) and when using overall intellectual functioning as a covariate (Bertrand, Sutton, Achim, Malla, & Lepage, 2007).

## **Significance of Research**

**The neuropathophysiology of deficits in social cognition.** In conjunction with research aimed at identifying and evaluating social cognitive deficits in individuals with schizophrenia, research evaluating the neurobiological underpinnings of such deficits has indicated the association of a number of structures with deficits. Pinkham, Hopfinger, Ruparel, and Penn (2008), for example, proposed a social cognition neural network comprised of the amygdala, the fusiform gyrus, and the superior temporal sulcus. Functional neuroimaging resonance (fMRI) technology was used to evaluate the validity of the proposed network in a group of individuals with schizophrenia or schizoaffective disorder ( $n = 12$ ) or without ( $n = 12$ ) paranoid symptomatology, as well as in a group of normal controls ( $n = 12$ ). Participants were asked to rate faces as either trustworthy or untrustworthy while undergoing the fMRI protocol. While results indicated increased activation of the proposed neural network in the normal control and non-paranoid groups when viewing untrustworthy faces as compared to trustworthy faces, no such difference in level of activation was found in the paranoid group. The results therefore provide support for the inclusion of the amygdala, fusiform gyrus, and superior temporal gyrus in a neurobiological model of social cognition as the construct is defined by the authors, although activation patterns may vary according to disease characteristics. Other structures proposed to be included in a “social cognition neural network” with corresponding research support have included the orbitofrontal cortex (Hornak et al., 2003), and the temporal and parieto-occipital cortical areas (Williams et al., 2009).

Lee, Farrow, Spence, and Woodruff (2004) proposed and evaluated a slightly different social cognitive neural network subsequent to a review of such studies in

individuals with schizophrenia. Conclusions regarding such a model included that the frontal lobe, together with the temporal cortex, the amygdala, and the prefrontal cortex, may be responsible for theory of mind and empathy, and in turn social cognition.

Research evaluating the neurobiology and the processing of emotional information in schizophrenia has primarily focused on the medial prefrontal cortex, the prefrontal cortex, the amygdala, and the inferior parietal lobe (Brunet-Gouet & Decety, 2006), as well as the dorsal cingulate gyrus (Grady & Keightley, 2002). Research has also focused on right hemispheric deficits, especially in terms of facial affect identification, in addition to the typical left hemispheric temporal lobe deficit, with at least one study reporting no significant differences in level of impairment on facial recognition and affect identification tasks between groups of individuals with schizophrenia ( $n = 50$ ) and those with right hemispheric brain damage ( $n = 50$ ; Kucharska-Pietura & Klimkowski, 2002).

The amygdala has been demonstrated to be associated with affect identification (e.g., Adolphs, 2002), especially in the identification of fear, through studies evaluating the performance of individuals with damaged or lesioned amygdala on such tasks (Adolphs et al., 2005; Adolphs, Tranel, Damasio, & Damasio, 1994; Adolphs, Tranel, Damasio, & Damasio, 1995; Adolphs et al., 1999; Calder et al., 1996; Young et al., 1995), as well as via functional magnetic resonance imaging studies demonstrating increased activation of the amygdala when viewing faces portraying fear (Morris et al., 1996; Whalen et al., 1998). For these reasons the amygdala has been the focus of much research in emotion-processing by individuals with schizophrenia. Structural findings in such individuals have included decreased amygdalar volume, especially in the right

amygdala, co-occurring with impaired facial affect identification (Exner et al., 2004; Namiki et al., 2007), decreased volume of portions of the medial prefrontal cortex with impaired facial identification of fear and neutrality (Das et al., 2007), and decreased volume of the fusiform gyrus, which was associated with poor performance on a facial memory task (Onitsuka et al., 2003). Structural findings have also indicated an association between left amygdalar volume and the identification of sadness as it is portrayed in faces (Exner et al., 2004; Namiki et al., 2007). Other abnormalities implicated via magnetic resonance imaging technology have included reduced white matter fractional anisotropy in the left occipital white matter and left posterior callosal regions (Miyata et al., 2010), as well as decreased volume of the fusiform gyrus, an area thought to be involved in the processing of faces, in individuals with schizophrenia as compared to normal controls (Nestor et al., 2007).

Functional neuroimaging studies have similarly demonstrated differences in levels of amygdalar activation in individuals with schizophrenia as compared to normal controls when processing emotional information. Specific differences have included hypoactivation of the amygdala while viewing faces portraying fear, but with greater activation being associated with more errors of affect identification (Das et al., 2007; Gur, Loughhead, et al., 2007; Rasetti et al., 2009), as well as hyperactivation of the amygdala during tasks of discrimination between different intensities of emotions portrayed in faces (Kosaka et al., 2002) and when viewing faces portraying neutrality (Hall et al., 2008). Other abnormalities in activation have included hyperactivation of the hippocampus during the processing of fearful (Holt et al., 2005) and both fearful and non-fearful faces (Gur, McGrath, et al., 2002; Hempel, Hempel, Schonknecht, Stippich, &

Schroder, 2003; Holt et al., 2006), hypoactivation of the fusiform, inferior frontal, middle and superior temporal and middle occipital gyri when processing faces portraying a variety of emotions, including fear (Fakra, Salgado-Pineda, Delaveau, Hariri, & Blin, 2008; Johnston, Stojanov, Devir, & Schall, 2005; Michalopoulou et al., 2008; Quintana et al., 2011), hypoactivation of the anterior cingulate gyrus during processing of faces portraying a variety of emotions (Hempel et al., 2003), hyperactivation of the right parahippocampal gyrus during the perception of both fearful and neutral faces (Surguladze et al., 2006), hypoactivation of the left fusiform gyrus when attempting to memorize faces portraying various emotions (Yoo et al., 2005), hypoactivation of the right fusiform gyrus during the processing of faces portraying fear, as well as those depicting positive, negative, and neutral emotional states (Quintana, Wong, Ortiz-Portillo, Marder, & Mazziotta, 2003; Streit et al., 2001), hypoactivation of the inferior prefrontal cortex, the right anterior temporal cortex, and the right inferior parietal cortex during the perception of faces portraying a variety of emotions (Streit et al., 2001), hyperactivation of the posterior cingulate gyrus and the precuneus, and hypoactivation of the anterior cingulate gyrus and the orbitofrontal cortex, in first-episode patients during a facial emotion discrimination task (Reske et al., 2009), and hyperactivation of the inferior parietal cortex, left middle temporal lobe, and right precuneus when viewing faces portraying fear and anger (Fakra et al., 2008). Such functional neuroimaging research has also yielded results consistent with an alteration in activation patterns of sub-cortical pathways, including between the amygdala and the prefrontal cortex (Das et al., 2007), between the thalamus, amygdala, and the middle and inferior frontal cortical regions during the processing of faces portraying fear (Leitman et al., 2008), and the negative

feedback loop between the right amygdala and Brodmann area 9 (i.e., the prefrontal limbic region) during the processing of angry faces (Radulescu & Mujica-Parodi, 2008). Furthermore, fMRI research has indicated that increased activation of the left medial prefrontal cortex may occur concurrently with clinical stabilization and improved social functioning in individuals with schizophrenia, therefore indicating that deficits in social functioning in such individuals may be negatively impacted by hypoactivation of the left medial prefrontal cortex during active phases of the illness and may not persist during periods of remission (Lee et al., 2006). Finally, hypoactivation of various areas of the prefrontal cortex is consistent with the hypofrontality commonly observed in schizophrenia (e.g., MacDonald et al., 2005; Weinberger, 1988) and may reflect a deficit in the ability of such individuals to generate and self-regulate appropriate responses on affect identification tasks.

Although research regarding the neurobiology of theory of mind has been limited to date, structural neuroimaging research has indicated a relationship between performance of individuals with schizophrenia as compared to normal controls and decreased volume of both the right superior temporal lobe (Benedetti et al., 2009) and the ventrolateral prefrontal cortex (Hirao et al., 2008). Additionally, functional neuroimaging studies have found evidence of hypoactivation of the right anterior cingulate cortex, medial prefrontal cortex, and insula (Brune et al., 2008), as well as of the left inferior frontal gyrus (Russell et al., 2000), and of abnormal activation patterns in the medial prefrontal-superior temporal network (Park et al., 2011) in individuals with schizophrenia as compared to normal controls on tasks measuring theory of mind. Interestingly, functional neuroimaging research has also demonstrated hyperactivation of

the supplementary motor area, the dorsal prefrontal cortex, the left supramarginal gyrus, and the precuneus in individuals with schizophrenia during a theory of mind task, purported by the authors to perhaps be reflective of increased effort of the schizophrenia group on a task which may have been more difficult for them to complete than for normal controls (Brune et al., 2008).

Overall, although research to date has found a number of structures to be related to social cognitive deficits in individuals with schizophrenia, a definitive social cognitive neural network has yet to be identified and validated.

**Social cognition as a potential endophenotypic marker for vulnerability to schizophrenia.** The identification of specific cognitive deficits in populations such as schizophrenia naturally leads to the question of the utility of such findings, especially in the uniqueness of such deficits to the given population and the potential determination of deficits as endophenotypic markers for the disorder.

Regarding affect identification, evidence has been found to support the hypothesis that deficits in social cognition may be unique to schizophrenia as compared to other psychotic disorders and mood disorders with and without psychosis (Edwards et al., 2001), while other studies have found such deficits to be significantly greater in severity in schizophrenia than those noted in other disorders (Addington & Addington, 1998; Weniger, Lange, & Ruther, 2004).

Furthermore, not only have deficits in facial emotion recognition been identified in individuals diagnosed with schizophrenia, but such deficits have also been noted in the relatives of such individuals, suggesting that these deficits may have a genetic component that could potentially serve as a marker for vulnerability to schizophrenia. Alfimova and

colleagues (2009), for example, evaluated groups of individuals who had been diagnosed with either schizophrenia ( $n = 90$ ) or schizoaffective disorder ( $n = 13$ ), non-affected first-degree relatives of these individuals ( $n = 55$ ), and normal controls who had no individual or family history of psychotic symptomatology ( $n = 99$ ). Participants were administered a facial affect identification task, with emotional categories depicted including happiness, surprise, sadness, anger, disgust, fear, interest/excitement, contempt, and shame, as well as a number of other neurocognitive assessments, including those measuring verbal memory and fluency, attention, and working memory. The schizophrenia group was found to perform significantly worse than the control group when asked to identify emotions in photographs depicting surprise, anger, disgust, fear, and contempt, with the level of performance of the first-degree relatives group falling between that of the schizophrenia and normal control groups. The relatives group also notably performed significantly worse than the normal control group in the identification of sadness as portrayed in the photographs. Overall, these results suggest that the correct identification of emotions based on facial cues may be impaired in first-degree relatives of individuals with schizophrenia, albeit to a lesser degree than in patients, indicating that such an impairment may serve as a genetic marker for vulnerability to the disorder.

Gur, Nimgaonkar and colleagues (2007) similarly compared groups of individuals with schizophrenia ( $n = 58$ ), first- and second-degree relatives of patients ( $n = 291$ ), and normal controls ( $n = 154$ ) on a number of neurocognitive measures, including mental flexibility, attention, spatial processing, sensorimotor dexterity, memory for verbal and spatial information, emotion discrimination, and memory for faces portraying various emotions. As expected, the schizophrenia group performed significantly worse than the

relatives and control groups in both accuracy and response time for correct responses for the majority of the neurocognitive variables measured, including memory for faces. Additionally, the relatives group exhibited intermediate accuracy of performance (i.e., performance which was better than that of the schizophrenia group and worse than that of the normal control group) for both the face memory and emotion identification tasks, although these differences were not statistically significant. Overall, these results are similar to those reported by Alfimova and colleagues (2009), in that relatives of individuals diagnosed with schizophrenia tend to demonstrate performance which is better than that of their affected relatives and worse than that of normal controls on tasks requiring one to identify and/or remember faces depicting various emotions, again suggesting that performance on such tasks could serve as a genetic marker for vulnerability to schizophrenia. Similar findings have been reported by others (Eack et al., 2010; Kee, Horan, Mintz, & Green, 2004).

Such findings have also been demonstrated cross-culturally, in that Leppanen, Niehaus, Koen, du Toit, and colleagues (2008) reported evidence of facial affect identification as a vulnerability marker for schizophrenia upon evaluation of a group of individuals from the African Xhosa group residing in Cape Town who were diagnosed with schizophrenia ( $n = 36$ ), their unaffected siblings ( $n = 23$ ), and a group of psychiatrically healthy normal controls ( $n = 22$ ). Participants were administered a computerized task of facial affect identification, and were asked to determine whether each photograph presented was portraying a positive (i.e., happy), negative (i.e., angry), or neutral emotion. Notably, the photographs were presented very briefly so as to measure affect identification in the early stages of stimulus perception. While the ability

of the normal control group to accurately identify the emotions was relatively equal for both the positive and negative emotional categories, results indicated that both the schizophrenia and unaffected siblings groups demonstrated a relative impairment in the ability to identify anger, with the ability to recognize and identify happiness apparently spared.

Although the mechanism underlying these deficits is unclear, studies utilizing eye-tracking technology to compare patterns of attentional focus on a facial affect identification task have found similarities in first-degree relatives of individuals with schizophrenia and patients themselves. Loughland, Williams, and Harris (2004), for example, found that a group of individuals with schizophrenia ( $n = 63$ ) tended to pay significantly less attention to salient facial features during such tasks as compared to a group of healthy controls ( $n = 61$ ). Interestingly, a group of first-degree relatives of the schizophrenia participants ( $n = 37$ ) exhibited even less attention to said facial features than did the schizophrenia group itself, suggesting similar, if not more severe, abnormal eye tracking patterns in such individuals when viewing emotionally-laden faces. This is in agreement with other studies which have demonstrated a tendency for individuals with schizophrenia not to look at such salient facial features as the individual's mouth when perceiving emotional state (Leppanen, Niehaus, Koen, Schoeman, et al., 2008).

Overall, research evaluating the potential utility of deficits in facial affect identification as endophenotypic markers for increased risk for schizophrenia has generally indicated that first-degree unaffected relatives of individuals with schizophrenia may exhibit deficits in affect identification, although to a less severe degree than their affected relatives. It remains unclear, however, whether such intermediate deficits may

be most prominent and notable for specific modalities of stimulus presentation (e.g., visual versus auditory), or are instead generalized across stimulus modalities.

Although less research has been conducted regarding deficits in complex social skills as a marker for schizophrenia, Gibson and colleagues (2010) compared the performance of a group of adolescents determined to be at high genetic risk for schizophrenia ( $n = 23$ ) to that of a group of healthy controls ( $n = 31$ ) on measures of complex social skills and theory of mind. Complex social skills were measured via the High-Risk Social Challenge Task, which required participants to “audition” for a new reality show. Ratings were made based speech fluency, social anxiety, engagement, facial affect, nonverbal affect, appropriate affect, guardedness, verbal expression, gaze, anergia, speech valence, appearance, odd speech, tangential speech, and clear communication. Theory of mind was measured via the previously described Reading the Mind in the Eyes Test. Results indicated that the genetic high risk group exhibited significant impairments in complex social skills, but not in theory of mind, as compared to the healthy controls. Findings are thus concordant with the hypothesis that complex social skills may be an endophenotypic marker for schizophrenia, but discordant with the hypothesis that theory of mind may be such a marker.

Finally, as with other sub-domains of social cognition, a number of studies have also investigated whether a theory of mind impairment may serve as an endophenotypic marker for schizophrenia. In an evaluation of whether individuals who are clinically or genetically at high-risk for developing schizophrenia exhibit intermediate levels of theory of mind deficits, Versmissen and colleagues (2008) compared the performance of a group of individuals with psychosis ( $n = 40$ ), a group of unaffected first-degree relatives ( $n =$

49), a group of individuals who exhibited a risk for psychosis as indicated by elevated scores on the Community Assessment of Psychic Experiences (CAPE) scale ( $n = 41$ ), and a group of normal controls ( $n = 54$ ) on a theory of mind task. Specific diagnoses within the psychiatric group included schizophrenia (13 of 40, or 32.5%), unspecified functional psychosis (20 of 40, or 50%), delusional disorder (3 of 40, or 7.5%), schizophreniform disorder (3 of 20, or 7.5%), and non-affective psychotic disorder (1 of 40, or 2.5%). The Hinting Task was included as a measure of theory of mind and was comprised of a series of short stories which were read aloud to the participants, after which each participant was asked several questions regarding an implicit message that could have been inferred from the dialogue between the story's characters. Successful completion of the task necessitated a consideration of the thoughts and goals of one or both of the story's characters, thus tapping into theory of mind. Results indicated that, as expected, the psychosis group performed significantly worse on the task than did the normal control group. In addition, the first-degree relatives group exhibited a trend towards an intermediate level of impairment, in that the group performed worse than the normal control group and better than the psychosis group, although neither of these differences was statistically significant. The psychometrically determined high-risk group notably performed similarly to the normal control group on the task. Furthermore, subsequent analyses indicated that impaired performance on the task was associated with the presence of symptoms of paranoia in both the psychosis and first-degree relatives groups, suggesting that paranoid symptomatology may be related to greater theory of mind deficits. This is in agreement with the previously reported findings in which those

with paranoid schizophrenia performed significantly worse than those with non-paranoid schizophrenia on a measure of facial affect identification (Carter & Neufeld, 2007).

Mazza, di Michele, Pollice, Casacchia, and Roncone (2008) similarly compared the performance of a group of individuals with schizophrenia ( $n = 38$ ) to a group of their unaffected first-degree relatives ( $n = 34$ ), as well as to a group of normal ( $n = 44$ ) controls on first- and second-order theory of mind tasks. Results indicated that the schizophrenia group performed significantly worse than both the first-degree relative and normal control groups, who in turn performed similarly to one another, on the first-order theory of mind tasks. In contrast, both the schizophrenia and first-degree relative groups performed significantly worse than the normal control group on the second-order theory of mind tasks, therefore suggesting that performance on higher level theory of mind tasks may serve as an endophenotypic marker for schizophrenia. Similar results were reported by Couture and colleagues (2008) when participants were asked to judge the trustworthiness of other individuals.

Genetic studies have also indicated that specific gene variants may be associated with theory of mind impairments in individuals with schizophrenia. Specifically, Bosia and colleagues (2011) found that individuals with schizophrenia who had a C/C variant of the 5-HT1A-R gene ( $n = 22$ ), as compared to those with C/G ( $n = 56$ ) and G/G ( $n = 40$ ) genotypes, performed significantly poorer on a theory of mind task. No significant differences were found in performance on neuropsychological measures of overall intellectual functioning, verbal fluency, verbal memory, processing speed, executive functioning, or working memory according to gene variant subgroups. Such research is consistent with the hypothesis that theory of mind impairments in individuals with

schizophrenia may co-occur with specific gene variants, although it is unclear whether or not this relationship is unique to schizophrenia.

Overall, although studies to date have indicated that deficits in theory of mind may be present in individuals who are at high risk of schizophrenia, differences in the technique of measuring theory of mind and susceptibility to schizophrenia warrant further research.

**Clinical correlates of deficits in social cognition.** Impairments in social cognition have been found to be associated with both other clinical factors at time of testing and functional outcome. Differential performance on tasks of social cognition have been noted according to presence and severity of psychiatric symptomatology at time of testing, although results have been mixed overall.

Regarding the relationship between positive symptomatology at time of testing and social cognition, statistically significant correlations have been identified between severity of positive symptoms and affect identification (e.g., Hall et al., 2004; Johnston et al., 2010; Weniger et al., 2004), performance on complex theory of mind tasks (Kern et al., 2009; Piskulic & Addington, 2011), interpersonal problem solving skills (Ucok et al., 2006). Conversely, correlations have also been identified between severity of negative symptomatology and basic auditory processing (Laurent et al., 1999) theory of mind (Coutoure et al., 2011), the identification of happiness (Turetsky et al., 2007) and fear (Schneider et al., 1995; van 't Wout et al., 2007) as presented via photographs of faces, memory for faces regardless of emotional content (Johnston et al., 2010; Nestor et al., 2007) and the discrimination between and identification of emotions portrayed in photographs (Gur et al., 2006; Piskulic & Addington, 2011), although at least one study

found evidence directly discordant with such findings (Silver & Shlomo, 2001). Some studies, however, have found evidence of relationships between performance on measures of social cognition and symptomatology at time of testing, with no differential performance according to positive versus negative symptomatology. Such associations have been found with performance on a false-belief theory of mind task (Langdon, Coltheart, & Ward, 2006), on measures of facial affect identification (Hofer et al., 2009), and perception of social cues in interpersonal interaction situations (Corrigan & Nelson, 1998). Other clinical variables have also been found to be related to performance on measures of social cognition, including between measures of facial affect identification and level of insight into illness (Goodman, Knoll, Isakov, & Silver, 2005), length of illness (Premkumar et al., 2008; Silver & Shlomo, 2001), years of education (Silver & Shlomo, 2001), and lifetime years of psychiatric hospitalization (Silver et al., 2002).

Finally, despite repeated identification of statistically relationships between symptomatology at time of testing and measures of social cognition, some researchers have reported findings which suggest a total lack of relationship between positive and negative symptomatology and performance on measures of facial affect identification (Fullam & Dolan, 2006). Bellack and colleagues (1996), for example, found no evidence of statistically significant relationships between history of illness or positive or negative symptomatology at time of testing and performance on visual and auditory affect identification tasks, although it should be noted that the study also failed to find evidence of the commonly reported impairment in affect identification in general in individuals with schizophrenia. Penn and colleagues (2002) similarly found no evidence of statistically significant relationships between positive or negative symptomatology at

time of testing and utilization of social contextual cues in affect identification and sequencing of events.

Overall, analyses of the relationships between psychiatric symptomatology at time of testing and performance on measures of various sub-constructs of social cognition have yielded mixed results. It is unclear whether these mixed results are due to instability of symptoms over time paired with relative stability of social cognitive performance over time, or to the presence of subgroups of individuals with schizophrenia who may exhibit differing levels of severity and/or patterns of performance across various measures of social cognition.

**Clinical implications.** As previously stated, social cognition is often impaired in individuals with schizophrenia, with such impairments generally characterized by social withdrawal and impaired social functioning, resulting in overall poorer quality of life in such individuals. Research evaluating the efficacy of treatment approaches for the amelioration of such deficits has yielded mixed results. Although some medication studies have indicated some utility of such atypical antipsychotics as risperidone, olanzapine, and quetiapine in improvements of individuals with schizophrenia on measures of affect identification and social cognition (e.g., Behere, Venkatasubramanian, Arasappa, Reddy, & Gangadhar, 2009; Kee, Kern, Marshall, and colleagues, 1998; Roberts et al., 2010), effect sizes have generally been small and findings have overall been conflicting (Harvey, Patterson, Potter, Zhong, & Brecher, 2006; Herbener, Hill, Marvin, & Sweeney, 2005; Lewis & Garver, 1995; Sergi, Green, et al., 2007). While therapeutic approaches to improvement in social cognition have similarly yielded some evidence of improvement on affect identification and social perception tasks, such

improvements have been minimal and have not been demonstrated to persist past two to three weeks post-treatment (Mazza et al., 2010; Roncone et al., 2004; Sanz et al., 2009; Silver, Goodman, Knoll, & Isakov, 2004). Given the limited success thus far in efforts to treat deficits in social cognition and functioning in individuals with schizophrenia, there is room for improvement in knowledge regarding the nature of such deficits in individuals with schizophrenia, which could potentially lead to improvements in the direction of future research aimed at alleviating these deficits.

Furthermore, although the onset of the negative or positive symptoms associated with schizophrenia rarely occurs before adolescence, some studies have demonstrated the presence of social cognitive deficits and social withdrawal as early as childhood in individuals who go on to develop schizophrenia. For example, studies utilizing blind researchers to code behavior recorded in videos of children who went on to develop schizophrenia have found that such individuals exhibit more negative affect and less social behavior as children compared to unaffected siblings and peers (Schiffman et al., 2004; Walker, Lewine, & Neumann, 1996; Walker, Savoie, & Davis, 1994). A more in-depth understanding of the nature of social cognitive deficits in individuals with schizophrenia may thus lead to a better understanding of early signs of the disorder, and may thus potentially lead to earlier and/or more unconventional intervention strategies.

Deficits in social cognition in individuals with schizophrenia have also been found to be related to and predictive of functional outcome in these individuals, with performance on measures of social cognition serving as significant predictors of degree of clinical remission (Ciudad et al., 2009), as well as of occupational functioning, degree of independent living, and global functioning (Fiszdon & Johannesen, 2010; Hofer et al.,

2009; Kee, Green, Mintz, & Brekke, 2003; Mancuso, Horan, Kern, & Green, 2011; Mathews & Barch, 2010; Sparks, McDonald, Lino, O'Donnell, & Green, 2010; Wynn et al., 2010). Subsequent to a review of studies, Couture and colleagues (2006) concluded that there is evidence to suggest a relationship between social cognition and functional outcome in individuals with schizophrenia, although the relationship is dependent upon the sub-domain of social cognition regarded. Specifically, the researchers identified relationships between emotion perception and several measures of functional outcome, including community functioning, social behavior, and social problem solving skills. Others have similarly found that impairments in social cognition significantly predicted functional outcome, as defined in terms of both social and occupational functioning, in that the greater the individuals were impaired in social cognition, the poorer their measured functional outcome (Anne-Kathrin et al., 2011; Hooker & Park, 2002; Mehl, Rief, Mink, Lullmann, & Lincoln, 2010; Mirabilio et al., 2006; Mueser et al., 1996; San, Ciudad, Alvarez, Bobes, & Gilaberte, 2007; Schneider et al., 1995). Additionally, path analysis techniques have demonstrated a mediating function of social cognition in the relationship between cognition and social functioning in individuals with a schizophrenia-spectrum disorder (Addington, Gerard, Christensen, & Addington, 2010).

Furthermore, some research has evaluated the relationships between lower- and higher-order levels of processing of social cognitive variables via path analysis, although such studies have been extremely limited. Brittain, ffytche, McKendrick, and Surguladze (2010), for example, used path analysis to evaluate the relationship between basic visual perception, social perception, and functional status in groups of individuals with schizophrenia ( $n = 64$ ) and normal controls ( $n = 64$ ). Basic visual perception was defined

as performance on a task depicting an array of moving dots, such that the dots initially moved in a pattern which depicted the image of a human walking; as more dots began to move, the image of the person walking became less apparent. Social perception was defined as performance on a task requiring individuals to utilize both theory of mind and complex social skills techniques to determine whether brief (2-second) clips of an individual speaking and moving were depicting one of two social situations (e.g., “ordering food in a restaurant” or “threatening someone”). Functional outcome was assessed via the Role Functioning Scale, which evaluated functional status in working productivity, independent living/self care, immediate social network relationships, and extended social network relationships. Between-group comparisons indicated significantly poorer performance on the tasks in the schizophrenia group as compared to the normal control group. Additionally, path analysis statistical techniques indicated support for a significant, albeit small and indirect (versus direct) relationship between performance on the biological motion task and functional status, with an apparent mediating effect of performance on the social perception task. However, it should be noted that the path analysis was conducted on the dataset as a whole, including both the schizophrenia and normal control groups combined. It is therefore unclear whether the path analysis results would have been different had the analyses been conducted on the groups individually, thus indicating differential relationship patterns between the groups according to group membership.

## **Conclusion**

It is clear from this literature review that social cognition is a complex construct and that many of the abilities that comprise the construct are impaired in schizophrenia.

It is also apparent that social cognitive abilities are generally and historically assessed using tasks that vary in level of complexity, with some abilities assessed using relatively simple tasks requiring, for example, the identification of basic emotions portrayed on static faces, while others are much more complex. With regard to these complex tasks, some require the perception and integration of both auditory and visual information that is conveyed during interactions of multiple individuals, as well as the ability to make inferences about the cognitive and emotional experiences of others. The complexity of these tasks is reflected to some extent in the ability that they are purported to measure, namely “theory of mind.” However, outside of these more general considerations regarding task complexity and discrete constructs that comprise social cognition, the literature also clearly demonstrates that deficits are also present at much lower levels in the processing of emotional information, including in the perception of non-affective auditory and visual information. For example, auditory and visual perception deficits have both been identified in schizophrenia, and auditory perception deficits have been linked to impaired processing of speech prosody. Similar links have been identified between visual perception and facial affect identification, including findings that patients with schizophrenia have abnormal gaze patterns which interfere with their ability to attend to and encode relevant information when trying to identify the emotions portrayed on faces. As the literature review suggests, much work has been done in the areas of social cognition, yet much more limited have been attempts to understand whether performance on tasks of social cognition of varying levels of complexity may predict one another. In other words, it is unclear to what extent that the deficits in more complex tasks reflect deficits in higher order social cognitive processes, or are simply the result of

impaired perceptual processing. Furthermore, it is unclear whether these deficits are primarily for auditory or visual modalities, or whether both modalities contribute to deficits in social cognition.

### **Research Aims and Study Hypotheses**

Based on these considerations, the general aim of the current study was to provide a systematic examination of the unique contributions of auditory and visual processing to social cognitive deficits, moving from basic perceptual processes to simple affect perception tasks, and finally to more complex tasks that assess complex social skills and theory of mind. To accomplish this aim, an extensive battery of diagnostic, clinical, symptom, perceptual, and social cognitive tasks was administered to a group of individuals with schizophrenia. Specific social cognitive tasks administered to participants included affect identification in still images of faces, visual affect identification, auditory affect identification, integrated visual-affect identification, perception of social cues within videotaped social interactions, and theory of mind as pertained to accurate perception of cues within social situations and interactions.

Based on the literature review and these considerations, the following hypothesis was made:

Hypothesis 1: When examined together, relationships between perceptual and social cognitive tasks will have indicated that while each is associated with the other, unique variability will have been accounted for by each task in a directional manner, such that perceptual tasks will have accounted for some of the variability in performance on

unimodal affect identification tasks, unimodal affect identification tasks will have accounted for some of the variance on multimodal affect identification tasks, and multimodal affect identification tasks will have accounted for some of the variability on theory of mind tasks. This hypothesis is based on those studies that have identified links between auditory perception abilities and speech prosody and between visual perception and facial affect identification, as well as studies linking deficits in unimodal affect perception tasks to deficits on more complex social cognitive abilities in patients with schizophrenia. The current study will allow for examination of these associations in a unitary group of individuals across visual and auditory modalities, allowing for a determination of the relative contribution of lower level auditory and visual perception deficits to affect identification and theory of mind deficits on more complex social cognition tasks. Competing models were evaluated using path analysis, with specific models discussed in the Data Entry and Analyses section.

## **Chapter 3:**

### **Method**

#### **Participants**

Fifty individuals with schizophrenia (SZ) were included in this study. Sample size was selected based on recommendations for path analysis, in that five participants are recommended per hypothesized relationship in the most complex model evaluated. Participants were either members of the Las Vegas community in general or patients at Mojave Adult, Child, and Family Services and were recruited via on-site recruitment and on-site distribution of fliers. Participants were compensated for their time, such that participants were paid \$5 per hour plus a \$30 bonus for completing the study, so that individuals who completed the study earned a total of \$60. Additionally, participants requiring transportation were taken to and from UNLV via a cab as arranged by the primary researcher, and all cab rides were paid for by the primary researcher. All participants were between the ages of 18 and 65. Additional exclusionary criteria included the following:

- a) English as a secondary language, as determined via self-report.
- b) A previous traumatic brain injury, as determined via self-report and medical record review.
- c) A neurological or seizure disorder, as determined via self-report and medical record review.
- d) Previous brain surgery, as determined via self-report and medical record review.

- e) A diagnosis of a chronic medical condition which has the potential to adversely affect central nervous system functioning (e.g., liver disease, HIV), as determined via self-report and medical record review.
- f) A current or recent (i.e., within the previous 6 months) diagnosis of a substance use disorder, as determined via the administration of the Structured Clinical Interview for the DSM-IV-TR (SCID; First, Spitzer, Gibbon, & Williams, 2002).
- g) Current (i.e., within the previous week) use of a prescribed or over the counter medication which has CNS effects, with the exception of medications that have been prescribed specifically for the purpose of treating and/or regulating SZ and its symptoms, as determined via self-report and medical record review.
- h) A reduction in hearing that would interfere with ability to understand verbal communication, as determined via the administration of a Hearing Test.
- i) Corrected vision worse than 20/50, as determined via the administration of a Visual Acuity Test.

### **Measures**

A battery of measures was selected to assess for relevant DSM-IV-TR Axis I diagnoses, as well as for symptomatology at time of testing, current and estimated intellectual ability, and social cognition. These assessments were administered as part of a more extended battery.

### **Diagnostic and clinical symptom measures.**

*Structured Clinical Interview for the DSM-IV-TR.* The Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID; First, Spitzer, Gibbon, & Williams, 2002) was designed for use with both psychiatric and general medical patients, as well as individuals from the community for whom no diagnosis is expected. The SCID is a semi-structured interview that was developed for the purpose of diagnosing DSM-IV-TR Axis I disorders in individuals aged 18 or older with an eighth grade reading level or higher. The SCID was administered by qualified researchers trained in the DSM-IV-TR diagnostic system (APA, 1994) to establish the presence (or absence) of DSM-IV-TR Axis I psychiatric disorders.

The inpatient version of the SCID (SCID-I) was used in this study. This version contains 10 modules, all of which were administered to each participant. The modules were designed to assess for the presence of mood episodes, psychotic symptoms, psychotic disorders, mood disorders, substance use disorders, anxiety disorders, somatoform disorders, eating disorders, adjustment disorders, and optional disorders. A screening module, which consists of 12 questions eliciting basic information regarding possible diagnoses, was also administered, with patient responses then being used to guide the administration of more probing questions later in the interview. Each symptom in the SCID is rated on a scale of 1 to 3 (1 = symptom is absent; 2 = symptom is sub-threshold; 3 = symptom is present). Specific DSM-IV-TR Axis I diagnoses are made following the scoring of each module.

Inter-rater reliability of the SCID-I has been found to be excellent, with Kappa values ranging from .71 to .97, with an average Kappa value of .85 (Ventura, Liberman, Green, Shaner, & Mintz, 1998). Furthermore, the SCID-I has demonstrated high validity

for the diagnoses of schizophrenia and bipolar disorder (Steiner, Tebes, Sledge, & Walker, 1995), with good sensitivity (.89), specificity (.96), and agreement (.86) when compared to best estimate diagnoses made by psychiatrists on first-admission psychotic patients (Fennig, Craig, Lavelle, Kovaszny, & Bromet, 1994).

***The Brief Psychiatric Rating Scale.*** The Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962) is an 18-item scale which is used to rate the presence and severity of a number of psychiatric symptoms. Symptoms are rated following a 15-20 minute semi-structured symptom ratings interview. Rated symptoms include somatic concern, anxiety, emotional withdrawal, conceptual disorganization, guilt feelings, tension, mannerisms and posturing, grandiosity, depressive mood, hostility, suspiciousness, hallucinatory behavior, motor retardation, uncooperativeness, unusual thought content, blunted affect, excitement, and disorientation. Each symptom is rated on a 7-point Likert scale (1 = not present, 2 = very mild, 3 = mild, 4 = moderate, 5 = moderately severe, 6 = severe, and 7 = extremely severe). Some items are rated according to the individual's self-report, while others are rated based on the clinician's observations.

Factor scores were calculated in addition to the total score for each individual. Mueser, Curran, and McHugo (1997) conducted an exploratory factor analysis of the BPRS in a sample of 474 individuals with schizophrenia, followed by a confirmatory factor analysis in a separate sample of 327 individuals with schizophrenia. A four-factor solution was found in the exploratory analysis and was confirmed via the confirmatory factor analysis. The first factor, named Thought Disturbance, is considered to be a reflection of the positive symptoms (including hallucinations and delusions) commonly

associated with schizophrenia and is comprised of items 8 (Grandiosity), 11 (Suspiciousness), 12 (Hallucinatory Behavior), and 15 (Unusual Thought Content). The second factor, named Anergia, is considered to be an indication of the negative symptoms generally related to schizophrenia and includes items 3 (Emotional Withdrawal), 13 (Motor Retardation), 14 (Uncooperativeness), and 16 (Blunted Affect). The third factor, named Affect, is considered to be a reflection of emotional disturbances and consists of items 1 (Somatic Concern), 2 (Anxiety), 5 (Guilt Feelings), 9 (Depressive Mood), and 10 (Hostility). Finally, the fourth factor, named Disorganization, is thought to reflect the symptoms of disorganized behavior often associated with schizophrenia and is comprised of items 4 (Conceptual Disorganization), 6 (Tension), and 7 (Mannerisms and Posturing). Items 17 (Excitement) and 18 (Disorientation) were not included in the final reported four-factor structure due to the inconsistent loadings of these items in the exploratory factor analysis. These factor scores, as well as the BPRS total score, were used in the analyses.

Regarding its psychometric properties, the BPRS has been found to have high rates of agreement for the rating of positive symptoms of schizophrenia, as well as for the symptoms of depression and mania (Andersen, Korner, Larsen, & Schultz, 1993). Additionally, overall inter-rater reliability coefficients have been found to range from .85 to .92, with at least one sample which was largely comprised (i.e., 94% of the sample) of individuals diagnosed with schizophrenia, bipolar disorder, or major depression (Bell, Milstein, Beam-Goulet, Lysaker, & Cicchetti, 1992; Engelsmann & Formankova, 1967; Ligon & Thyer, 2000). Other studies have found the inter-rater reliability of the BPRS to

be satisfactory when used to rate the psychiatric symptoms of individuals with schizophrenia (e.g., Andersen, Larsen, Schultz, & Nielsen, 1989).

*Schedule for the Assessment of Positive Symptoms.* The Schedule for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984) was designed to evaluate the presence and severity of positive symptoms associated with schizophrenia, namely hallucinations, delusions, bizarre behavior, and positive formal thought disorder. Clinician ratings are made following a structured clinical interview and are based on both direct observations of behavior during the interview and subjective reports of behavior and experience. Definitions and examples, as well as anchor points for the 6-point rating scale, are provided for each item to guide clinician ratings. The “Auditory Hallucinations” item, for example, is operationalized as the following: “The patient has reported voices, noises, or sounds. The most common auditory hallucinations involve hearing voices speaking to the patient or calling him names. The voices may be male or female, familiar or unfamiliar, and critical or complementary. Typically, patients suffering from schizophrenia experience the voices as unpleasant and negative. Hallucinations involving sounds other than voices, such as noises or music, should be considered less characteristic and less severe.” Additionally, the rating anchor points for the “Auditory Hallucinations” item are as follows: 0 – None; 1 – “Questionable.”; 2 – “Mild: Patient hears noises or single words; they occur only occasionally.”; 3 – “Moderate: Clear evidence of voices; they have occurred at least weekly.”; 4 – “Marked: Clear evidence of voices, which occur frequently.; and, 5 – “Severe: Voices occur almost every day.” Furthermore, the “Global Rating of Severity of Hallucinations” item is defined as follows: “This global rating should be based on the duration and severity of

hallucinations, the extent of the patient's preoccupation with the hallucinations, his degree of conviction, and their effect on his actions. Also consider the extent to which the hallucinations might be considered bizarre or unusual. Hallucinations not mentioned above, such as those involving taste, should be included in this rating." In turn, the rating anchor points for the "Global Rating of Severity of Hallucinations" item are as follows: 0 – "None."; 1 – "Questionable."; 2 – "Mild: Hallucinations definitely present, but occur very infrequently; at times the patient may question your existence."; 3 – "Moderate: Hallucinations are quite vivid and occur occasionally; they bother him to some extent."; 4 – "Marked: Hallucinations are very vivid, occur frequently and pervade his life."; and, 5 – "Severe: Hallucinations occur almost daily and are sometimes unusual or bizarre; they are very vivid and extremely troubling."

The measure includes 30 ratings of individual symptoms and 4 global ratings of symptoms (namely, Global Rating of Severity of Hallucinations, Global Rating of Severity of Delusions, Global Rating of Severity of Bizarre Behavior, and Global Rating of Positive Formal Thought Disorder), for a total of 34 ratings. Each item is rated on a scale from 0 to 5 for a total possible score of 0 to 170. The SAPS total score, as well as the four global ratings scores, were used in the analyses.

Inter-rater reliability of the summary score for the SAPS has been found to be good ( $r = .84$ ; Norman, Malla, Cortese, & Diaz, 1996). Furthermore, the summary score of the SAPS was found to be highly correlated with the positive symptom subscale of The Positive and Negative Syndrome Scale (PANSS;  $r = .91$ ).

***Schedule for the Assessment of Negative Symptoms.*** The Schedule for the Assessment of Negative Symptoms (SANS; Andreasen, 1983) was designed as a

complementary scale to be used in conjunction with the SAPS as an evaluation of the presence and severity of negative symptoms associated with schizophrenia. As with the SAPS, clinician ratings are made following a structured clinical interview and are based on both direct observations of behavior during the interview and subjective reports of the participant's own behavior and experience. Definitions and examples, as well as anchor points for the 6-point rating scale, are provided for each item. The "Unchanging Facial Expression" item, for example, is operationalized as the following: "The patient's face appears wooden, mechanical, frozen. It does not change expression, or changes less than normally expected, as the emotional content of discourse changes. Since phenothiazines may partially mimic this effect, the interviewer should be careful whether or not the patient is on medication, but should NOT try to 'correct' his rating accordingly."

Additionally, the rating anchor points for the Unchanging Facial Expression item are as follows: 0 – "Not at all. Patient is normal or labile."; 1 – "Questionable decrease."; 2 – "Mild decrease in facial expressiveness."; 3 – "Moderate decrease in facial expressiveness."; 4 – "Marked decrease in facial expressiveness."; and, 5 – "Severe. Facial expression is essentially unchanging." Furthermore, the "Global Rating of Affective Flattening" item is defined as follows: "The global rating should focus on overall severity of affective flattening or blunting. Special emphasis should be given to such core features as unresponsiveness ([Items] 1, 5), inappropriateness ([Item] 6), and overall decrease in emotional intensity." In turn, the rating anchor points for the "Global Rating of Affective Flattening" item are as follows: 0 – "No flattening. Normal affect."; 1 – "Questionable affective flattening."; 2 – "Mild affective flattening."; 3 – "Moderate

affective flattening.”; 4 – “Marked affective flattening.”; and, 5 – “Severe affective flattening.”

The measure includes 25 ratings of individual symptoms and 5 global ratings of symptoms (namely, Global Rating of Affective Flattening, Global Rating of Alogia, Global Rating of Avolition, Global Rating of Anhedonia-Asociality, and Global Rating of Attention). Each item is rated on a scale from 0 to 5 for a total possible score of 0 to 150. The SANS total score, as well as the five global ratings scores, were used in the analyses.

Measures of inter-rater reliability of the summary scores for the SANS have been found to be moderate to good, ranging from .60 to .84 (Andreasen & Olsen, 1982; Norman et al., 1996). Furthermore, the summary score of the SANS was found to be highly correlated with the negative symptom subscale of the PANSS ( $r = .88$ ).

### **Measures of intellectual functioning.**

Current estimated intellectual functioning was assessed using a dyadic short form of the third edition of the Wechsler Adult Intelligence Scale (WAIS-III; Wechsler, 1997) in which the Vocabulary and Block Design subtests are used to estimate one’s current Full Scale Intelligence Quotient (IQ) based on a series of regression equations (Ringe, Saine, Lacritz, Hynan, & Cullum, 2002). The equation used has been found to estimate Full Scale IQ within 10 points in 81-93% of a mixed neurological/psychiatric sample (Ringe et al., 2002).

Additionally, premorbid intellectual functioning was assessed by taking an average of the scaled scores obtained on the WAIS-III Vocabulary and Information subtests (Wechsler, 1997). These subtests have been shown to have the highest reliability

coefficients (.89 and .96, respectively) among the subtests of the WAIS-III Verbal Comprehension Index (Vanderploeg, Schinka, & Axelrod, 1996). Furthermore, they are considered to be “hold” tests which change little over time, including following brain dysfunction (Bilder et al., 1992; Vanderploeg, Schinka, & Axelrod, 1996).

***WAIS-III Vocabulary Subtest.*** The Vocabulary subtest of the WAIS-III (Wechsler, 1997) is comprised of 33 items of increasing difficulty which the participant is asked to define. Each response is given a score of 0, 1, or 2 points for a total possible score of 66. Higher scores are indicative of more accurate definitions. Subtest administration is discontinued following four consecutive scores of zero. The Vocabulary subtest has demonstrated good reliability, reported to be approximately .96 (Vanderploeg, Schinka, & Axelrod, 1996). Each participant’s Vocabulary total score was converted to a scaled score according to the age-based norms published in the WAIS-III administration manual. The Vocabulary scaled score, along with the Block Design scaled score, was entered into the aforementioned regression equation for an estimation of current intellectual functioning, which was used in the analyses. The Vocabulary scaled score was also averaged with the Information scaled score for an estimation of premorbid intellectual functioning as previously described, which was used in the analyses.

***WAIS-III Block Design Subtest.*** The Block Design subtest of the WAIS-III (Wechsler, 1997) is comprised of 14 designs of increasing difficulty and complexity which the participant is asked to recreate using a set of either four (on the easier items) or nine (on the more difficult items) blocks. The blocks are identical and each have two red sides, two white sides, and two sides that are half red and half white as divided diagonally. Items are scored according to accuracy, with bonuses awarded for rapid

completion times. The number of possible points awarded for each item varies according to the complexity of the item and the presence or absence of time bonuses, for a total possible raw score of up to 68. Administration of the subtest is discontinued following three consecutive scores of zero. A score of zero is awarded if the design is completed incorrectly, as well as if the design is not completed correctly by the end of the time limit. The time limit for each item varies according to the complexity of the item, with the time limit of the most complex items being 2 minutes. Each participant's Block Design total score was converted to a scaled score according to the age-based norms published in the WAIS-III administration. As previously described, the Block Design and Vocabulary scaled scores were entered into the aforementioned regression equation for an estimation of current intellectual functioning, which was used in the analyses.

***WAIS-III Information Subtest.*** The Information subtest of the WAIS-III (Wechsler, 1997) is comprised of a series of 28 increasingly difficult questions which are thought to test one's general fund of information. The items require broad knowledge of current and historical facts (e.g., "Who painted the Sistine Chapel?"). Items are given a score of either 0 or 1 depending on response accuracy, for a total possible score of 28. The subtest is discontinued following 6 consecutive scores of zero. The Information total score was converted to a scaled score based on the age-based norms published in the WAIS-III administration manual. As previously described, the Information scaled score was then averaged with the Vocabulary scaled score for an estimation of premorbid intellectual functioning, which was used in the analyses.

**Visual and auditory screening measures.**

***Visual Acuity Check.*** The Visual Acuity Check is a gross measure of the acuity of one's eyesight. Participants were asked to read from an eye chart on the wall while standing 4 feet away. The acuity check was used to ensure that each participant's visual abilities were intact enough to complete all tasks.

***Hearing Check.*** Audiometric testing was used to ensure that participants did not have significant hearing impairments which would have interfered with the administration of tasks with an auditory component. Each participant was administered a series of frequencies in each ear via audiometry headphones, with specific frequencies administered including 250 Hz, 500 Hz, 750 Hz, 1000 Hz, 1500 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz, and 8000 Hz. Participants were instructed to raise the right hand if a tone is heard in either ear. For each ear, participants were first administered a clearly audible sound, which was then progressively decreased in intensity until no indication of having heard the tones was indicated. Thresholds of no longer being able to hear specific frequencies were identified, verified, and recorded for each ear for each participant.

### **Measures of sensory perception.**

***Inverted Face Identification Task.*** For the Inverted Face Identification Task, two faces were presented centrally on the computer screen, one above the other, with both faces inverted. Upon presentation of each pair of faces, participants were asked to determine whether the faces were the same or different individuals. Participants indicated their selection by pressing the corresponding labelled button (i.e., "Same" or "Different") on the Serial Response Box. Stimuli were presented with interstimulus intervals (ISI) of 1 second, with each pair of faces remaining on the screen for either 5 seconds, or until a response was made. There were 10 practice stimuli and 120

experimental stimuli (60 of which were comprised of faces of matching identities, and 60 of which were comprised of faces of differing identities). Percent correct of number of responses was used in the analyses.

***Tone Discrimination Task.*** For the Tone Discrimination Task, a paradigm modified from Javitt, Strous, Grochowski, Ritter, and Cowan (1997) was used to assess pure-tone frequency discrimination. Each trial was comprised of two tones presented sequentially, each of 100 milliseconds in duration, with an ISI of 1 second. Upon presentation of each pair of tones, participants were asked to determine whether the tones were the “same” or “different.” The first tone of each pair had a frequency of 500, 1000, or 2000 Hz, while the second was either identical (i.e., was of the same frequency) or had a higher (5% or 20% higher) or lower (5% or 20% lower) frequency. Stimuli which were different in frequency by 5% were considered “difficult” trials, while those which were different in frequency by 20% were considered “easy” trials. There were 60 easy and 60 difficult trials for a total of 120 trials. Furthermore, 60 of the trials were “same” trials, while 60 were “different” trials. There were 10 practice stimuli, followed by the aforementioned 120 trials.

**Measures of affect identification.**

***The Bell-Lysaker Emotion Recognition Test.*** The Bell-Lysaker Emotion Recognition Test (BLERT; Bell et al., 1997; Fiszdon et al., 2007; Lysaker, Tsai, Maulucci, & Stanghellini, 2008) is a 21-item measure of affect identification that has been demonstrated to be sensitive to deficits in individuals diagnosed with schizophrenia (e.g., Bell, Tsang, Greig, & Bryson, 2009). Stimuli are videotaped monologues of an actor portraying one of a number of emotional states, namely happiness, sadness, anger,

surprise, disgust, fear, and neutral. Each stimulus is presented for 10 seconds, after which the participant is asked to identify which emotional state the actor was portraying. Stimuli are comprised of a series of 3 different monologues, each of which is presented 7 times, once for each of the 7 emotional states. A score of 0 or 1 is awarded for each item, allowing for a possible total score of 21. According to the authors, scores falling in the 19-21 range indicate normal performance, those in the 15-18 range suggest mild impairment, those in the 11-14 range reflect moderate impairment, those in the 7-10 range indicate moderately severe impairment, and those in the 0-6 range suggest severe impairment. In addition to the Total score yielded by the measure, the BLERT allows for the calculation of number of correct positive affect responses (i.e., happiness and surprise) and number of correct negative affect responses (i.e., sadness, anger, disgust, and fear).

The BLERT stimuli were utilized in three different forms for presentation to participants – visual affect identification, auditory affect identification, and auditory-visual affect identification. In other words, the original 21 BLERT stimuli were spliced so that the visual information alone (i.e., the moving image of the actor talking) and the auditory information alone (i.e., the sound clips of the actor talking) were presented in addition to the original stimuli providing both visual and auditory information. A total of 63 clips – 21 visual information only clips, 21 auditory information only clips, and 21 visual-auditory information clips – were thus presented to the participants, allowing for measures of visual affect identification, auditory affect identification, and visual-auditory affect identification. The 63 stimuli were intermixed and presented in a pre-determined randomized order. Three orders of administration were included, with each participant

receiving one of the three orders according to random selection. Within each order, the order of administration of each of the items within the seven emotional categories was fixed, such that the three items from each original stimulus was be presented in each of the first, second, and third order presentation spots.

Variables used in the analyses included the following: visual affect identification total score; auditory affect identification total score; combined auditory-visual affect identification total score; positive valence visual affect identification total score; positive valence auditory affect identification total score; positive valence combined auditory-visual affect identification total score; negative valence visual affect identification total score; negative valence auditory affect identification total score; and, negative valence combined auditory-visual affect identification total score.

Although use of the BLERT has been limited thus far, some research has demonstrated its utility in clinical populations, including in individuals with schizophrenia. In one comparison of performance on the BLERT in individuals with schizophrenia, individuals with a substance abuse diagnosis, and normal controls, the BLERT was found to detect impairments in social functioning in the clinical groups, and to differentiate between the groups, in that the normal control group was in the normal to mild ranges, the substance abuse group performed in the mild and moderate ranges, and the schizophrenia group exhibited performance that fell into the moderate to severe ranges (Bell et al., 1997). Furthermore, test-retest reliability over a 5-month period of time was good ( $r = .76$ ), and stability of categorization of participants into levels of severity was excellent (weighted  $\kappa = .93$ ; Bell et al., 1997). Similarly, its internal

consistency has been reported to be good with a coefficient alpha of .79 (Combs & Gouvier, 2004).

The BLERT has also been found to detect impairments in social cognition which were not found to be significantly related to estimated intelligence quotients (IQs), suggesting that the BLERT is sensitive to deficits in social cognition independent of those in global cognition or intelligence (Bryson et al., 1997). The BLERT has also been found to be sensitive to improvements in social cognition following therapeutic interventions aimed at improving emotion perception (Combs et al., 2008).

### **Measures of social cognition in complex social situations.**

*Situational Feature Recognition Test.* The Situational Feature Recognition Test (SFRT; Corrigan, Buican, & Toomey, 1996; Corrigan, Garman, & Nelson, 1996; Corrigan & Green, 1993) is a theory of mind measure which is comprised of a series of nine hypothetical situations, five of which are situations are “familiar” to most individuals (i.e., taking a test, reading in a library, driving a car, getting a haircut, and playing Monopoly), and four of which are “unfamiliar” to most individuals (i.e., building an igloo, celebrating a Bar Mitzvah, performing surgery, and performing an ultrasound). A demonstration scene is also included, namely “going to a movie.” For each situation, participants are asked to identify actions usually associated with the activity from a list of distractor actions. Each situation includes six target actions and eight distractor actions. For example, target actions for the “going to a movie” demonstration situation include eating popcorn, looking at the screen, drinking a coke, holding hands, buying a ticket, and waiting in line, while the distractor actions include dancing with a friend, playing a game, shooting the puck, swinging the racket, smoking a cigar, playing with a computer,

riding a horse, and fixing a salad. Participants are asked to select target actions from a stimulus card which lists both the target and distractor actions. Participants are then asked to identify goals associated with each activity from a list of distractor goals. As with actions, each situation includes six target goals and eight distractor goals. For example, target goals for the “going to a movie” demonstration situation include to have fun, to be entertained, to acquire knowledge, to kill time, to relax, and to avoid conversation, while distractor goals include to learn math, to hit the ball, to learn the piano, to travel lightly, to win the Superbowl, to tackle an opponent, to save money, and to win an award. Participants are asked to select target goals from a stimulus card which lists both the target and distractor items. Finally, upon each participant’s identification of the target actions and goals for each situation, he/she is asked to rate his/her familiarity with the situation on a scale from 1 to 7 (1 = extremely familiar, 2 = very familiar, 3 = familiar, 4 = equally familiar or unfamiliar, 5 = unfamiliar, 6 = very unfamiliar, and 7 = extremely unfamiliar). The following were used as variables in the analyses: total number of goals correctly identified; % correct responses for identified goals; total number of actions correctly identified; and, % correct responses for identified actions.

Regarding its psychometric properties, the SFRT has been found to be sensitive to impairments in social cognition in individuals with schizophrenia and schizoaffective disorder as compared to normal controls, as well as to differences in severity of impairment in both outpatients and inpatients with schizophrenia (Corrigan, Garman et al., 1996). Furthermore, performance in first- and multi-episode schizophrenia patients on the SFRT has been found to be stable over time, with no statistically significant

differences found between performance at baseline and 1 year later in such individuals, despite evidence of significant improvements in normal controls (Addington et al., 2006).

*The Assessment of Interpersonal Problem Solving Skills.* The Assessment of Interpersonal Problem Solving Skills (AIPSS; Donahoe, Carter, Bloem, Hirsch, et al., 1990; Donahoe, Carter, Bloem, & Leff, 1990) is comprised of a series of 13 video-taped social interactions, as well as one demonstration interaction, portraying a variety of scenarios, including such situations as having to assert oneself in response to someone “cutting” in line and having to appropriately negotiate a conflict with one’s roommate. Each scene thus has a goal which the participant is expected to infer, such as “to get the woman to go to the end of the line” for the aforementioned jumping in line scene, and “to get the roommate to clean up his clothes without alienating him” for the conflict with roommate scene.

Administration involves presenting the scenes one at a time to the participant. Upon initiation of each scene, the video is paused and the participant is instructed to identify with one of the characters in the scene. He/She is then assessed on a number of scales measuring social cognition and interpersonal problem solving skills. The first scale, Identification, is assessed by asking the participant, “Is there a problem in this scene?”. The participant is asked to provide a Yes/No response, with a response of “Yes” being awarded a score of 1, and “No” being awarded a score of 0, for the 10 of 13 scenes in which there is a problem. There are three scenes in which there is no problem, for which a response of “Yes” is awarded a score of 0, and “No” is awarded a score of 1. For the no-problem scenes, the remaining questions are asked if the participant indicates that there is a problem, although no subsequent scores are awarded. For the problem scenes,

following the Identification question, the participant is asked to describe the scene to the examiner in as much detail as possible. The participant's response is recorded and awarded a score of 0 if the participant provided no response or indicated that there was no problem, a score of 2 if the participant correctly described the problem according to the scoring guidelines for each scene, and a score of 1 if an adequate, but not good, response is provided, again according to the scoring guidelines for each scene. The Identification and Description scores are together considered a reflection of the participant's Receiving Skills. The participant's Processing Skills are then evaluated by asking the participant, "If you were in this situation, what would you say or do now?". The participant's response is recorded and is awarded a score of 0 if the participant provided no response or had indicated that there was no problem, a score of 2 if the participant provided a good response according to the scoring guidelines provided for each scene, and a score of 1 if an adequate, but not good, response is provided, again according the scoring guidelines outlined for each respective scene. Finally, the participant's Sending Skills are measured by evaluating the Performance and Content of the participant's response when asked, to demonstrate to the examiner what he/she would do in that particular situation. The Performance of the participant is recorded by the examiner and is awarded a score ranging from 0 to 2 according to the following criteria, which are standard for all scenes: a score of 0.0 is given if the participant provides no response, had indicated that there was no problem for that scene, or provides a response that is extremely inappropriate, bizarre, or highly offensive; a score of 0.5 is awarded if the participant provides a response that is clearly less than adequate, or if there is a substantial omission of important nonverbal components; a score of 1.0 is given if the participant provides a response which is barely

adequate or has room for considerable improvement, but is not really inappropriate; a score of 1.5 is awarded if the participant's response is appropriate or adequate, but is not "polished"; and, a score of 2.0 is given if the participant's response is very appropriate and polished and is characterized by a "smooth delivery." Similarly, the Content of the participant's response is given a score ranging from 0 to 2 according to the following scoring guidelines, which are standard for all scenes: a score of 0.0 is awarded if the participant provides no response, had indicated that there was no problem, or provides a response which is extremely unlikely to attain the goal, or likely to produce significant negative consequences; a score of 0.5 is given if the participant's response is not likely to get the goal, but is also not likely to produce any really severe negative consequences; a score of 1.0 is given if the participant's response may get the goal, but is clearly not the best response, and if the participant's response is not likely to produce any really bad consequences; a score of 1.5 is awarded if the participant's response is likely to get the goal and is a good response, but could be improved and lacks polish; and, a score of 2.0 is given if the participant's response is very effective, minimizes negative consequences, is very likely to get the goal, and is a smooth, polished response. Finally, an Overall Score is given for the participant's response to the problematic situation, with possible scores ranging from 0 to 2 according to the following scoring criteria, which are standard across all scenes: a score of 0.0 is awarded if the participant provides no response, had indicated that there wasn't a problem, or provides an overall response which is extremely unlikely to get the goal or is likely to produce significant negative consequences; a score of 0.5 is given if the participant's overall response is not likely to get the goal, but results in no really severe negative consequences; a score of 1.0 is awarded if the participant's

overall response may get the goal, but is clearly not the best response, and will likely result in no really bad consequences; a score of 1.5 is given if the participant's overall response is likely to get the goal and is a good response, but could be improved and lacks polish; and, a score of 2.0 is awarded if the participant's overall response is very effective, minimizes negative consequences, is very likely to get the goal, and is a smooth, polished response. Given the subjective nature of the Performance, Content, and Overall scores, each participant's responses were videotaped and five randomly selected cases were selected to be scored by a second trained researcher. Inter-rater reliability was found to be acceptable for each of the Performance ( $r = .702$ ), Content ( $r = .832$ ), and Overall ( $r = .816$ ) scores.

Additional measures of theory of mind were added to the AIPSS for the purposes of this research study – namely, Identification of Emotion and Rationale for Emotion items.

The Identification of Emotion item for each problem scene was comprised of an evaluation of the participant's perception of a probable current emotion of the main character. This was evaluated by asking, "How do you think that individual is feeling right now?" Scoring criteria were discussed and determined by the research team of a larger study being conducted in the research lab and were as follows: a score of 0.0 was given if the participant provided no response, a bizarre response, or the opposite of an acceptable response; a score of 0.5 was given if the participant provided a "Not \_\_\_\_\_ (e.g., happy)" response, the opposite of an accepted "Like he/she is being \_\_\_\_\_" response, or a situationally inappropriate overreaction; a score of 1.0 was given if the participant provided a broad emotion when there are subtleties to consider, or a "Like

he/she is being \_\_\_\_\_” response without consideration of subtleties; a score of 1.5 was given if the participant provided a “Like he/she is being \_\_\_\_\_” response with consideration of subtleties; and, a score of 2.0 was given if the participant provided an emotion which picked up on the subtleties of the situation. A range of possible responses were developed by the researchers, and scores for those responses were discussed and agreed upon. Given the subjective nature of the item, the responses for the present study were double scored, and inter-rater reliability was determined to be high ( $r = .808$ ).

The Rationale for Emotion item for each problem scene was comprised of an evaluation of the participant’s perception of why the main character might be feeling a particular emotion. This was evaluated by asking, “Why do you think he/she is feeling that way?” Scoring criteria were discussed and determined by the research team of a larger study being conducted in the research lab and were identical to the scoring criteria used for the Description item for each respective scene. Given the subjective nature of the item, the responses for the present study were double scored, and inter-rater reliability was determined to be high ( $r = .865$ ).

As previously delineated, the scores awarded for the AIPSS are comprised of: Receiving Skills, which include the Identification and Description scores; Processing Skills, which include the participant’s hypothetical response to the problem; Sending Skills, which include the Performance and Content scores; and, an Overall score of the participant’s overall response to the problematic situation. Two theory of mind items were also included, namely Identification of Emotion and Rationale for Emotion. Items from the AIPSS were summed to provide total scores as measures of Complex Social Skills (the sum of the Identification, Description, Processing Skills, Sending Skills, and

Overall scores) and Theory of Mind (i.e., the sum of the Identification of Emotion and Rationale for Emotion scores). The Complex Social Skills and Theory of Mind total scores were used as variables in the path analysis for the corresponding domains.

Previous research utilizing the AIPSS as a measure of social cognition, and more specifically, interpersonal skills within a problem-solving context, has demonstrated the measure's psychometric properties, including its sensitivity to deficits in social cognition in individuals with first- and multi-episode schizophrenia (Addington et al., 2006; Grant et al., 2001; Stalberg et al., 2008; Zanello et al., 2006). The AIPSS has also been found to be sensitive to interventions targeting improvement in social cognition, specifically in the improvement of interpersonal skills in situations with a problematic component (Lieberman, Eckman, & Marder, 2001; Ucock et al., 2006). Ucock and colleagues (2006), for example, found evidence of significant improvements in a group of individuals with schizophrenia who received a 6-week-long targeted treatment, and no significant changes in performance in a group of such individuals who received treatment as usual. The change in the treatment group demonstrates the measure's sensitivity to treatment, while the stability in performance of the treatment as usual group exhibits the measure's test-retest reliability over a 6-week-period. Others have also demonstrated the measure's test-retest reliability across a period of one year in the absence of any targeted interpersonal problem solving skills treatment (Addington et al., 2006).

### **Measures of theory of mind.**

*The Reading the Mind in the Eyes Test.* The Reading the Mind in the Eyes Test (Eyes Test; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) is a theory of mind task which measures one's ability to evaluate the mental and emotional state of

individuals upon viewing pictures of their eyes, and which has been found to be sensitive to theory of mind impairments in individuals with schizophrenia as compared to normal controls (e.g., Schimansky, David, Rossler, & Haker, 2010). The measure is comprised of a series of 36 still photographs of the eyes of individuals portraying various emotional and mental states. Each photograph is accompanied by four complex mental and emotional states, each of which is presented with a short definition to ensure knowledge of the meanings of the terms. For example, a photograph may be presented with the following response choices and definitions: “A) PLAYFUL, full of high spirits and fun”; “B) COMFORTING, consoling, compassionate”; “C) IRRITATED, exasperated, annoyed”; and, “D) BORED, uninterested, tired”. The task was presented via E-prime software, and total score of number of correct responses was used as a variable in the analyses.

Originally created as a measure of theory of mind in individuals with Asperger’s disorder and high-functioning autism, the Eyes Test has been found to successfully discriminate such individuals from a large group of normal controls (Baron-Cohen et al., 2001). A significant negative correlation was also found between performance of the groups and the Autism Spectrum Quotient, a measure of traits associated with autism in adults with otherwise normal intelligence, suggesting that poorer performance on the Eyes Test is associated with greater severity of autistic traits in adults, thus providing support for the construct validity of the measure (Baron-Cohen et al., 2001).

Furthermore, support of the measure’s sensitivity to theory of mind deficits in individuals with schizophrenia has been demonstrated in studies which have found the performance of such individuals to be significantly poorer than that of normal controls (e.g., Craig,

Hatton, Craig, & Bentall, 2004; Hirao et al., 2008; Kettle, O'Brien-Simpson, & Allen, 2008; Shur, Shamay-Tsoory, & Levkovitz, 2008).

***Hinting Task.*** The Hinting Task (Corcoran, Mercer, & Frith, 1995) is a theory of mind measure which evaluates one's ability to detect underlying meaning behind statements within a social context. The task is comprised of a series of 10 short vignettes which are read aloud to the participant. After each vignette is read, the participant is asked what was really meant by the last statement. If the participant provides a 2-point response as outlined by the scoring criteria for each vignette, the next vignette is presented. If a 2-point response is not initially provided by the participant, another statement within the context of the vignette is provided by the examiner, after which the participant is asked a more specific question aimed at measuring whether the individual perceives the underlying meaning. If an adequate response is given indicating understanding of the underlying meaning as outlined by the scoring criteria provided for each vignette, 1 point is awarded. Individuals thus receive a score of 0, 1, or 2 for each vignette, for a total possible score of 20. The total score was be used as a variable in the analyses.

Previous research has demonstrated the sensitivity of the Hinting Task in measuring theory of mind impairments in individuals with schizophrenia, specifically as compared to normal controls (Corcoran & Frith, 2005; Corcoran et al., 1995), to individuals with schizoaffective disorder (Fiszdon et al., 2007), and to individuals with a history of psychosis but in the absence of symptoms which are severe enough to warrant a diagnosis of schizophrenia (Marjoram et al., 2006). Findings have been mixed, however, as evidence has been found to suggest that impairments on the Hinting Task

may only be present during active phases of schizophrenia, and not during periods of remission (Corcoran, 2003; Corcoran et al., 1995), although such findings are more reflective of an underlying etiology question rather than an issue regarding the measure's sensitivity to schizophrenia.

## **Procedure**

Participants were recruited primarily through referrals from local mental health agencies. Additionally, participants from prior studies conducted within the Neuropsychology Research Program at UNLV under the direction of Daniel N. Allen, Ph.D. who had signed a Consent to be Contacted for Future Research Studies, or who approached the researcher during recruitment efforts within the local mental health agencies with interest in participating in another study, were given information regarding the current study and asked if they were interested in participating, were contacted for potential participation in the current study. Participants initially contacted the research team by either telephone or in person during recruitment efforts. An initial brief screen was conducted during which time verbal consent were obtained for the procedures used in the phone screen (see Appendix I). The screen requested information relevant to study inclusion and exclusion criteria. If it was determined that the individual likely met criteria to participate in the study, either according to the results of the phone screen, knowledge obtained from previous participation, or confidence asserted by local mental health referral agencies, an initial evaluation session was scheduled in order to conduct a more extensive interview to establish the diagnosis and determine eligibility to participate based on the inclusion and exclusion criteria.

The interviews, questionnaires and neuropsychological measures used in this study were administered as part of a larger battery of tests being conducted in the Neuropsychology Research Lab at the University of Nevada Las Vegas. Administration was scheduled across two 2.5-hour sessions, with the entire battery lasting a total of approximately 5 hours. The initial session included diagnostic and clinical symptom measures, while the second included the administration of the neurocognitive measures. When possible, both sessions were scheduled on the same day, with a 1-hour lunch break in between sessions. Furthermore, several mandatory breaks were scheduled into each evaluation session in order to circumvent fatigue and maintain motivation. All participants were compensated for their time, with \$5 awarded for each hour completed and a \$30 bonus given for completion of all testing procedures, for a total of approximately \$55-60.

During the first session, the participant was given an Informed Consent (see Appendix II for the full consent forms for both individuals recruited from the community and those recruited from the psychology department at UNLV). The consent form was read aloud in its entirety to each participant and an opportunity was provided for questions, each of which was addressed and clarified. Both the participant and the researcher signed two Informed Consents – one for the researcher to keep for the participant’s file and one for the participant to keep for his/her own records and information. Following informed consent, a Demographics Questionnaire was administered in order to gain in-depth information regarding the participant’s personal and family history (see Appendix III for the full Demographics Questionnaire). The participant was then administered the battery of interviews, questionnaires, and

neurocognitive tests in the following order: 1) Structured Clinical Interview for DSM-IV-TR; 2) Brief Psychiatric Rating Scale; 3) Schedule for the Assessment of Negative Symptoms; 4) Schedule for the Assessment of Positive Symptoms; 5) Visual Acuity Check; 6) Hearing Check; 7) Inverted Face Identification Task; 8) Frequency Discrimination Test; 9) Hinting Task; 10) WAIS-III Vocabulary Subtest; 11) Situational Feature Recognition Task; 12) The Reading the Mind in the Eyes Test; 13) WAIS-III Information Subtest; 14) WAIS-III Block Design Subtest; 15) Bell-Lysaker Emotion Recognition Test (including Visual Affect Identification, Auditory Affect Identification, and Auditory-Visual Affect Identification tasks); and, 16) Assessment of Interpersonal Problem Solving Skills. If the participant did not meet diagnostic criteria based on the Structured Clinical Interview for the DSM-IV-TR, the study was discontinued. If diagnostic and inclusion criteria were met, the neurocognitive measures were administered as part of a more extensive test battery. All assessment procedures were administered by a doctoral level graduate student who have been extensively trained to do so in a reliable and valid manner.

### **Data Entry and Analyses**

**Data entry and screening.** All measures were scored according to standardized procedures by two trained individuals. Data was entered twice into a Microsoft Access database, and SPSS version 16.0 was used to analyze the data. Standard scores (z-scores) were calculated for each of the neurocognitive variables based on the mean and standard deviation of the current sample in order to standardize variables to be included in the path analysis. Prior to analysis of the primary hypothesis, raw data from the dependent variables was examined to confirm that assumptions for path analysis had been met (e.g.,

multivariate normality, absence of outliers, linearity, absence of multicollinearity and singularity, and small residual covariances).

### **Data analysis.**

*Preliminary analyses.* Several preliminary analyses were conducted before the primary hypotheses were analyzed. Specifically, descriptive statistics were calculated for the group for a handful of demographic variables, including age, education, estimated current intelligence quotient (IQ), estimated premorbid IQ, gender, handedness, ethnicity, and marital status. Descriptive statistics were also calculated for a number of clinical variables, including number of lifetime hospitalizations, duration of illness, Global Assessment of Functioning (GAF) score based on level of functioning only, GAF score based on severity of symptoms only, overall GAF score, severity of psychiatric symptomatology at time of testing as measured via the Brief Psychiatric Rating Scale (BPRS), the Schedule for the Assessment of Negative Symptoms (SANS), and the Schedule for the Assessment of Positive Symptoms (SAPS), and medication status at time of testing. Finally, descriptive statistics were calculated for a number of diagnostic variables, including subtype of schizophrenia, course specifier, severity, and dual diagnosis.

Furthermore, correlational analyses were used to evaluate the relationships between performance on social cognitive measures and the aforementioned demographic, clinical, and diagnostic variables.

### *Primary analyses.*

*Introduction to path analysis.* Path analysis was used to evaluate both the primary and secondary hypotheses. Path analysis is essentially an extension of regression analysis and allows for the comparison of two or more causal models. However, unlike regression, goodness of fit indexes can be derived for competing models based on model fit with the correlation matrix for the data. Path models are typically illustrated using circles and arrows, with circles indicating the measured variables in the models, and arrows indicating the hypothesized causative relationships between the variables. Regression analyses are then performed for each of the relationships specified in the model, and the weights predicted by the model are subsequently compared to the correlation matrix that was obtained from the actual data. Model fit indexes allow for comparisons between models in order to identify which of a number of competing models provides the best explanation of the observed data.

The adequacy of fit of proposed models is determined using a number of procedures. Path coefficients, which are standardized regression coefficients, can be evaluated to determine whether individual causal relationships in the hypothesized model are present in the actual data. The overall fit of the model, which includes all of the specified paths and their associated path coefficients, can be evaluated in a number of ways. According to the recommendations set forth by Tabachnick and Fidell (2007), the following were used as evaluations of model fit: chi-square, the ratio of chi-square to degrees of freedom, the comparative fit index (CFI), the normed fit index (NFI), and the Tucker-Lewis index (TLI).

*Models examined in the current study.* The path models that were evaluated for the primary and secondary path analyses are presented in Figures 1-4. In these models,

each variable is assessed using a single indicator. Indicators are the total score from the relevant measures used to assess the variables. The domains assessed, dependent variables, and measures used to assess the dependent variables for the primary analysis are presented in Table 1, and for the secondary analyses in Tables 2 and 3.

The models depict the relationships between the independent, intermediary and dependent variables. In all of the models, auditory and visual perception are independent variables, auditory, visual, and auditory/visual affect identification and complex social interactions are intermediary variables, and theory of mind is the dependent variable. In the models, causative relationships between the independent variables (or exogenous variables) and intermediary variables are indicated by single arrows from the independent variables to the intermediary variables, in order to indicate their hypothesized causative influence in the models, with the direction of each arrow indicating the direction of the hypothesized causal influence of one variable on another. The causative influences of the paths from one variable on another are determined by a standardized regression coefficient (beta). Exogenous variables in the model have no explicit causes as indicated by no arrows going to them. The exception to this is when exogenous variables are correlated, which is indicated by a curved, bidirectional arrow (see AP and VP in the models in Figures 1-4). On the other hand, endogenous variables do have arrows coming to them, with a distinction between endogenous variables that are intervening variables, which they have both incoming and outgoing arrows, and dependent endogenous variables, which have only incoming causal arrows. Error terms are not specified in any of the model diagrams presented in the figures, but could be included in the diagrams for each of the variables with an arrow from the error term to the respective variable.

Table 1. Variables included in the primary path analysis.

Domain	Measure	Dependent Variable
AP	Tone Discrimination Task	Percent correct of completed trials standard score
VP	Inverted Face Identification Task	Percent correct of completed trials standard score
AA	BLERT Auditory Affect Identification	Number total correct standard score
VA	BLERT Visual Affect Identification	Number total correct standard score
A/VA	BLERT Auditory-Visual Affect Identification	Number total correct standard score
CSS	Situational Feature Recognition Test Goals	Total standard score
	Assessment of Interpersonal Problem Solving Skills	Total standard score
ToM	The Reading the Mind in the Eyes Test	Number total correct standard score
	The Hinting Task	Total standard score
	Assessment of Interpersonal Problem Solving Skills	Theory of mind total standard score

*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification.

A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind. BLERT = Bell-Lysaker Emotion Recognition Test.

Table 2. Variables included in the positive valence affect identification path analysis.

Domain	Measure	Dependent Variable
AP	Tone Discrimination Task	Percent correct of completed trials standard score
VP	Inverted Face Identification Task	Percent correct of completed trials standard score
AA	BLERT Positive Auditory Affect Identification	Positive valence number total correct standard score
VA	BLERT Positive Visual Affect Identification	Positive valence number total correct standard score
A/VA	BLERT Positive Auditory-Visual Affect Identification	Positive valence number total correct standard score
CSS	Situational Feature Recognition Test Goals	Total standard score
	Assessment of Interpersonal Problem Solving Skills	Total standard score
ToM	The Reading the Mind in the Eyes Test	Number total correct standard score
	The Hinting Task	Total standard score
	Assessment of Interpersonal Problem Solving Skills	Theory of mind total standard score

*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification.

A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind. BLERT = Bell-Lysaker Emotion Recognition Test.

Table 3. Variables included in the negative valence affect identification path analysis.

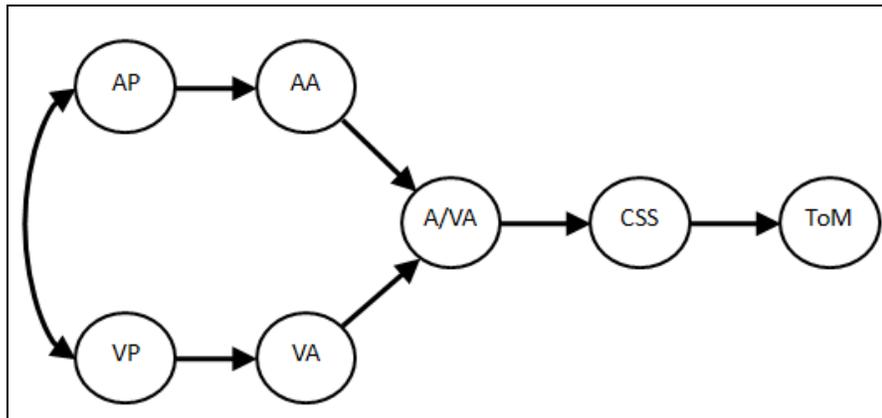
Domain	Measure	Dependent Variable
AP	Tone Discrimination Task	Percent correct of completed trials standard score
VP	Inverted Face Identification Task	Percent correct of completed trials standard score
AA	BLERT Negative Auditory Affect Identification	Negative valence number total correct standard score
VA	BLERT Negative Visual Affect Identification	Negative valence number total correct standard score
A/VA	BLERT Negative Auditory-Visual Affect Identification	Negative valence number total correct standard score
CSS	Situational Feature Recognition Test Goals	Total standard score
	Assessment of Interpersonal Problem Solving Skills	Total standard score
ToM	The Reading the Mind in the Eyes Test	Number total correct standard score
	The Hinting Task	Total standard score
	Assessment of Interpersonal Problem Solving Skills	Theory of mind total standard score

*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification.

A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind. BLERT = Bell-Lysaker Emotion Recognition Test.

As demonstrated in Figures 1-4, the correlation between the two exogenous variables (auditory perception [AP] and visual perception [VP]) is indicated with a curved two-headed arrow. Additionally, their respective causative influences on simple affect identification tasks are indicated with arrows traveling from AP to AA and from VP to VA, respectively. These paths are specified to indicate the direct causative influence of basic auditory and visual perceptual processes on auditory and visual affect identification, respectively. Deficits in the early stages of auditory and visual perception are anticipated to decrease accuracy in the identification of modality congruent emotional information. In Figure 1, causal paths that are relevant to auditory/visual affect perception (A/VA) are the paths from AA and VA. These causative paths from AA and VA to A/VA indicate that degree of accurate perception of affect based on auditory and visual information presented individually of one another is predictive of accuracy in the identification of affect based on the presentation of both auditory and visual information simultaneously. Also relevant are paths reflecting common antecedent causes, which include the paths from VP to VA to A/VA, and from AP to AA to A/VA. The antecedent causes, in this case AP and VP, are thought to exert indirect causative influence on A/VA via AA and VA, respectively. These paths suggest that while auditory perception (AP) and visual perception (VP) do not directly influence the accurate identification of emotions that are conveyed in bimodal auditory and visual stimuli (A/VA), they do contribute indirectly based on their direct influence on unimodal auditory and visual affect identification, respectively. In turn, the model further indicates that A/VA has a direct causative influence on accurate perception of emotion conveyed in complex social

Figure 1. Model 1: Simple additive model for the primary and secondary analyses.



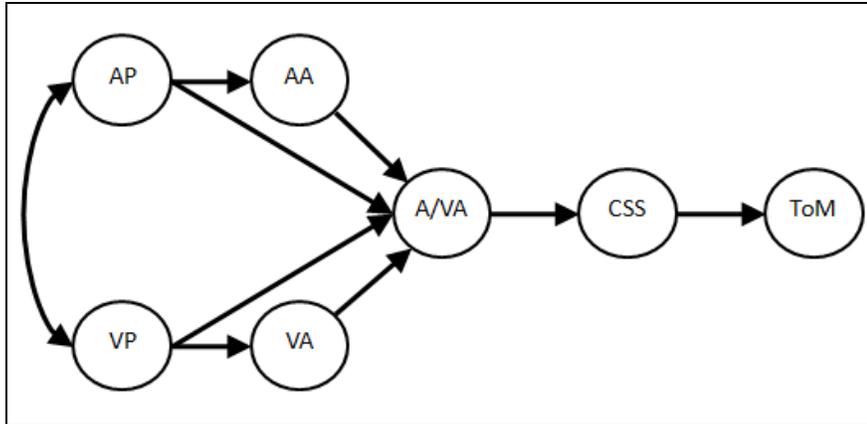
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

situations (CSS), and CSS on the ability to make inferences about the thoughts and feelings of others (i.e., theory of mind [ToM]).

The models presented in Figures 2, 3 and 4 represent elaborations of the model presented in Figure 1. The model in Figure 2 differs from the model presented in Figure 1 by including direct causative pathways from AP to A/VA and from VP to A/VA. As such, Model 2 (presented in Figure 2) indicates that, in addition to any indirect influence that AP might exert through AA on A/VA, AP will also have a direct influence on A/VA. Similarly, in addition to any indirect influence that VP might exert through VA on A/VA, VP will also have a direct influence on A/VA.

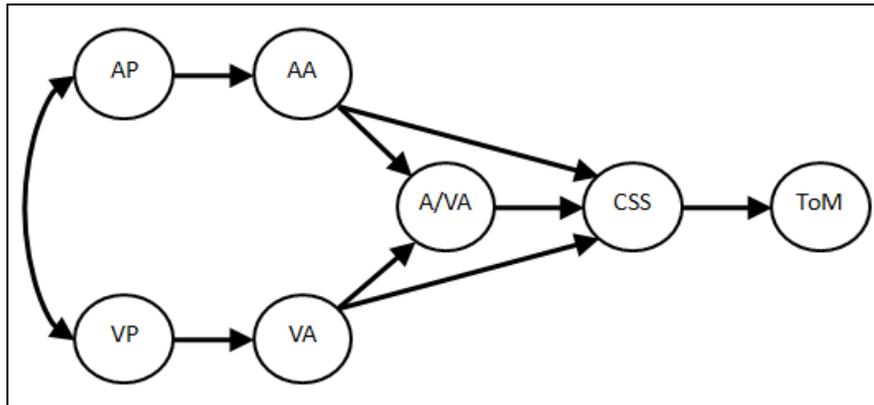
The model presented in Figure 3 differs from the model presented in Figure 1 by indicating direct causative pathways from AA to CSS, as well as from VA to CSS. By specifying these additional pathways, Model 3 indicates that in addition to any indirect

Figure 2. Model 2: Model proposing direct contributions of basic auditory and visual perception to auditory/visual affect identification for the primary and secondary analyses.



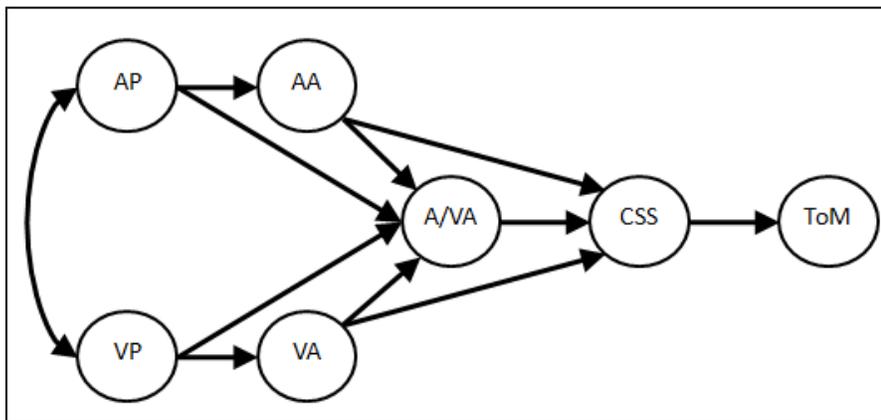
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 3. Model 3: Model proposing direct contributions of auditory and visual affect identification to complex social situation perception for the primary and secondary analyses.



*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 4. Model 4: Full model for the primary and secondary analyses.



*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

influence that AA might exert on CSS through A/VA, AA will also have a direct influence on CSS. Likewise, in addition to any indirect influence that VA might exert on CSS through A/VA, VA will also have a direct influence on CSS.

The model presented in Figure 4 is a full model, in which all of the pathways initially specified in models 1, 2 and 3 are also specified. This model is the most complex of the four models, and indicates all of the direct and indirect influences previously discussed.

## **Hypotheses**

**Primary hypothesis.** Based on the existing literature, it was hypothesized that Model 1 will have provided the best fit of the data. Model 1 is appealing not only because it is the most parsimonious of the models, but also because there is little support for the more complex models based on the existing literature. For example, while deficits in auditory perception have been linked to deficits in accurate perception of prosody (i.e., the causal pathway from AP to AA), there has not been a link established between auditory perception and auditory/visual affect identification (i.e., causal pathway between AP and A/VA). It was recognized that the other, more complex models may have provided a better fit to the actual data, but Model 1 was selected as the hypothesized optimal model for the aforementioned reasons.

**Secondary hypotheses.** A number of secondary analyses were conducted with the primary emphasis on contrasting distinctions between positive and negative emotions. These analyses were designed to allow for an evaluation of differential impairment in affect identification according to emotional valence (i.e., positive versus negative emotions), since there is evidence suggesting differential deficits in emotion perception

for patients with schizophrenia according to type of emotion. The positive emotion valence category was comprised of happiness and surprise, while the negative emotion valence category included anger, sadness, fear, and disgust. Composite scores were developed for the positive and negative valence categories for the variables derived from the BLERT (i.e., AP, VP and A/VP) since these are the only variables for which responses were able to be separated according to type of emotion. Two sets of parallel analyses comparable to those described for the primary hypothesis were subsequently conducted, the first with the positive emotion composites and the second with the negative emotion composites. No specific a priori hypotheses were made for these analyses, although the most parsimonious of the models will have been considered optimal if other parameters did not suggest significant differences in fit between the models.

## Chapter 4:

### Results

#### Data Screening

Data was screened according to the guidelines put forth by Tabachnick and Fidell (2007), such that the following assumptions were evaluated: multivariate normality and presence of outliers, linearity, absence of multicollinearity and singularity, and residual covariances.

**Multivariate normality.** Multivariate normality was evaluated by examining the skewness and kurtosis of the measured variables. General recommendations indicate that skewness and kurtosis values ranging from -1 to +1. See Tables 4 and 5 for the skewness and kurtosis values of the measured variables. Given that the skewness and kurtosis values for all variables fall within the recommended range, normality of the distributions of the variables was assumed.

**Absence of outliers.** According to Tabachnick and Fidell (2007), data undergoing structural equation modeling analyses must be examined for both univariate and multivariate outliers. The authors recommend first evaluating for the presence of univariate outliers and, if necessary, transforming the data to adjust for such outliers prior to evaluating for the presence of multivariate outliers, as the statistics commonly used to evaluate for the presence of multivariate outliers are sensitive to the absence of normality of the univariate variables.

Regarding the presence of univariate outliers, it is recommended that values falling  $\geq 3.30$  standard deviations above or below the mean for any given variable be considered as potential outliers (Tabachnick & Fidell, 2007). Upon examination of the

Table 4. Skewness and kurtosis values for measured variables for the primary analysis.

	Skewness	Kurtosis
Tones	.497	-.122
Faces	.078	-.993
BLERT AA	.478	.219
BLERT VA	-.249	.244
BLERT A/V	-.376	-.624
AIPSS CSS	-.127	-.303
SFRT	-.590	.754
Hinting	-.331	-.909
Eyes	.012	-.484
AIPSS ToM	-.105	-.415

*Note.* Tones = Tone Discrimination Task. Faces = Inverted Face Identification Task.

BLERT AA = Bell-Lysaker Emotion Recognition Test auditory affect identification.

BLERT VA = Bell-Lysaker Emotion Recognition Test visual affect identification.

BLERT A/V = Bell-Lysaker Emotion Recognition Test auditory/visual affect

identification. AIPSS CSS = Assessment of Interpersonal Problem Solving Skills

complex social skills situations. SFRT = Situational Feature Recognition Test. Hinting =

Hinting Task. Eyes = The Reading the Mind in the Eyes Test. AIPSS ToM =

Assessment of Interpersonal Problem Solving Skills theory of mind score.

Table 5. Skewness and kurtosis values for measured variables for the secondary analyses.

	Skewness	Kurtosis
BLERT Pos Aud	-.010	-.770
BLERT Pos Vis	-.315	-.644
BLERT Pos Aud/Vis	-.608	-.493
BLERT Neg Aud	-.525	.126
BLERT Neg Vis	.674	.865
BLERT Neg Aud/Vis	-.411	-.556

*Note.* BLERT Pos Aud = Bell-Lysaker Emotion Recognition Test positive valence auditory affect identification. BLERT Pos Vis = Bell-Lysaker Emotion Recognition Test positive valence visual affect identification. BLERT Pos Aud/Vis = Bell-Lysaker Emotion Recognition Test positive valence auditory/visual affect identification. BLERT Neg Aud = Bell-Lysaker Emotion Recognition Test negative valence auditory affect identification. BLERT Neg Vis = Bell-Lysaker Emotion Recognition Test negative valence visual affect identification. BLERT Neg Aud/Vis = Bell-Lysaker Emotion Recognition Test negative valence auditory/visual affect identification.

data, no values were found to fall outside of this accepted range (see Tables 6 and 7 for the means, standard deviations, and observed ranges of values for each of the variables). Therefore, no transformations were made subsequent to an evaluation for the presence of univariate outliers.

Regarding the presence of multivariate outliers, Tabachnick and Fidell (2007) recommend a consideration of Mahalanobis distance for each case as measured on the variables, with  $p < .001$  for the  $\chi^2$  value as the recommended cutoff value for a potential outlier. With 10 variables used in each of the analyses, the  $\chi^2$  value for a significance level of .001 is 29.588, indicating that a Mahalanobis distance  $\geq 29.588$  for any given case would suggest status as a potential multivariate outlier. Upon examination of the Mahalanobis distance values for the present data set, the observed Mahalanobis values ranged from 1.301 to 14.054 for the primary analysis, from 1.697 to 16.123 for the secondary analysis with positive emotional categories, and from 1.860 to 15.983 for the secondary analysis with negative emotional categories, therefore indicating the presence of no multivariate outliers. No data transformations were therefore made subsequent to an evaluation for the presence of multivariate outliers.

**Linearity.** The linearity of the relationships between the measured variables was evaluated via examining (a) the correlation matrix and (b) scatter plots of the relationships amongst the variables. Subsequent to these techniques it was determined that the relationships amongst the measured variables were of a linear nature, thus necessitating no data transformations to adjust for non-linear relationships.

**Absence of multicollinearity and singularity.** The determinant of the covariance matrix was examined to evaluate for the presence of multicollinearity and/or

Table 6. Evaluation of potential outliers for the primary analysis variables.

	Mean	SD	Min (-3.30 SD)	Max (+3.30 SD)
Tones	69.92	12.00	49.46 (30.32)	99.17 (109.52)
Faces	74.28	11.37	52.99 (36.76)	96.23 (111.80)
BLERT AA	7.00	2.70	2.00 (-1.92)	14.00 (15.92)
BLERT VA	11.08	3.49	3.00 (-0.45)	18.00 (22.61)
BLERT A/V	11.12	3.94	2.00 (-1.87)	18.00 (24.11)
AIPSS CSS	54.92	16.93	17.50 (-0.94)	90.00 (110.78)
SFRT	96.58	11.21	63.00 (62.90)	117.00 (130.21)
Hinting	11.94	4.73	1.00 (-3.67)	19.00 (27.55)
Eyes	18.52	5.45	7.00 (0.53)	30.00 (36.51)
AIPSS ToM	17.98	6.23	4.50 (-2.58)	31.50 (38.54)

*Note.* Tones = Tone Discrimination Task. Faces = Inverted Face Identification Task.

BLERT AA = Bell-Lysaker Emotion Recognition Test auditory affect identification.

BLERT VA = Bell-Lysaker Emotion Recognition Test visual affect identification.

BLERT A/V = Bell-Lysaker Emotion Recognition Test auditory/visual affect

identification. AIPSS CSS = Assessment of Interpersonal Problem Solving Skills

complex social situations score. SFRT = Situational Feature Recognition Test. Hinting =

Hinting Task. Eyes = The Reading the Mind in the Eyes Test. AIPSS ToM =

Assessment of Interpersonal Problem Solving Skills theory of mind score. SD =

Standard deviation. Min = Minimum observed value. Max = Maximum observed value.

Table 7. Evaluation of potential outliers for the secondary analyses variables.

	Mean	SD	Min (-3.30 SD)	Max (+3.30 SD)
BLERT Pos Aud	2.98	1.39	0.0 (-1.61)	6.0 (7.57)
BLERT Pos Vis	3.94	1.58	0.0 (-1.27)	6.0 (9.15)
BLERT Pos Aud/Vis	4.28	1.59	0.0 (-0.97)	6.0 (9.53)
BLERT Neg Aud	5.76	2.01	0.0 (-0.87)	9.0 (12.39)
BLERT Neg Vis	2.94	1.72	0.0 (-2.73)	8.0 (8.62)
BLERT Neg Aud/Vis	5.52	2.30	0.0 (-2.07)	9.0 (13.11)

*Note.* BLERT Pos Aud = Bell-Lysaker Emotion Recognition Test positive valence

auditory affect identification. BLERT Pos Vis = Bell-Lysaker Emotion Recognition Test

positive valence visual affect identification. BLERT Pos Aud/Vis = Bell-Lysaker

Emotion Recognition Test positive valence auditory/visual affect identification. BLERT

Neg Aud = Bell-Lysaker Emotion Recognition Test negative valence auditory affect

identification. BLERT Neg Vis = Bell-Lysaker Emotion Recognition Test negative

valence visual affect identification. BLERT Neg Aud/Vis = Bell-Lysaker Emotion

Recognition Test negative valence auditory/visual affect identification. SD = Standard

deviation. Min = Minimum observed value. Max = Maximum observed value.

singularity. Tabachnick and Fidell (2007) suggest considering a covariance determinant that is (a) positive and (b) not equal to zero to indicate the absence of multicollinearity and singularity. The determinant of the covariance matrix for the primary analysis was .490, for the secondary analysis with positive emotional categories was 8.806, and for the secondary analysis with negative emotional categories was 47.833, suggesting the absence of multicollinearity and singularity. No data transformations were therefore indicated.

**Residual covariances.** Tabachnick and Fidell (2007) indicate that, subsequent to model estimation, the residual covariances should be small, and the distribution of the residual covariances is expected to be symmetrically centered around zero. Examination of the residual covariance matrices indicated the presence of a handful of medium-sized covariance coefficients. Tabachnick and Fidell (2007), however, indicate that while the presence of such coefficients may suggest a poor fitting model, they may also be present despite a good fitting model. The authors recommend considering adding additional paths to the model in attempts to identify a better fitting model with fewer medium to large residual covariance coefficients (Tabachnick & Fidell, 2007). In contrast, others have recommended caution when altering models in order to improve goodness of fit, particularly when making changes that contradict the theory-based path design (Streiner, 2005). Given that the purpose of the present study was to evaluate a number of models which were designed a priori and was not characterized by an exploratory consideration of different models, no paths were added or deleted.

## **Data Analyses**

**Preliminary analyses.** Descriptive statistics were calculated for a number of demographic characteristics, namely age, education, estimated current intelligence quotient (IQ), estimated premorbid IQ, gender, handedness, ethnicity, and marital status. The means and standard deviations of the continuous variables, as well as the frequency percentages of the categorical variables, are presented in Table 8.

Descriptive statistics were also calculated for a number of clinical characteristics, namely number of psychiatric hospitalizations, duration of illness, Global Assessment of Functioning (GAF) score based on functioning, GAF score based on symptoms, overall GAF score, Brief Psychiatric Rating Scale (BPRS) total and factor scores, Schedule for Assessment of Negative Symptoms (SANS) total and factor scores, and Schedule for the Assessment of Positive Symptoms (SAPS) total and factor scores. The means and standard deviations of the sample for these variables are reported in Table 9. Descriptive statistics were also calculated for medication status of patients at time of testing, including typical antipsychotics, atypical antipsychotics, antidepressants, anxiolytics, and other medications. Frequency percentages of adherence to various categories of psychiatric medications according to patient records are reported in Table 10.

Finally, descriptive statistics were calculated for a number of diagnostic characteristics, including subtype of schizophrenia, course specifier, severity of illness, and dual diagnosis. Frequency percentages of category membership for these variables are presented in Table 11.

Correlational analyses were used to evaluate the relationships between performance on the social cognitive variables included in the primary analysis and each of the aforementioned variables. Pearson product-moment correlation coefficients were

Table 8. Demographic characteristics of the sample.

	Mean	SD
Age	46.02	10.89
Education	11.44	2.01
Current IQ	81.31	12.43
Premorbid IQ	88.38	13.49
	%	
Gender (% males)	54.0	
Handedness (% right)	90.0	
Ethnicity		
Caucasian	58.0	
African American	26.0	
Hispanic/Latino	6.0	
Hawaiian/Pacific Islander	2.0	
Native American	4.0	
Biracial	4.0	
Marital Status		
Never Married	66.0	
Married	10.0	
Married, Separated	4.0	
Divorced	10.0	
Widowed	10.0	

*Note.* IQ = Intelligence quotient. SD = Standard deviation.

Table 9. Clinical characteristics of the sample.

	Mean	SD
Number of hospitalizations	8.42	9.69
Illness duration	26.56	11.88
GAF		
Functioning	44.52	6.89
Symptoms	41.26	8.19
Overall	39.10	6.22
BPRS		
Thought Disturbance	9.84	3.48
Anergia	6.82	3.19
Affect	8.66	3.13
Disorganization	3.12	1.12
Total Score	35.06	6.63
SANS		
Affective Flattening	1.84	1.53
Alogia	0.70	1.27
Avolition	1.24	1.26
Anhedonia-Asociality	1.66	1.26
Attention	1.72	1.05
Total Score	24.52	13.97
SAPS		
Hallucinations	2.60	2.01
Delusions	2.26	1.60
Bizarre Behavior	0.74	0.92
Formal Thought Disorder	2.18	1.34
Total Score	26.14	14.84

*Note.* GAF = Global Assessment of Functioning. BPRS = Brief Psychiatric Rating

Scale. SANS = Schedule for Assessment of Negative Symptoms. SAPS = Schedule for

Assessment of Positive Symptoms. SD = Standard deviation.

Table 10. Medication status of participants at time of evaluation.

	%
Typical antipsychotic	18.2
Atypical antipsychotic	90.9
Antidepressant	54.5
Anxiolytic	29.5
Other	95.5

*n* = 44.

Table 11. Diagnostic characteristics of the sample.

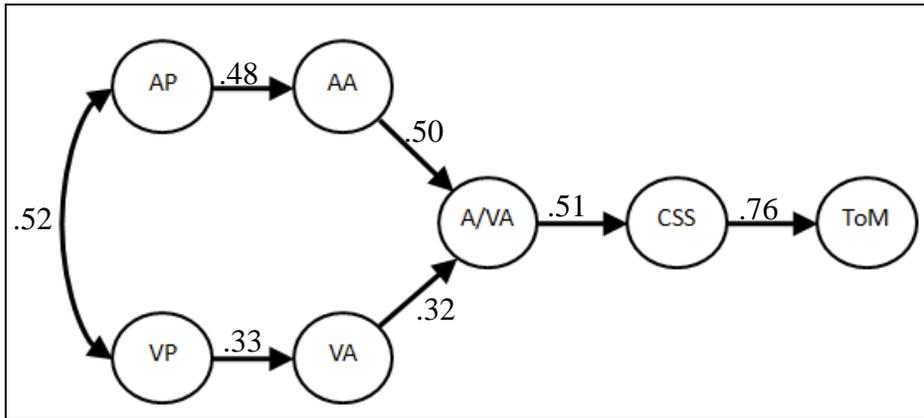
	%
Subtype of Schizophrenia	
Paranoid	12.0
Undifferentiated	82.0
Residual	6.0
Course Specifier	
Episodic, with interepisode residual symptoms, with prominent negative symptoms	4.0
Episodic, with interepisode residual symptoms	6.0
Continuous, with prominent negative symptoms	30.0
Continuous	60.0
Severity	
Mild	16.0
Moderate	68.0
Severe	16.0
Dual Diagnosis	
No Dual Diagnosis	32.0
Affective Disorder	28.0
Anxiety Disorder	20.0
Substance Use Disorder	58.0
Eating Disorder	2.0

calculated for the continuous variables and Spearman correlation coefficients were calculated for the categorical variables. Regarding demographic variables, statistically significant correlations were found between the following: age and auditory affect identification ( $r = -.345, p < .05$ ) and performance on the Hinting Task ( $r = .358, p < .05$ ); estimated current IQ and auditory perception ( $r = .453, p < .01$ ), visual perception ( $r = .401, p < .01$ ), auditory affect identification ( $r = .542, p < .01$ ), visual affect identification ( $r = .415, p < .01$ ), auditory/visual affect identification ( $r = .445, p < .01$ ), Situational Feature Recognition Test (SFRT) total goals score ( $r = .569, p < .01$ ), and performance on the Eyes Test ( $r = .453, p < .01$ ); and, estimated premorbid IQ and auditory perception ( $r = .397, p < .01$ ), visual perception ( $r = .345, p < .05$ ), auditory affect identification ( $r = .488, p < .01$ ), auditory/visual affect identification ( $r = .350, p < .05$ ), SFRT total goals score ( $r = .476, p < .01$ ), and performance on the Eyes Test ( $r = .508, p < .01$ ). Regarding clinical variables, statistically significant correlations were found between the following: duration of illness and auditory perception ( $r = -.301, p < .05$ ) and auditory affect identification ( $r = -.416, p < .01$ ); Brief Psychiatric Rating Scale (BPRS) Anergia factor score and visual affect identification ( $r = -.443, p < .01$ ), auditory/visual affect identification ( $r = -.432, p < .01$ ), Assessment of Interpersonal Problem Solving Skills (AIPSS) complex social skills score ( $r = -.302, p < .05$ ), and the SFRT total goals score ( $r = -.329, p < .05$ ); Schedule for Assessment of Negative Symptoms (SANS) global rating for Affective Flattening and visual perception ( $r = -.297, p < .05$ ), auditory/visual affect identification ( $r = -.288, p < .05$ ), and SFRT total goals score ( $r = -.332, p < .05$ ); SANS global rating for Alogia and AIPSS complex social situations score ( $r = -.371, p < .01$ ), SFRT total correct goals ( $r = -.403, p < .01$ ), and

AIPSS total theory of mind score ( $r = -.315, p < .05$ ); and, SANS total score and auditory affect identification ( $r = -.310, p < .05$ ). Regarding medication status, statistically significant correlations were found between the use of anxiolytics and SFRT total correct goals ( $r = .369, p < .01$ ) and performance on the Eyes Test ( $r = .336, p < .05$ ). Regarding diagnostic characteristics, statistically significant correlations were found between the following: continuous with prominent negative symptoms course specifier and visual perception ( $r = -.349, p < .05$ ), visual affect identification ( $r = -.390, p < .01$ ), auditory/visual affect identification ( $r = -.402, p < .01$ ), and performance on the Eyes Test ( $r = -.361, p < .05$ ); continuous course specifier and visual affect identification ( $r = .312, p < .05$ ), auditory/visual affect identification ( $r = .358, p < .05$ ), SFRT total goals score ( $r = .299, p < .05$ ), and performance on the Eyes Test ( $r = .383, p < .01$ ); severe course specifier and visual perception ( $r = -.340, p < .05$ ); no dual diagnosis and visual perception ( $r = -.354, p < .05$ ); and, the dual diagnosis of an affective disorder and visual perception ( $r = .414, p < .01$ ), auditory/visual affect identification ( $r = .296, p < .05$ ), AIPSS complex social skills score ( $r = .286, p < .05$ ), and performance on the Eyes Test ( $r = .408, p < .01$ ).

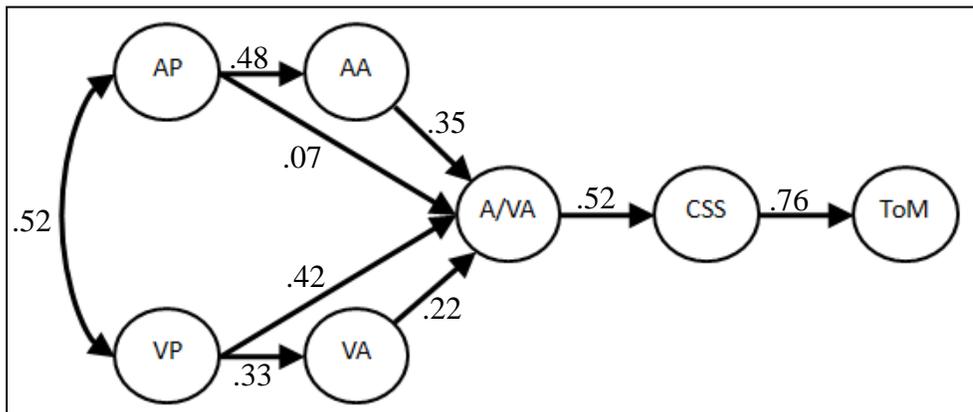
**Model identification.** The final models for the primary analysis are presented in Figures 5-8, and for the secondary analyses in Figures 9-16. There have been multiple model identification techniques which have been developed to help elucidate which of a number of different path models may best fit the data and may be the relatively closest approximation of the true model (Tabachnick & Fidell, 2007). Current recommendations for the utilization of various selection techniques generally include reporting two fit indices (Hu & Bentler, 1999; Stage, Carter, & Nora, 2004), one of which should be a

Figure 5. Model 1: Simple additive model for the primary analysis.



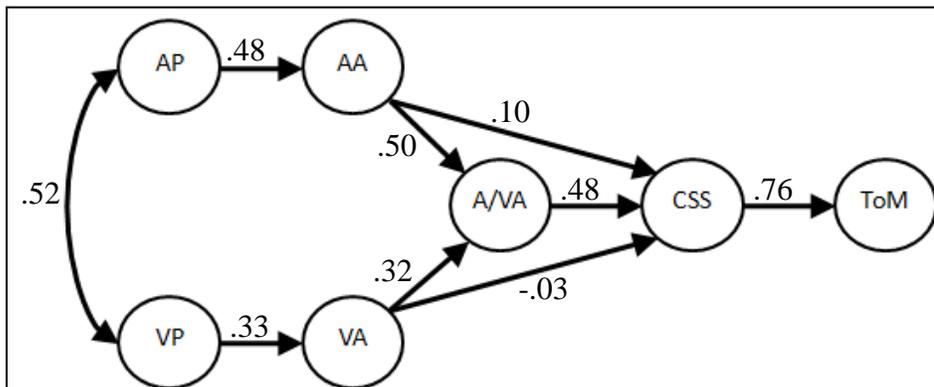
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 6. Model 2: Model reflecting direct contributions of basic auditory and visual perception to auditory/visual affect identification for the primary analysis.



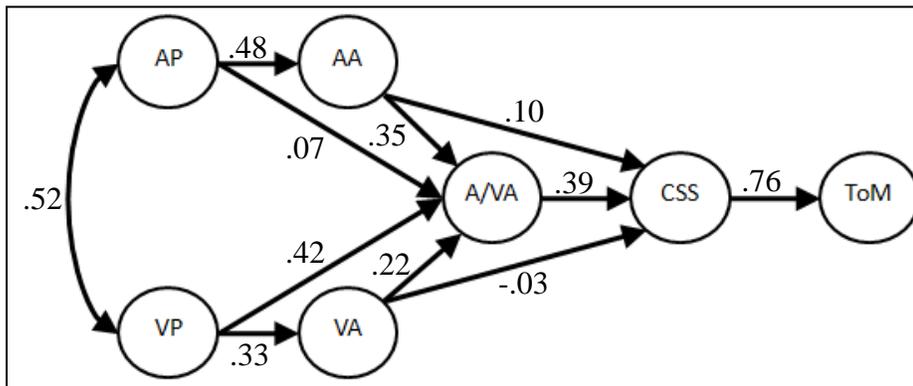
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 7. Model 3: Model reflecting direct contributions of auditory and visual affect identification to complex social situation perception for the primary analysis.



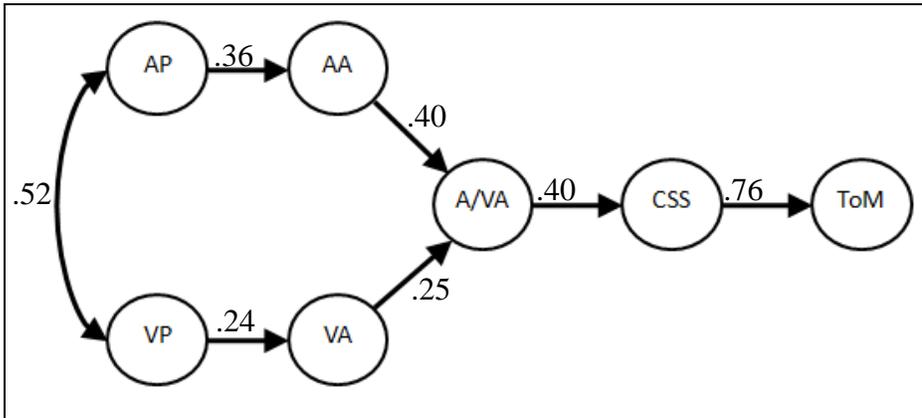
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 8. Model 4: Full model for the primary analysis.



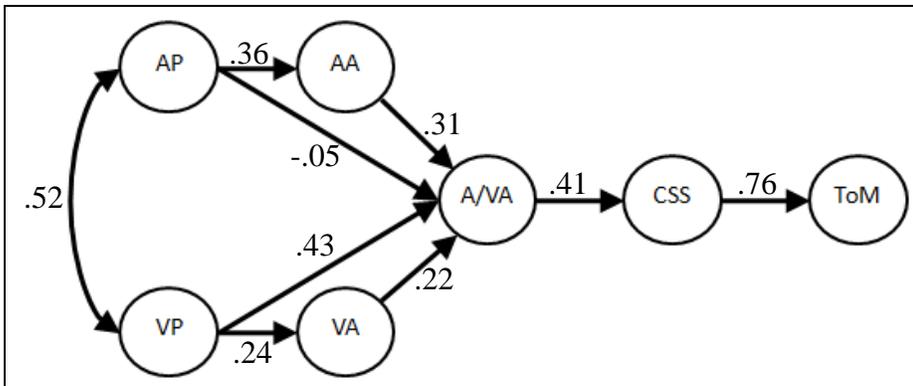
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 9. Model 1: Simple additive model for the positive valence affect identification path analysis.



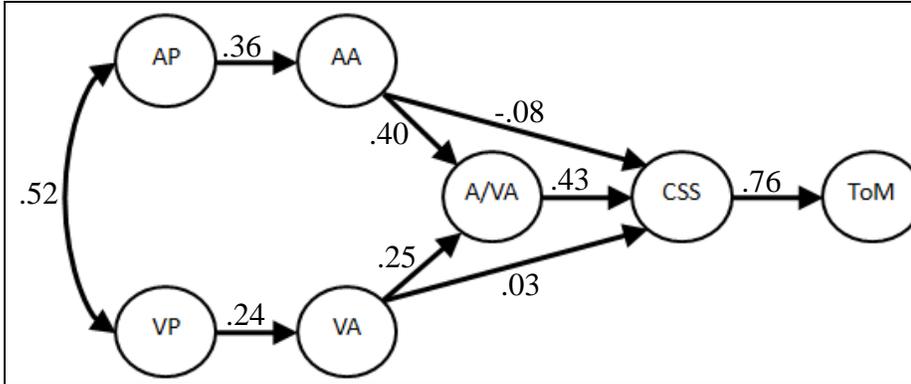
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 10. Model 2: Model reflecting direct contributions of basic auditory and visual perception to auditory/visual affect identification for the positive valence affect identification path analysis.



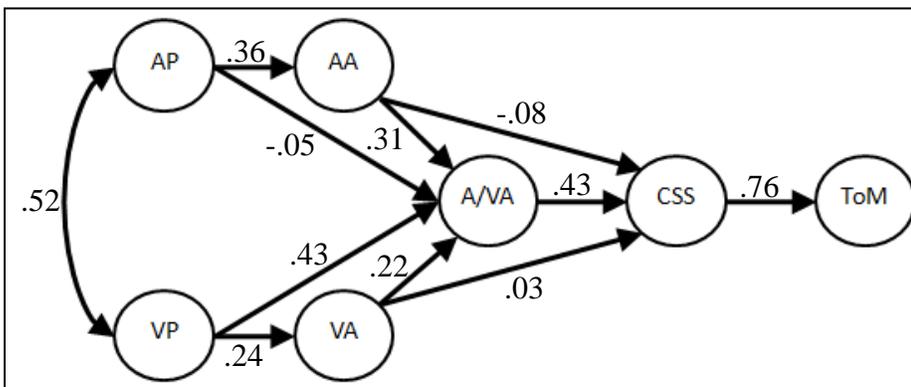
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 11. Model 3: Model reflecting direct contributions of auditory and visual affect identification to complex social situation perception for the positive valence affect identification path analysis.



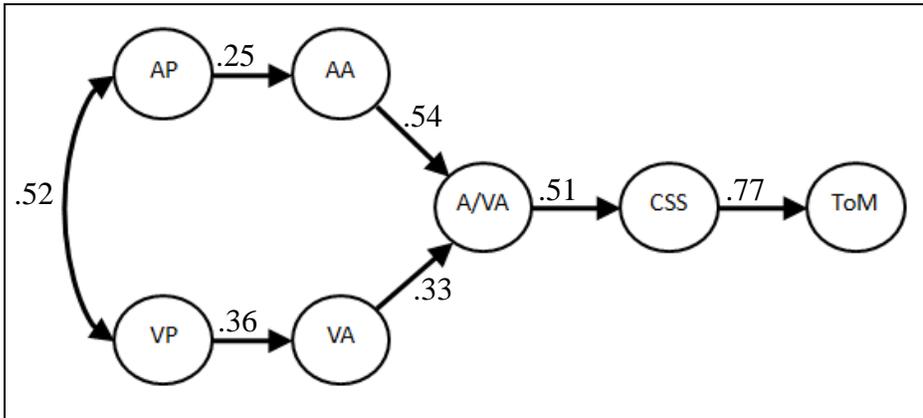
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 12. Model 4: Full model for the positive valence affect identification path analysis.



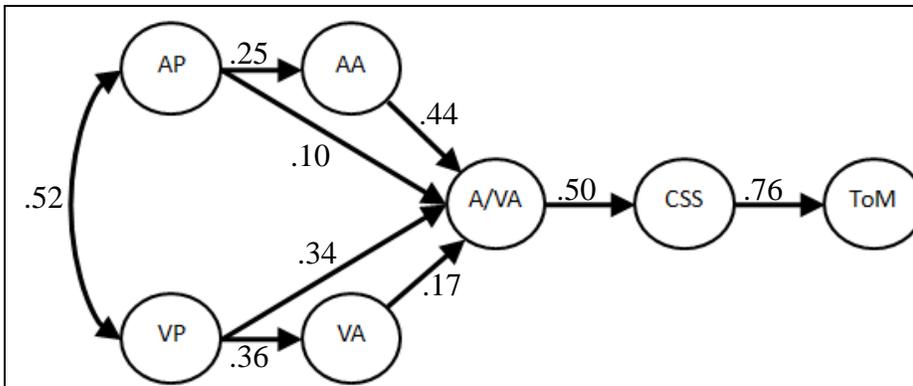
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 13. Model 1: Simple additive model for the negative valence affect identification path analysis.



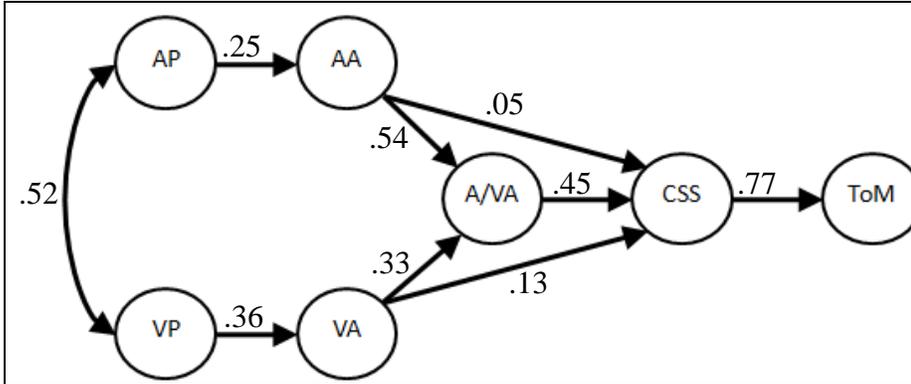
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 14. Model 2: Model reflecting direct contributions of basic auditory and visual perception to auditory/visual affect identification for the negative valence affect identification path analysis.



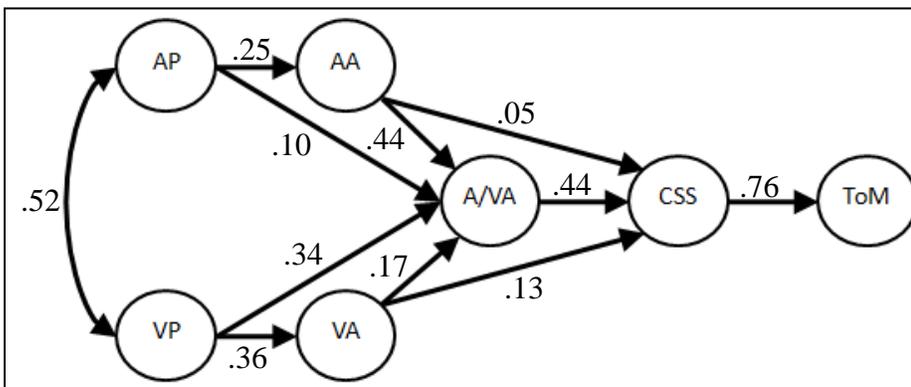
*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 15. Model 3: Model reflecting direct contributions of auditory and visual affect identification to complex social situation perception for the negative valence affect identification path analysis.



*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

Figure 16. Model 4: Full model for the negative valence affect identification path analysis.



*Note.* AP = Auditory perception. VP = Visual perception. AA = Auditory affect identification. VA = Visual affect identification. A/VA = Auditory/visual affect identification. CSS = Complex social situations. ToM = Theory of mind.

comparative fit index (Hu & Bentler, 1999). The particular techniques used to assess the fit of the four models in the present study included evaluations of chi-square ( $\chi^2$ ), the ratio of chi-square to degrees of freedom, the comparative fit index (CFI), the normed fit index (NFI), and the Tucker-Lewis index (TLI). The values of each of these evaluation methods for each of the four models are presented in Table 12 for the primary analysis, and Tables 13-14 for the secondary analyses.

*Chi-square.* When used in path analysis, the chi-square analysis for each evaluated model provides an indication of the “goodness of fit” between the sample covariance matrix and the estimated population covariance matrix (Tabachnick & Fidell, 2007). A good fitting model should yield a non-statistically significant chi-square value, thus indicating no statistically significant difference between the two matrices (Tabachnick & Fidell, 2007). The significance values of the chi-square analyses for each of the four models for each of the respective analyses were therefore examined, with a non-significant chi-square considered to be an indication of a good fitting model. Regarding the primary analysis, Models 2 and 4 yielded chi-square significance values greater than .05, suggesting that each of these models may be a “good fit” (see Table 12). Notably, however, the chi-square significance value of Model 4 is marginally significant and approaches the .05 level, suggesting it may be a relatively less good fitting model than Model 2.

Regarding the secondary analysis using measures of positive valence affect identification, none of the models yielded chi-square significance values greater than .05, suggesting that none of the models were a good fit (see Table 13).

Table 12. Goodness of model fit indices for the primary path analysis.

	$\chi^2$	df	<i>p</i>	$\chi^2/df$	CFI	NFI	TLI
Model 1	33.37	14	.003	2.38	.857	.787	.786
Model 2	18.42	12	.103	1.54	.953	.882	.917
Model 3	33.25	12	.001	2.77	.843	.788	.726
Model 4	18.30	10	.050	1.83	.939	.883	.872

*Note.* df = Degrees of freedom. CFI = Comparative fit index. NFI = Normed fit index.

TLI = Tucker-Lewis index.

Table 13. Goodness of model fit indices for the negative valence affect identification

path analysis.

	$\chi^2$	df	<i>p</i>	$\chi^2/df$	CFI	NFI	TLI
Model 1	26.13	14	.025	1.87	.892	.806	.840
Model 2	15.87	12	.197	1.32	.966	.882	.941
Model 3	24.50	12	.017	2.04	.890	.818	.808
Model 4	14.24	10	.163	1.42	.963	.894	.922

*Note.* df = Degrees of freedom. CFI = Comparative fit index. NFI = Normed fit index.

TLI = Tucker-Lewis index.

Regarding the secondary analysis using measures of negative valence affect identification, Models 2 and 4 yielded chi-square significance values greater than .05, suggesting that each of these models may be a good fit. In contrast, Models 1 and 3 yielded chi-square significance values less than .05, suggesting that neither of these models may be a good fit (see Table 14).

*The ratio of chi-square to degrees of freedom.* Also in consideration of the chi-square analyses of the models, the ratio of the chi-square value to the degrees of freedom for any given model has also been suggested to be a gross evaluation of model goodness of fit, with ratio values of less than two thought to indicate a good fitting model (Tabachnick & Fidell, 2007).

Regarding the primary analysis, Models 2 and 4 yielded ratio values of less than two, while Models 1 and 3 yielded values which were greater than two (see Table 12). Notably, however, the ratio value for Model 2 is smaller than that of Model 4, whose ratio value approaches two more closely, suggesting that Model 2 may be a relatively better fitting model than Model 4.

Regarding the secondary analysis using measures of positive valence affect identification, none of the models yielded values of less than two, suggesting that none of the models may be a good fit for the data (see Table 13).

Regarding the secondary analysis using measures of negative valence affect identification, Models 1 and 4 yielded ratio values of less than two, while Models 2 and 3 yielded values which were greater than two (see Table 14). Notably, however, the ratio value for Model 4 is smaller than that of Model 1, whose ratio value approaches two more closely, suggesting that Model 4 may be a relatively better fit than Model 1.

Table 14. Goodness of model fit indices for the positive valence affect identification path analysis.

	$\chi^2$	df	<i>p</i>	$\chi^2$ /df	CFI	NFI	TLI
Model 1	41.34	14	.000	2.95	.766	.700	.649
Model 2	30.11	12	.003	2.51	.845	.782	.729
Model 3	41.03	12	.000	3.42	.752	.703	.566
Model 4	29.80	10	.001	2.98	.831	.784	.645

*Note.* df = Degrees of freedom. CFI = Comparative fit index. NFI = Normed fit index.

TLI = Tucker-Lewis index.

***The comparative fit index (CFI).*** The comparative fit index (CFI) allows for a comparison of model-to-model relative goodness of fit (Tabachnick & Fidell, 2007) and has been found to perform well when estimating relative model fit in small samples (Bentler, 1990). Comparative fit index values range from zero to one, with larger values indicating better goodness of fit (Tabachnick & Fidell, 2007). Values greater than .95 are considered to indicate good fitting models (Hu & Bentler, 1999; Tabachnick & Fidell, 2007), as a cutoff CFI of .95 has been demonstrated to yield low Type II error rates with acceptable Type I error rates (Hu & Bentler, 1999), although other recommended cutoffs have included .90 if the chi-square is not significant and .95 if the chi-square is significant (Streiner, 2006).

Regarding the primary analysis, a cutoff of .95 would suggest a good fit for Models 1 and 3, and a cutoff of .90 for Models 2 and 4, given the respective chi-square significance values of these models (Streiner, 2006). For the primary analysis, Model 2 yielded a CFI value of .952, indicating that Model 2 may be a good fitting model. According to the recommendations put forth by Streiner (2006), Model 4's CFI value of .941 may indicate that Model 4 is also a good fit given that the chi-square analysis of

Model 4 was not statistically significant. In contrast, Models 1 and 3 yielded CFI values which were smaller than the recommended cutoff of .95, indicating that these may be poor fitting models (see Table 12).

Regarding the secondary analysis using measures of positive valence affect identification, a CFI cutoff of .95 would be recommended given that the chi-square values for all of the models were statistically significant (Streiner, 2006). None of the CFI values for the positive valence affect identification path analyses were greater than the recommended cutoff of .95, indicating that none of the models were a good fit for the data (see Table 13).

Regarding the secondary analysis using measures of negative valence affect identification, a CFI cutoff of .90 would be acceptable for Models 2 and 4 given that neither of these models yielded statistically significant chi-square values, and a CFI cutoff of .95 would be recommended for Models 1 and 3 given that both of these models yielded statistically significant chi-square values (Streiner, 2006). The recommendations therefore indicate that Models 2 and 4 may be good fitting models. In contrast, Models 1 and 3 yielded CFI values which were smaller than the recommended cutoff of .95, indicating that neither of these may be good fitting models (see Table 14).

***The normed fit index (NFI).*** The normed fit index (NFI) is derived from a comparison of the chi-square values of a specified model to the independence model, in which all correlations between all variables are fixed at zero (Tabachnick & Fidell, 2007). Normed fit index values range from 0-1, with larger values indicating better goodness of fit (Tabachnick & Fidell, 2007). Values greater than .95 are considered to indicate good fitting models (Tabachnick & Fidell, 2007), although other recommended

cutoffs have included .90 if the chi-square is not significant and .95 if the chi-square is significant (Streiner, 2006).

Regarding the primary analysis, none of the models yielded a NFI value equal to or greater than .90 (see Table 12), suggesting that none of the models are a “good fit” according to this criterion. However, a reported weakness of the NFI has been that the index may underestimate the goodness of fit of a model with small sample sizes, thereby underestimating the potential goodness of fit of a given model (Bearden, Sharma, & Tell, 1982; Tabachnick & Fidell, 2007).

Regarding the secondary analysis using measures of positive valence affect identification, an NFI cutoff of .95 would be recommended given that the chi-square values for all of the models were statistically significant (Streiner, 2006). None of the NFI values for the positive valence affect identification path analyses were greater than the recommended cutoff of .95, thus indicating that none of the models were a “good fit” for the data (see Table 13).

Regarding the secondary analysis using measures of negative valence affect identification, an NFI cutoff of .90 would be acceptable for Models 2 and 4 given that neither of these models yielded statistically significant chi-square values, and an NFI cutoff of .95 would be recommended for Models 1 and 3 given that both of these models yielded statistically significant chi-square values (Streiner, 2006). The recommendations therefore indicate that Model 4 may be a good fit for the data, as it yielded an NFI value which was greater than .95. In contrast, Models 1, 2, and 3 yielded NFI values which were smaller than the respective recommended cutoffs, indicating that these models may be poor fitting models for the data (see Table 14).

*The Tucker-Lewis index (TLI).* The Tucker-Lewis index (TLI), also known as the non-normed fit index (NNFI), is a comparative fit index which adjusts the NFI by incorporating a consideration of the degrees of freedom in any given model, although the index also tends to yield underestimations of model goodness of fit in small samples (Tabachnick & Fidell, 2007). Tucker-Lewis values greater than .95 are considered to indicate good fitting models (Hu & Bentler, 1999; Tabachnick & Fidell, 2007), as a cutoff CFI of .95 has been demonstrated to yield low Type II error rates with acceptable Type I error rates (Hu & Bentler, 1999), although other recommended cutoffs have included .90 if the chi-square is not significant and .95 if the chi-square is significant (Streiner, 2006).

Regarding the primary analysis, a cutoff of .95 would suggest a good fit for Models 1 and 3, and a cutoff of .90 for Models 2 and 4, given the respective chi-square significance values of these models (Streiner, 2006). For the primary analysis, the TLI value of Model 2 suggests that the model is a good fit. In contrast, the TLI values of Models 1, 3, and 4 were smaller than the recommended cutoffs, thus indicating poor goodness of fit of each of these models (see Table 12).

Regarding the secondary analysis using measures of positive valence affect identification, a TLI cutoff of .95 would be recommended given that the chi-square values for all of the models were statistically significant (Streiner, 2006). However, none of the TLI values for the positive valence affect identification path analyses were greater than the recommended cutoff of .95, indicating that none of the models were a good fit for the data (see Table 13).

Regarding the secondary analysis using measures of negative valence affect identification, a TLI cutoff of .90 would be acceptable given for Models 2 and 4 given that neither of these models yielded statistically significant chi-square values, and a TLI cutoff of .95 would be recommended for Models 1 and 3 given that both of these models yielded statistically significant chi-square values (Streiner, 2006). The recommendations therefore indicate that Models 2 and 4 may be good fitting models. In contrast, Models 1 and 3 yielded TLI values which were smaller than the recommended cutoff of .90, indicating that these models may be poor fitting models (see Table 14).

***Conclusions regarding model fit.*** Regarding the primary analysis, a consideration of all of the techniques for evaluating goodness of fit indicated that Model 2 was the best fitting model for the data. In contrast, no models were found to be a good fit for the secondary analysis using measures of positive valence affect identification, and Model 4 was found to be the best fitting model for the secondary analysis using measures of negative valence affect identification.

## **Chapter 5:**

### **Discussion**

Although a number of research studies to date have evaluated the presence of deficits in basic auditory and visual perception, visual affect identification, auditory affect identification, visual/auditory affect identification, perception and interpretation of complex social situations, and theory of mind in schizophrenia, research regarding the severity of and etiology underlying these deficits in such individuals has yielded mixed and inconclusive results. Additionally, while psychiatric and psychotherapeutic treatment approaches for individuals with schizophrenia have yielded improvements in a number of positive and negative symptoms associated with the disorder, such treatments have failed to consistently yield persistent statistically and clinically significant improvements in social functioning in such individuals. Continued research into the nature of deficits in social cognition is therefore warranted, as further research could potentially help to guide further treatment approaches for individuals with schizophrenia. The purpose of the current study was to evaluate the relationships between various sub-domains of social cognition in a group of individuals with schizophrenia, particularly in terms of the potential impact that more basic perceptual and social cognitive processes may have on higher order social cognitive processes in such individuals. A secondary purpose of the current study was to evaluate whether the nature of these relationships may differ according to whether positive or negative emotional categories were included in the analyses, thus potentially indicating differential relationships between social cognitive sub-domains according to valence of emotion in individuals with schizophrenia.

In light of the aforementioned goals of the current study, path analysis was used to evaluate the nature of the relationships between the measured sub-domains of perception and social cognition – namely, auditory perception, visual perception, auditory affect identification, visual affect identification, auditory/visual affect identification, perception and interpretation of complex social situations, and theory of mind. The goodness of fit of the covariance matrix of the present data set with each of four models was evaluated in order to determine which of the four models best explained the data.

Regarding the path analysis models evaluated, Model 1 hypothesized the following: performance on measures of auditory and visual perception would predict performance on measures of auditory and visual affect identification, respectively; performance on measures of auditory and visual affect identification would predict performance on a measure of auditory/visual affect identification; performance on a measure of auditory/visual affect identification would predict performance on a measure of perception and interpretation of complex social situations; and, performance on measures of perception and interpretation of complex social situations would predict performance on measures of theory of mind. Model 2 hypothesized that, in addition to the hypothesized relationships identified in Model 1, performance on measures of auditory and visual perception would add further predictive value to performance on a measure of auditory/visual affect identification. Model 3 hypothesized that, in addition to the hypothesized relationships identified in Model 1, performance on measures of auditory and visual affect identification would add further predictive value to performance on measures of perception and interpretation of complex social situations. Model 4 hypothesized that, in addition to the hypothesized relationships identified in

Model 1, performance on measures of auditory and visual perception would add further predictive value to performance on a measure of auditory/visual affect identification, and that performance on measures of auditory and visual affect identification would add further predictive value to performance on measures of perception and interpretation of complex social situations. These four models were used to evaluate both the primary and secondary analyses, such that the relative goodness of fit of the four models to the data was compared in each of the three analyses.

### **Primary Analysis**

The primary hypothesis predicted that Model 1 would be the best fit for the data. This hypothesis was based on the relatively parsimonious nature of Model 1 as compared to the other three models, on previous research which has yielded evidence of relationships between more basic sensory processing and auditory affect identification in individuals with schizophrenia, and on the lack of previous research in the current literature suggesting the validity of more complex models.

Upon comparison of the various goodness of fit indices for the four models, Model 2 was in fact found to be the best fit for the data, which suggests further predictive value of performance on measures of auditory and visual perception on performance on a measure of auditory/visual affect identification in addition to the predictive relationships identified in the simple model (i.e., Model 1).

The sizes of the direct effects represented by Model 2 were variable across paths. Regarding auditory affect identification, a medium to large direct effect was found from auditory perception. Regarding visual affect identification, a medium direct effect was found from visual perception. Regarding auditory/visual affect identification, a small

direct effect was found from auditory perception, a small to medium direct effect was found from visual affect identification, a medium direct effect was found from auditory affect identification, and a medium to large direct effect was found from visual perception. These relative direct effects on auditory/visual affect identification therefore indicated that the strongest direct effect on auditory/visual affect identification was from visual perception, and that the weakest direct effect was from auditory perception. Regarding perception and interpretation of complex social situations, a large direct effect was found from auditory/visual affect identification. Regarding theory of mind, a large direct effect was found from perception and interpretation of complex social situations.

Regarding the implications of Model 2's goodness of fit as compared to other models, the finding that Model 2 was the best fit for the observed data indicates that the data was best explained when direct paths reflecting the relationships from auditory and visual processing to auditory/visual affect identification were added to the original model. The finding that Model 2 was the best fit further suggests that the data was best explained when direct paths reflecting the relationships from auditory and visual affect identification to perception and interpretation of complex social situations were excluded.

Overall, the finding that Model 2 was the best fit for the current data suggests that the inclusion of a consideration of the direct effects of auditory and visual processing on auditory/visual affect identification improves the model's explanation of the data. However, the relatively small direct effect of auditory perception on auditory/visual affect identification warrants a consideration that improvement of model fit upon adding the direct paths from auditory and visual processing to auditory/visual affect identification may have been most reflective of the additional predictive value provided

by including the direct effect from visual processing to auditory/visual affect identification, and that the path reflecting a direct effect from auditory processing to auditory/visual affect identification may be relatively negligible. However, the presence of an indirect effect of auditory processing on auditory/visual affect identification via auditory affect identification suggests that auditory processing is still a noteworthy sub-domain in the consideration of social cognition in schizophrenia.

The present findings are consistent with previous research which has identified relationships between performance by individuals with schizophrenia on measures of basic visual processing and visual affect identification (e.g., Hooker & Park, 2002; Kerr & Neale, 1993; Silver, Bilker, & Goodman, 2009), and between performance by such individuals on measures of basic auditory processing and auditory affect identification (e.g., Leitman et al., 2005), but discordant with reported findings of no such relationships for visual processing and visual affect identification (e.g., Gooding, Luh, & Tallent, 2001; Gooding & Tallent, 2002; Hall et al., 2004; Wynn, Lee, Horan, & Green, 2008).

There remains a paucity, however, in the current literature regarding the relationships between basic auditory and visual processing on multimodal affect identification. Although previous research comparing performance by individuals with schizophrenia to that by healthy controls has demonstrated evidence of impaired multimodal affect identification in individuals with schizophrenia (e.g., Bell, Bryson, & Lysaker, 1997; Bryson, Bell, & Lysaker, 1997; Fiszdon, Richardson, Greig, & Bell, 2007; Huang et al., 2009), research to date has neglected to thoroughly evaluate the relationship between unimodal sensory processing and multimodal affect identification. Further research is therefore warranted.

Additionally, while research has found relationships between such higher-order social cognitive processes as multimodal affect identification, perception and interpretation of complex social situations, and theory of mind, research to date has neglected the predictive value of these abilities upon one another. Future research evaluating these relationships in greater detail and in larger and more representative samples may help to guide the focus of treatment approaches, such that treatment may not need to focus on the improvement of performance in all of these domains; instead, improvements due to treatment focused on subsets of these domains may yield improvements in other domains as well.

### **Secondary Analyses**

Secondary analyses were conducted in order to evaluate the goodness of fit of the aforementioned four models when valence of affective category was considered in the analyses. No a priori hypotheses were made regarding relative model goodness-of-fit for the secondary analyses.

**Positive valence affect identification path analysis.** Regarding the positive valence affect identification path analysis, none of the four hypothesized models demonstrated acceptable indications of goodness of fit. For this reason, no conclusions can be made regarding variables which may serve to improve accuracy of prediction of performance on measures of affect identification, perception and interpretation of complex social situations, and theory of mind in individuals with schizophrenia. Possible reasons for these findings and suggested directions for future research will be discussed below.

**Negative valence affect identification path analysis.** Regarding the negative valence affect identification path analysis, Model 4 was found to be the best fit for the data upon comparison of the various goodness of fit indices for the four models. This finding suggests further predictive value of performance on measures of auditory and visual perception on performance on a measure of auditory/visual affect identification, as well as of performance on measures of auditory and visual affect identification on performance on measures of perception and interpretation of complex social situations, in addition to the predictive relationships identified in the simple model (i.e., Model 1). The sizes of the direct effects represented by Model 4 were variable across paths. Regarding auditory affect identification, a medium direct effect was found from auditory perception. Regarding visual affect identification, a medium to large direct effect was found from visual perception. Regarding auditory/visual affect identification, a small direct effect was found from auditory perception, a small to medium direct effect was found from visual affect identification, a medium direct effect was found from auditory/visual affect identification, and a medium to large direct effect was found from auditory affect identification. Regarding perception and interpretation of complex social situations, a small direct effect was found from auditory affect identification, a small to medium direct effect was found from visual affect identification, and a medium to large effect was found from auditory/visual affect identification. Regarding theory of mind, a large direct effect was found from perception and interpretation of complex social situations.

Overall, the finding that Model 4 was the best fit for the current data suggests that the inclusion of a consideration of the direct effects of auditory and visual processing on

auditory/visual affect identification improves the model's explanation of the data, as does the inclusion of a consideration of the direct effects of auditory and visual affect identification on perception and interpretation of complex social situations. However, the relatively small direct effects of auditory perception on auditory/visual affect identification and of auditory affect identification on perception and interpretation of complex social situations warrants a consideration that improvement of goodness of fit indices for Model 4 as compared to the other three models may have been most reflective of the additional predictive value provided by including the direct effects from visual perception to auditory/visual affect identification and from visual affect identification to perception and interpretation of complex social situations, and that the paths reflecting direct effects from auditory perception to auditory/visual affect identification and from auditory affect identification to perception and interpretation of complex social situations may be relatively negligible.

**Conclusions regarding the secondary analyses.** Overall the present findings are consistent with previous research which has identified differential performance on measures of affect identification by individuals with schizophrenia according to the affective valence of the stimuli, as research has generally demonstrated greater impairments in negative affect identification as compared to positive affect identification (e.g., Bediou, Franck, et al., 2005; Bediou, Krolak-Salmon, et al., 2005; Premkumar et al., 2008; Tsoi et al., 2008), with a handful of studies also having demonstrated greater impairments in positive affect identification as compared to negative affect identification (e.g., Sachs et al., 2004). The present findings are discordant, however, from previous research which has found no evidence of differential impairment in affect identification

according to affective category by individuals with schizophrenia (e.g., Norton et al., 2002; Silver et al., 2002).

The present findings therefore add to the current literature regarding differential performance on affect identification tasks according to valence of affective category in individuals with schizophrenia. While the present findings do not particularly indicate greater impairment in one affective category as compared to another, the findings do suggest differential relationships between basic sensory processing and multimodal affect identification, and between multimodal affect identification and perception and interpretation of complex social situations, according to the valence of the emotions included in the affect identification task. This may be consistent with reports of demonstrated structural differences in the amygdala associated with perception of fear and sadness by individuals with schizophrenia as compared to healthy controls (e.g., Adolphs et al., 2005; Adolphs et al., 1994; Adolphs et al., 1995; Adolphs et al., 1999; Calder et al., 1996; Exner et al., 2004; Namiki et al., 2007; Young et al., 1995), as well as differential activation patterns in individuals with schizophrenia as compared to healthy controls in a number of cortical and subcortical areas when processing faces portraying such negatively valenced affective categories as fear, sadness, and anger (e.g., Das et al., 2007; Fakra et al., 2008; Gur, Loughhead, et al., 2007; Gur, McGrath, et al., 2002; Hempel et al., 2003; Holt et al., 2005; Holt et al., 2006; Johnston et al., 2005; Michalopoulou et al., 2008; Morris et al., 1996; Quintana et al., 2011; Rasetti et al., 2009; Surguladze et al., 2006; Whalen et al., 1998).

### **Conclusions Regarding Current Findings**

Overall, the current findings suggest that performance on measures of a number of social cognitive sub-domains may serve to predict performance on other such measures in individuals with schizophrenia. In particular, performance on more basic sensory and social cognitive tasks may predict performance on measures of more complex sub-domains of social cognition in such individuals. Additionally, visual perception and auditory affect identification provided the most predictive value amongst the multiple direct effects demonstrating prediction of performance on a measure of auditory/visual affect identification within this model.

Furthermore, a re-evaluation of the data while including only negatively valenced affective categories indicated a different best-fitting predictive model as compared to the primary analyses. Within this best-fitting model, visual perception and auditory affect identification provided the most predictive value amongst the multiple direct effects demonstrating prediction of performance on a measure of auditory/visual affect identification. Also within this best-fitting model, auditory/affect identification provided the most predictive value amongst the multiple direct effects demonstrating prediction of performance on measures of perception and interpretation of complex social situations.

Finally, a re-evaluation of the data while including only positively valenced affective categories yielded no apparent advantage of one of the four models over another, thus preventing any specific conclusions to be drawn other than that which assumes differential predictive patterns according to valenced affective category, such that the hypothesized Model 2 may fit the positively valenced affective categories more poorly than it does the full dataset, and that the hypothesized Model 4 may fit the

positively valenced affective categories more poorly than it does the negatively valenced affective categories dataset.

The present findings overall provide support for the hypothesis that performance on measures of more basic social cognitive processes may predict performance on measures of more complex social cognitive processes. The present findings also suggest that differential predictive relationships may be present according to the inclusion of positive versus negative affective categories in the affect identification tasks.

Additionally, the present findings suggest, for both the overall data and the negatively valenced data, (1) that visual perception may better directly predict auditory/visual affect identification than does visual affect identification, and (2) that auditory affect identification may better directly predict auditory/visual affect identification than does auditory perception.

### **Clinical Implications**

The present findings indicate differential influence of more basic sensory processes and unimodal affect identification on multimodal affect identification, a finding which has not yet been reported in the literature. The present findings suggest that individuals with schizophrenia may rely more on basic (i.e., figural perception) than complex (i.e., perception of facial features) visual information, and in turn may rely more on complex (i.e., prosodic) than basic (i.e., tone) auditory information, when interpreting others' affective states.

The clinical implications of these findings include a consideration that improved social functioning subsequent to improved perception of others' affective states by individuals with schizophrenia may necessitate simultaneous improvement of auditory

and visual information processing, although perhaps at different levels of complexity of processing. In other words, given that multimodal affect identification is likely more frequently necessitated in real-world day-to-day interactions than is unimodal affect identification, improvements in multimodal affect identification should likely be prioritized over improvements in unimodal affect identification. To achieve this end, the present findings suggest that treatment approaches for individuals with schizophrenia would perhaps yield the greatest results if focused on basic visual processing and more complex auditory affect identification. While treatment approaches may include targeted attempts to improve more complex visual auditory affect identification and basic auditory processing, which may in turn yield improvements in multimodal affect identification through the indirect paths suggested in the present model, the most beneficial strategies will likely be those which utilize the aforementioned strategy. It then follows that, according to the present findings, targeted improvements in multimodal affect identification should yield improvements in higher-order perception and interpretation of complex social situations and theory of mind in individuals with schizophrenia. Future research exploring these hypotheses in greater detail should in turn provide further guidance for improving social cognition and social functioning in individuals with schizophrenia.

### **Study Limitations and Directions for Future Research**

A number of methodological and practical issues likely negatively impacted the present study's ability to accurately measure social cognition and its sub-domains, and subsequently to evaluate the relative predictive relationships between performance on measures of these social cognitive sub-domains.

One potential limitation of the study in terms of an alternative explanation for the pattern of performance of the current sample lies in the demonstrated statistically significant relationships between performance on a number of the neurocognitive variables (including auditory perception, visual perception, auditory affect identification, visual affect identification, auditory/visual affect identification, and theory of mind) and estimated current and premorbid intellectual functioning. The presence of this relationship suggests that individuals with higher estimated intellectual functioning, in terms of both estimated premorbid and current intellectual functioning, tended to complete the neurocognitive tasks with greater accuracy. Future research evaluating differential path analyses according to level of intellectual functioning may help to determine whether intellectual functioning may account for the relationships demonstrated in the current study. However, previous research demonstrating the presence of social cognitive deficits either independent of or over and beyond deficits in overall intellectual functioning (e.g., Edwards et al., 2001; Schneider et al., 1995; Pan et al., 2009; Zanello et al., 2006) suggests that similar findings could be expected.

Additionally, the nature of path analysis, in that the statistical procedure is based on a comparison of the observed covariance matrix to that of the expected covariance matrix, includes a somewhat artificial designation of causation assumption onto a correlation matrix. In other words, the present findings and conclusions are based on correlational data only and therefore cannot be extrapolated to assumptions of directionality of relationships or causality in general. Additionally, there may be other models that fit the data well which were out of the scope of the current study to evaluate.

Furthermore, the differential nature of the basic auditory and visual perception tasks may have confounded the current findings, such that the differential predictive direct effects of basic auditory and visual perception on measures of auditory, visual, and auditory/visual affect identification may have been due to the stimulus properties themselves rather than to differential modality effects per se. In particular, the visual perception task may have been tapping into higher-order visual processing skills as compared to the auditory perception task, which may have in turn been tapping into relatively lower order auditory processing skills. Future research using more congruent stimuli may be beneficial in further elucidating this debate.

Further study limitations regarding research design should also be considered. In particular, the sample size of the present study was likely a limiting factor, such that a larger sample size would likely have provided a more clear and more accurate depiction of social cognitive functioning in individuals with schizophrenia. Due to study feasibility and practical limitations, the sample size of the present study was on the lower end of what would be recommended and deemed acceptable for path analysis according to current recommendations in the literature (e.g., Tabachnick & Fidell, 2007). Small sample sizes in path analysis can lead to unstable paths, results which are limited in generalizability to the larger population, and tendencies to both over- and under-estimate that goodness of fit of various path models (Tabachnick & Fidell, 2007). Future research using a larger sample size to confirm the present results is therefore warranted.

Another limitation of the present study is the advanced nature of the disorder in many of the participants. In particular, no first-episode participants were included. The generalizability of the present findings to individuals with first-episode schizophrenia is

therefore limited, as it cannot be determined whether the present findings are due to the disorder itself or to disease course and other factors which may negatively impact social cognition in individuals with schizophrenia over time. Future research comparing first-episode individuals with schizophrenia to individuals with schizophrenia with a longer time since disease onset is therefore warranted. Such research could also help determine when targeted interventions may be warranted and/or most effective, as well as to evaluate the validity of these models in medication-naïve individuals.

Additionally, future research utilizing more diverse participant recruitment strategies would be beneficial. In particular, all of the participants included in the current study were recruited from a local outpatient mental health day treatment program, which may have resulted in an unintentional sample bias, as all participants were likely seeking similar psychiatric and psychotherapeutic care. Future research including participants recruited from the community, as well as from both inpatient and outpatient treatment facilities, would increase the generalizability of the present findings. An inclusion of a more diverse sample in terms of subtype and course of schizophrenia would also increase generalizability.

Furthermore, future research exploring potential differences in patterns according to affective valence (i.e., positive versus negative) is warranted. Such an evaluation was attempted in this particular study, but was likely limited by the small number of items for the measures of affect identification specific to the affective categories, particularly in terms of the positive valence category, which included only happiness and sadness. This restriction in range of possible number of items correct may have led to an erroneous evaluation of the four models for each of the two affective categories. Future research

using more extensive positive and negative affect identification measures could help to further evaluate relative model fit and better evaluate whether differential patterns according to affective category may be present.

Although a consideration of further variables is potentially an endless process, future research including different measures of the designated domains could allow for a more thorough evaluation of social cognitive sub-domains, potentially helping to account for more variance in predicting performance on measures of more complex sub-domains based on performance on measures of simpler sub-domains.

Future research should also include a consideration of different models than the four evaluated in the present study. In particular, a more exploratory approach to path analysis may help to evaluate what paths may not have been included in the present study but which may be valuable to include in the models nonetheless. Specific statistical analyses such as the Lagrange Multiplier Test and the Wald Test can be used to help guide such path alterations (Tabachnick & Fidell, 2007).

A final recommendation for future research would be comprised of the inclusion of healthy control and psychiatric groups for comparison in order to determine whether the patterns observed in the present study are unique to schizophrenia.

## **Conclusion**

The purpose of the current study was to compare the relative goodness of fit of four hypothesized models to obtained data regarding performance on measures of various sub-domains of social cognition by a group of individuals with schizophrenia. A secondary purpose of the current study was to compare the relative goodness of fit of the models according to valence of emotional category (i.e., positive versus negative).

Contrary to the hypothesis that the simplest, most parsimonious model would be the best fit for the data for the primary analyses, a slightly more complex model was found to be the best fit for the data, such that an additional predictive influence of auditory and visual processing on auditory/visual affect identification was found. Similarly, within the negative valence analysis, the most complex model evaluated was found to be the best fit for the data, such that additional predictive influences of auditory and visual processing on auditory/visual affect identification, as well as of auditory and visual affect identification on perception and interpretation of complex social situations, were found. Within the positive valence analyses, no model was found to be a good fit for the data. Overall, upon comparison of the standardized weights of the paths, the predictive contributions of visual processing and auditory affect identification to auditory/visual affect identification were found to be the most notable for both the primary analyses and the negative valence analysis. The results of the present study therefore suggest that basic visual processing and auditory affect identification may have the most significant direct effects on multimodal affect identification, and thus may be the most ideal domains for targeted intervention in order to improve social cognition, and thus potentially social functioning, in a bottom-up fashion in individuals with schizophrenia. Further research, however, is warranted with a larger and more diagnostically diverse sample in order to further explore and confirm these findings, as well as to increase generalizability of findings to the overall schizophrenia population.

**Appendix I:**  
**Phone Screening Form**



Pre-screening consent – to be read verbatim

You are being asked to participate in a study being conducted by Dr. Daniel Allen from the Psychology Department at the University of Nevada, Las Vegas. The study will investigate social cognition. It is hoped that information from this study will help us to better understand social cognition abilities as they apply to most individuals, as well as those with schizophrenia and bipolar disorder.

If you choose to participate, I will be asking you a few questions about your personal history in order to determine if you meet criteria to participate in the study. They will include questions concerning your psychiatric and medical history. There are risks involved in all research studies. This study includes only minimal risks. Although it is not expected to occur, should you feel uncomfortable answering any of the questions or performing any of the tasks, you are encouraged to discuss concerns with me. Also as you will be asked questions regarding your personal history, please notify me if you are uncomfortable answering any questions or if you become upset. Your participation is voluntary and you may refuse to answer questions or withdraw from the study at any time. All information gathered in this study will be kept completely confidential. No reference will be made in written or oral materials that could link you to this study. This is just a verbal consent to conduct the screening questions. If you are eligible for the study, a full consent form detailing the rest of the study will be issued to you during the first session and you will be able to consent to the study by signing that form.

Do you consent to be administered these screening questions and that you are at least 18 years of age?

Consent Obtained? Yes No – discontinue

Date:



17. Please list any medications you are currently taking

Current Medications	Dosage	Reasoning	Date Started

**18. Psychotic screen:**

Now I'm going to ask you about unusual experiences that people sometimes have.

a. Has it ever seemed like people were talking about you or taking special notice of you?

---

b. What about anyone going out of their way to give you a hard time, or trying to hurt you?

---

c. Have you ever felt that you were especially important in some way, or that you had special powers to do things that other people couldn't do?

---

d. Have you ever felt that something was very wrong with you physically even though your doctor said that nothing was wrong... like you had cancer or some other terrible disease?

---

e. Did you ever hear things that other people couldn't hear, such as noises, or the voices of people whispering or talking?

---

f. Did you ever have visions or see things that other people couldn't see?

---

g. Have you ever had any unusual religious experiences?

---

19. ASK ONLY IF PSYCHOTIC FEATURES AND MOOD EPISODES ARE PRESENT: Do your delusions/hallucinations occur only during your depressed/manic episodes OR do they also occur outside of your depressed/manic episode?

---

20. What is your schedule like?

---

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

***End Screening Questions***

**Appendix II:**  
**Informed Consents**



## INFORMED CONSENT

Department of Psychology

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**TITLE OF STUDY:** Social Cognition Deficits in Bipolar and Schizophrenia

**INVESTIGATOR(S):** Daniel N. Allen, Ph.D., Nicholas S. Thaler, M.A., Griffin P. Sutton, M. A.

**CONTACT PHONE NUMBER:** (702) 217-5365

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Purpose of the Study: You are being asked to participate in a study being conducted by Daniel N. Allen, PhD, Nicholas S. Thaler, MA, and Griffin P. Sutton, MA, from the Psychology Department at the University of Nevada, Las Vegas. The study will investigate different areas of social cognition such as emotional recognition, theory of mind, and functional outcome. It is hoped that information from this study will help us to better understand social cognition variables as they apply to most individuals, as well as those with bipolar disorder and schizophrenia.

Participants: You are being asked to participate in the study because you meet one of the following criteria: 1) You have a history of bipolar disorder; 2) You have a history of schizophrenia; 3) You and your family do not have a history of either bipolar disorder or schizophrenia.

Procedures: If you choose to participate in this study, you will be asked to complete up to 6 hours of testing, interviews, and surveys. You will be interviewed and asked to respond to some surveys about your personal history and personality. The interview may include questions concerning psychiatric and substance use history. This information will be used to determine if you meet the criteria to participate in the rest of the research study. Researchers in this study are also trained therapists and will provide on-site help if needed.

If you continue on in the research study you will then be given many different types of tests measuring social cognition. You will also be given tests and questionnaires that examine your satisfaction in different areas of your life and your performance of tasks in those areas. You will be asked to recall emotions presented in several pictures displaying facial expressions as well as roleplay some social interactions. You will also be given a variety of tests that measure the your ability to identify what others are thinking and why they are thinking that way, to recognize common social cues, and your reinforcement strategies. Most of these tests are paper-and-pencil tests, although some tests are administered on the computer. Many of these tests are quite easy while others may seem more difficult. Some have time limits while others do not. You will be provided with rest breaks as needed.



## INFORMED CONSENT

Department of Psychology

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You will not receive individual feedback after the testing, but you will be given information on how to contact the researchers when the project is completed to receive the general results of the project.

**Benefits of Participation:** Your participation will add to the understanding of social cognition and their differences in individuals with bipolar disorder and schizophrenia. This could lead to improvement in the detection and treatment of mental illness and facilitate a greater understanding of the causes of psychiatric disorders.

**Risks of Participation:** There are risks involved in all research studies. This study includes only minimal risks. There is a chance you may experience some mental fatigue during the assessments. To decrease the chance of fatigue, the researcher will allow breaks as necessary for your comfort. Although it is not expected to occur, should you feel uncomfortable answering any of the questions or performing any of the tasks, you are encouraged to discuss concerns with the researcher. You will also be asked questions regarding your personal history. Please notify the researcher if you are uncomfortable answering any questions or if you become upset. Your participation is voluntary and you may refuse to answer questions or withdraw from the study at any time.

**Cost /Compensation:** There will not be financial cost to you to participate in this study. The study will take approximately 6 hours to complete. You will receive \$5.00 for every hour completed while participating in this study. If you complete the entire study, you will receive a bonus of \$30.00, resulting in a total compensation of \$60.00. If you are unable or unwilling to complete all of the study procedures, you will be paid for the time you participate (\$2.50 for each half hour). The University of Nevada, Las Vegas may not provide compensation or free medical care for an unanticipated injury sustained as a result of participating in this research study.

**Contact Information:** If you have any further questions about the study or if you experience any harmful effects as a result of participation in this study, you may contact Dr. Daniel Allen at the UNLV Psychology Department at 895-0121. For questions



**INFORMED CONSENT**

**Department of Psychology**

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**TITLE OF STUDY:** Social Cognition Deficits in Bipolar and Schizophrenia

**INVESTIGATOR(S):** Daniel N. Allen, Ph.D., Nicholas S. Thaler, M.A., Griffin P. Sutton, M. A.

**CONTACT PHONE NUMBER:** (702) 217-5365

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regarding the rights of research subjects, you may contact the **UNLV Office for the Protection of Human Subjects at 702-895-2794.**

**Voluntary Participation:** Your participation in this study is voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with the university. You are encouraged to ask questions about this study at the beginning or any time during the research study. You are encouraged to ask questions about this study at any time during the study.

**Confidentiality:** All information gathered in this study will be kept completely confidential. No reference will be made in written or oral materials that could link you to this study. All records will be stored in a locked facility at UNLV for at least 5 years after completion of the study. After the storage time the information gathered will be destroyed.

**Participant Consent:** I have read the above information and agree to participate in this study. I am at least 18 years of age. A copy of this form has been given to me.

---

Signature of Participant

---

Date

---

Participant Name (Please Print)

---

Signature of Investigator

---

Date

***Participant Note: Please do not sign this document if the Approval Stamp is missing or is expired.***



## INFORMED CONSENT

Department of Psychology

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Participants: You are being asked to participate in the study because you meet one of the following criteria: 1) You have a history of bipolar disorder; 2) You have a history of schizophrenia; 3) You and your family do not have a history of either bipolar disorder or schizophrenia.

Procedures: If you choose to participate in this study, you will be asked to complete up to 6 hours of testing, interviews, and surveys. You will be interviewed and asked to respond to some surveys about your personal history and personality. The interview may include questions concerning psychiatric and substance use history. This information will be used to determine if you meet the criteria to participate in the rest of the research study. Researchers in this study are also trained therapists and will provide on-site help if needed.

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**Cost /Compensation:** There will not be financial cost to you to participate in this study. By participating in this study, you will gain a research participation credit for every hour of research participation. Participation time in this study is expected to be approximately 6.0 hours, therefore participants who complete the study will receive 6.0 credits for participation. Participants who do not complete the entire study or elect not to participate after signing the informed consent will be given one hour of research credit (1.0 credits) for each hour completed. The University of Nevada, Las Vegas may not provide compensation or free medical care for an unanticipated injury sustained as a result of participating in this research study.

**Contact Information:** If you have any further questions about the study or if you experience any harmful effects as a result of participation in this study, you may contact



**INFORMED CONSENT**

**Department of Psychology**

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**TITLE OF STUDY:** Social Cognition Deficits in Bipolar and Schizophrenia

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**Confidentiality:** All information gathered in this study will be kept completely confidential. No reference will be made in written or oral materials that could link you to this study. All records will be stored in a locked facility at UNLV for at least 5 years after completion of the study. After the storage time the information gathered will be destroyed.

**Participant Consent:** I have read the above information and agree to participate in this study. I am at least 18 years of age. A copy of this form has been given to me.

\_\_\_\_\_  
Signature of Participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Participant Name (Please Print)

\_\_\_\_\_  
Signature of Investigator

\_\_\_\_\_  
Date

***Participant Note: Please do not sign this document if the Approval Stamp is missing or is expired.***

**Appendix III:**  
**Demographics Questionnaire**

Gender **Male** **Female**

20. What ethnicity do you identify with:

Asian American       American Indian/Alaska Native  
 African American       Hawaiian/Pacific Islander  
 Hispanic/Latino       Biracial  
 Caucasian       Other: \_\_\_\_\_

21. Highest Level of Education Completed \_\_\_\_\_ (Years of formal education) \_\_\_GED

22. Marital Status:  Married       Widowed       Divorced  
 Remarried       Separated       Never married  
 Committed relationship

If married, how many times have you been married? \_\_\_\_\_

23. Current Occupation \_\_\_\_\_

24. How long have you been employed in this position? \_\_\_\_\_

25. What is the source of your income? (Check all that apply)

Paid employment       Unemployment compensation  
 Social Security Disability Income (SSDI)  
 Retirement, investment or savings  
 Supplemental Security Income (SSI)       Alimony or child support  
 Veteran's disability or pension benefits       General assistance  
 Money shared by your spouse/partner       Money from your family  
 AFDC       Other source: \_\_\_\_\_

26. Usual living arrangements (past 3 yr.):

With partner and children       With partner alone  
 With children alone       With parents  
 With family       With friends  
 Alone       Controlled environment  
 No stable arrangements       Other \_\_\_\_\_

27. Who would you like to live with? (Check all that apply)

With partner and children       With partner alone  
 With children alone       With parents  
 With family       With friends  
 Alone       Controlled environment  
 No stable arrangements       Other \_\_\_\_\_

28. During the past four weeks, you lived primarily: (Check one)

In an apartment/home       at school/college  
 In a boarding home       in an institution (i.e. hospital or  
nursing  
 In a group home or halfway house       home)  
 Homeless       in jail/prison  
 Other \_\_\_\_\_

29. Where would you like to live: (Check one)

_____ In an apartment/home	_____ at school/college
_____ In a boarding home	_____ in an institution (i.e. hospital or
nursing	home)
_____ In a group home or halfway house	_____ in jail/prison
_____ Homeless	_____ Other _____

30. Do you have any children? **Yes No** How many children do you have? \_\_\_\_\_

31. Have you ever been homeless? **Yes No**

32. Do you have a twin? **Yes No**

33. Are you left handed, right handed, or ambidextrous? **Left Right**

**Ambidextrous**

**HEALTH-RELATED QUESTIONS**

34. Are you color-blind? **Yes No**

35. Do you have diabetes? **Yes No**

36. Is your vision corrected (glasses/contacts)? **Yes No**

Are you wearing them now? **Yes No**

37. Do you have severe visual impairments, such as cataracts or glaucoma? **Yes No**

38. Do you have any hearing loss (hearing aid)? **Yes No**

39. Do you have a learning disability? **Yes No**

Has this been formally diagnosed? **Yes No** Diagnosis: \_\_\_\_\_

40. Have you ever been hospitalized for a psychiatric/mental condition? **Yes No**

Date

Location

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

41. Have you ever been hospitalized for a physical condition? **Yes No**

Date

Location

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

42. Have you ever seen a counselor, psychotherapist or other mental health professional? **Yes No**

If yes, please describe dates and reason:

---

---

---

---

---

43. Do you smoke? **Yes No**
- a. Cigarettes? **Yes No**
  - b. Cigars / Pipes? **Yes No**
  - c. Chewing tobacco? **Yes No**
  - d. How much do you smoke/chew per day? \_\_\_\_\_

44. When you were born...
- a. Were you born full term? **Yes No Don't Know**
    - i. If premature, how many months was the pregnancy? \_\_\_\_\_
  - b. Were there any prenatal complications? **Yes No Don't Know**  
*(please describe)* \_\_\_\_\_

- c. Was your mother exposed to anything during her pregnancy (e.g., disease, toxins, alcohol, etc.)? **Yes No Don't Know**
- d. Was your birth normal (e.g., head first, natural birth)? **Yes No Don't Know**
- e. Did your mother smoke when she was pregnant? **Yes No Don't Know**

**FAMILY HISTORY QUESTIONS**

*The following questions concern your family. Please **DO NOT** list any specific names or identify any specific person in your answers.*

45. Has anyone in your family seen a counselor or mental health professional? **Yes No**  
*(please describe)* \_\_\_\_\_

- 
46. Does anyone in your family have a mental disorder? **Yes No**
47. Do you have any first degree relatives (e.g., mother, father, brother, child) with a mental disorder? **Yes No**
- a. What is the disorder?
    - i. Schizophrenia **Yes No**
    - ii. Affective disorder **Yes No**
    - iii. Alcoholism/Substance Abuse (circle) **Yes No**
    - iv. Parkinsonism **Yes No**
    - v. Movement disorder **Yes No**
    - vi. Schizophrenia spectrum disorder **Yes No**
    - vii. Other \_\_\_\_\_
48. Do you have any second degree relatives (e.g., aunt, uncle, grandmother, grandfather) with a mental disorder? **Yes No**

- a. What is the disorder?
- |      |                                     |            |            |           |
|------|-------------------------------------|------------|------------|-----------|
| i.   | Schizophrenia                       |            | <b>Yes</b> | <b>No</b> |
| ii.  | Affective disorder                  | <b>Yes</b> | <b>No</b>  |           |
| iii. | Alcoholism/Substance Abuse (circle) |            | <b>Yes</b> | <b>No</b> |
| iv.  | Parkinsonism                        |            | <b>Yes</b> | <b>No</b> |
| v.   | Movement disorder                   | <b>Yes</b> | <b>No</b>  |           |
| vi.  | Schizophrenia spectrum disorder     | <b>Yes</b> | <b>No</b>  |           |
| vii. | Other _____                         |            |            |           |

SUICIDE HISTORY

- 49. Have you had thoughts of suicide in the past? **Yes No**
- 50. Have you had thoughts of suicide within the last week? **Yes No**
- 51. Have you had any suicide attempts? **Yes No** If yes, how many? \_\_\_\_\_

Please use the following lines to note the date and method of past suicide attempts:

Date	Method
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Suicide History Rating scale

- 1 – No history of any suicidal ideations
  - 2 – History of suicidal ideation only, no self-injury
  - 3 – Minor self-injury / suicidal gesture(s) only
  - 4 – One serious suicide attempt either alone or in presence of prior ideation/self-injury/gestures
  - 5 – More than one serious suicide attempt
- Overall Rating: \_\_\_\_\_

**Suicide Risk Assessment**

Check and describe if present:

- \_\_\_ Yes \_\_\_ No      Plan:
- \_\_\_ Yes \_\_\_ No      Lethality:
- \_\_\_ Yes \_\_\_ No      Availability Means to carry out the plan:
- \_\_\_ Yes \_\_\_ No      Significant Loss:
- \_\_\_ Yes \_\_\_ No      Substance Abuse:
- \_\_\_ Yes \_\_\_ No      Family History of Suicide:

### No Suicide Contract

I, \_\_\_\_\_, agree to not kill myself, or cause harm to myself during the period of time from \_\_\_\_\_ to \_\_\_\_\_.

I agree to get enough sleep and eat well.

I agree to get rid of things that I could use to kill myself (guns, pills, etc.).

I agree that if I have a bad time and feel that I might hurt myself, I will call my counselor, \_\_\_\_\_, at \_\_\_\_\_. I will also call the Suicide Prevention Center at 731-2990.

Signed: \_\_\_\_\_

Witnessed: \_\_\_\_\_

Date: \_\_\_\_\_

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healthy subjects. *Psychiatry Research*, 142, 67-78. doi: 10.1016/j.psychres.2003.07.009

# ***CURRICULUM VITAE***

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## **EDUCATION**

**University of Nevada Las Vegas** (Las Vegas, NV) Fall 2007–present  
Doctoral student in Clinical Psychology program Advisor: Daniel N. Allen, Ph.D.  
Thesis: “Verbal and Visual Learning and Memory Deficits as Trait Markers for Psychosis in Bipolar Disorder.”  
Dissertation: “Affect Identification and Interpersonal Skills: An In-Depth Evaluation of Social Cognition in Schizophrenia

**Wake Forest University** (Winston-Salem, NC) Fall 2002–Spring 2006  
Bachelor of Arts in Psychology with a Minor in Neuroscience

## **PUBLICATIONS AND POSTER PRESENTATIONS**

### **Manuscripts in Preparation:**

Stolberg PC, **Sutton GP**, Kazakov D, Mayfield J, Allen DN (in preparation). Reynolds Intellectual Assessment Scale (RIAS) profiles in children with brain damage.

### **Manuscripts In Press or Published:**

**Sutton GP**, Barchard KA, Bello DT, Thaler NS, Ringdahl E, Mayfield J, & Allen DN (2011). Beery-Bukentica Developmental Test of Visual-Motor Integration performance in children with traumatic brain injury and attention-deficit/hyperactivity disorder. *Psychological Assessment*, 23, 805-809.

Allen DN, **Sutton GP**, Donohue BC, & Haderlie M (2010). Neuropsychology of substance-use disorders in forensic settings. In AM Horton Jr (Ed.), *Handbook of Forensic Neuropsychology (2<sup>nd</sup> Edition)*, pp 507-539. Springer Publishing Co: New York, NY.

**Sutton GP**, Allen DN, Strauss GP, Bello DT, Armstrong CM, Randall C, Duke LA, Ross SA, & Pinegar J (2009). Learning and memory deficits as trait markers for psychosis in bipolar disorder [Abstract]. *Archives of Clinical Neuropsychology*.

Randall C, Bello D, Armstrong C, **Sutton GP**, Ringdahl EN, Thaler NS, McMurray JC, Sanders L, Isaac H., Allen DN (2009). Spatial Memory Deficits in Bipolar I and II

Disorder: Evidence in Favor of a Bipolar Spectrum Model? [Abstract]. *Archives of Clinical Neuropsychology*.

Allen DN, Donohue B, **Sutton GP**, Haderlie M, LaPota H (2009). Application of a standardized assessment methodology within the context of an evidence-based treatment for substance abuse and its associated problems. *Behavior Modification*, 33, 618-654.

**Sutton GP**, Allen DN (2009). Alcohol induced disorders. In GL Fisher and NA Roget (Eds.), *Encyclopedia of Substance Abuse Prevention, Treatment, and Recovery*, pp 56-62. SAGE Publications: Thousand Oaks, CA.

**Sutton GP**, Allen DN, Donohue B (2009). Physiological aspects of drug use. In GL Fisher and NA Roget (Eds.), *Encyclopedia of Substance Abuse Prevention, Treatment, and Recovery*, pp 688-692. SAGE Publications: Thousand Oaks, CA.

**Sutton GP**, Bello DT, Mayfield J, Allen DN (2008). Criterion and construct validity of the DTVMI in children with brain damage [Abstract]. *Archives of Clinical Neuropsychology*, 23, 643-644.

**Posters Presented:**

**Sutton GP**, Thaler NS, Garcia AE, Mayfield J, & Allen, DN (2010). Memory and attention profiles in pediatric traumatic brain injury. Poster presented at the American College of Professional Neuropsychology Conference, Las Vegas, NV.

**Sutton GP**, Allen DN, Strauss GP, Bello DT, Armstrong CM, Randall C, Duke LA, Ross SA, & Pinegar J (2009). Learning and memory deficits as trait markers for psychosis in bipolar disorder. Poster presented at the National Academy of Neuropsychology Conference, New Orleans, LA.

Randall C, Bello D, Armstrong C, **Sutton GP**, Ringdahl EN, Thaler NS, McMurray JC, Sanders L, Isaac H, & Allen DN (2009). Spatial Memory Deficits in Bipolar I and II Disorder: Evidence in Favor of a Bipolar Spectrum Model? Poster presented at the National Academy of Neuropsychology, New Orleans, LA.

Haderlie MM, Thaler N, Kazakov D, **Sutton GP**, Mayfield J, & Allen DN (2009). The Comprehensive Trail Making Test's sensitivity to traumatic brain injury. Poster presented at the Western Psychological Association Conference, Portland, OR.

Stolberg PC, **Sutton GP**, Kazakov D, & Allen DN. (2009). The utility of the Reynolds Intellectual Assessment Scales (RIAS) in the identification of traumatic brain injury. Poster presented at the Western Psychological Association Conference, Portland, OR.

**Sutton GP**, Bello DT, Mayfield J, & Allen DN (2008). Criterion and construct validity of the Beery VMI in children with brain damage. Poster presented at the National Academy of Neuropsychology Conference, New York, NY.

## RESEARCH EXPERIENCE

### **Cognitive Aging Lab**

Wake Forest University

Fall 2005–Spring 2006

Advisor: Janine Jennings, Ph.D.

Study: The effects of memory training on the attention span of older adults

Responsibilities included recruitment, phone screening of potential participants, and subject testing. Each participant was assessed six times over a 2-3 week period.

### **Puente Neuropsychology Lab**

University of North Carolina Wilmington

Summer 2006–Summer 2007

Advisor: Antonio E. Puente, Ph.D.

Study: The effects of pre-surgical anxiety on memory in cardiac bypass patients

Responsibilities included recruitment of participants at a local cardiologist's practice. Participants were recruited and assessed immediately following notification that they would need to receive cardiac bypass surgery, as well as approximately 1 month post-operation.

### **Neuropsychology Research Program**

University of Nevada Las Vegas

Fall 2007–present

Advisor: Daniel N. Allen, Ph.D.

Study: Emotion processing in adults with bipolar disorder (*Fall 2007–Spring 2010*)

Responsibilities included phone screening of potential participants and scheduling of participants. Further responsibilities included assessment of participants on a 6-hour-long neuropsychological battery, as well as scoring of assessments and entry of data into a database. Assessments included the Structured Clinical Interview for DSM-IV Diagnoses (SCID), quality of life self-report questionnaires, a semi-structured interview regarding and ratings of current psychiatric symptomatology, measures of verbal and visual learning and memory, executive functioning and processing speed measures, and functional outcome measures.

Study: Longitudinal study of neuropsychological and functional deficits in adults with bipolar disorder (*Summer 2008–Spring 2010*)

Responsibilities included assessment of participants on a 4-hour-long neuropsychological battery, as well as scoring of assessments. Assessments included the Structured Clinical Interview for DSM-IV Diagnoses (SCID), quality of life self-report questionnaires, a semi-structured interview regarding and ratings of current psychiatric symptomatology, measures of verbal and visual learning and memory, executive functioning and processing speed measures, and functional outcome measures.

Study: Verbal and visual learning and memory deficits as trait markers for psychosis in bipolar disorder (*Fall 2008–Summer 2009*)

Responsibilities included phone screening of potential participants and scheduling of participants. Further responsibilities included assessment of participants on a 6-hour-long neuropsychological battery, as well as scoring of assessments. Assessments included the Structured Clinical Interview for DSM-IV Diagnoses (SCID), quality of life self-report questionnaires, a semi-structured interview regarding and ratings of current psychiatric symptomatology, measures of verbal and visual learning and memory, executive functioning and processing speed measures, and functional outcome measures.

**Achievement Center**

Fall 2007–Fall 2009

University of Nevada Las Vegas

Advisor: Bradley Donohue, Ph.D.

Study: Concurrent drug abuse treatment and HIV prevention in child neglecting mothers, NIDA funded RO1 grant (DA020548-01A1)

Responsibilities included evaluating substance abusing mothers who had been identified by Child Protective Services (CPS) to participate in a therapeutic program. Assessments were administered in the clients' homes and included the Structured Clinical Interview for DSM-IV Diagnoses (SCID) and verbally administered self-report measures of child abuse potential, family interaction styles, and life satisfaction.

**Auditory Cognitive Neuroscience Laboratory  
and Neuropsychology Research Program**

Fall 2008–present

University of Nevada Las Vegas

Advisors: Joel S. Snyder, Ph.D.

Daniel N. Allen, Ph.D.

Study: Neural mechanisms of perceptual processing in schizophrenia and bipolar disorder

Responsibilities have included phone screening of potential participants and scheduling of participants for assessments, electroencephalograms, and magnetic resonance imaging scans. Responsibilities have also included assessments of participants on a 2-hour-long battery, which includes the Structured Clinical Interview for DSM-IV Diagnoses (SCID), Responsibilities: Phone screening, subject scheduling, subject testing, scoring

**CLINICAL EXPERIENCE****UNLV Psychological Assessment and Testing Clinic**

Fall 2008–present

University of Nevada, Las Vegas

Supervisors: Michelle G. Carro, Ph.D.

Sylvia A. Ross, Ph.D.

Responsible for administering neuropsychological evaluations and completing reports for adult and child clients referred from the community and the university disability center.

**Center for Individual, Couple, and Family Counseling**

Fall 2008–Spring 2009

University of Nevada, Las Vegas

Supervisor: Christopher A. Kearney, Ph.D.

Provided individual therapy 6-10 hours per week as clinical practicum training experience. Therapeutic orientations included cognitive-behavioral and interpersonal process. Diagnoses seen included personality disorders, affective disorders, adjustment disorders, and schizophrenia.

**Etcoff and Associates**

Summer 2009–Summer 2010

Las Vegas, NV

Supervisor: Lewis M. Etcoff, Ph.D.

Administered neuropsychological and psychological assessments to children and adults. Assessments occurred two days per week for half or full day testing sessions. Cases seen were clinical child and adult referred by schools, parents or therapists. Responsibilities further included scoring assessments, conducting partial clinical interviews and feedback sessions, and writing comprehensive neuropsychological reports.

**SERVICE AND PROFESSIONAL AFFILIATIONS**

**Service Within Organizations**

**National Academy of Neuropsychology**

Membership Committee Member

Spring 2009–Fall 2011

**Clinical Psychology Doctoral Student Committee**

Member

Fall 2008–Fall 2009

Served as liaison between clinical faculty and graduate students; responsibilities included coordinating assisting with interview weekend activities, organizing student focused events, and serving as a liaison between clinical faculty and graduate students.

**Membership in Professional and Scientific Societies**

National Academy of Neuropsychology, Student Affiliate

Summer 2005–present

American Psychological Association, Student Affiliate

Summer 2008–present