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Theory of Mind Impairment and Schizotypy

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THEORY OF MIND IMPAIRMENT AND SCHIZOTYPY

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ABSTRACT

This study used abbreviated versions of the Magical Ideation (MagId) and Revised Social Anhedonia (SocAnh) scales to measure schizotypal tendencies among a sample of undergraduates. Theory of mind (ToM) ability was also assessed using the Character Intention Task (CIT) and the revised adult version of the Reading the Mind in the Eyes Test. It was hypothesized that individuals scoring high on the schizotypy measures would perform worse on ToM measures than lower scoring participants. Multiple regression analyses revealed partial support for the current hypothesis. MagId and SocAnh together were significantly related to the Eyes scores, but only MagId shared a significant negative relationship with Eyes scores. CIT scores only shared a significant negative relationship with the non-realism MagId factor. Significant negative associations were also noted between Eyes negative emotions and the following variables: MagId, non-realism, and New Age ideas. Limitations of the current study include strong ceiling effects on the CIT measure and limited participant recruitment options. Future studies should further investigate the validity of existing ToM measures in both normal and high schizotypy populations and further investigate the nature of ToM and social cognition in mental illness.

THEORY OF MIND IMPAIRMENT AND SCHIZOTYPY

INTRODUCTION

Among the cluster "A" Axis II personality disorders in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Text Revision* (*DSM-IV-TR*; APA, 2000) is schizotypal personality disorder (SPD). This disorder is characterized by an array of perceptual, cognitive, and social abnormalities commonly found in non-psychotic family members of individuals suffering from schizophrenia (Cadenhead, Light, Geyer, McDowell, & Braff, 2002). The positive symptoms of SPD encompass perceptual and cognitive aberrations such as bodily illusions and magical thinking (e.g., a belief in extra-sensory perception) whereas negative symptoms include interpersonal deficits and social withdrawal (Squires-Wheeler et al., 1997). A diagnosis of SPD is warranted when at least five of the nine *DSM-IV-TR* criteria are met (see Table I), and consistent with Axis II disorders, symptoms must arise in early adulthood, persisting and enduring across multiple situations and circumstances (APA, 2000). Although negative symptomatology of SPD may be as severe as the negative symptoms of schizophrenia, the positive symptoms are less pronounced and do not clinically qualify as delusions and hallucinations (Walker & Gale, 1995).

History of SPD

Schizotypal personality disorder boasts a rich theoretical tradition that begins with the early work of Bleuler (1950), who elaborated on Kraeplin's construct of dementia praecox in his writings on latent schizophrenia. This type of schizophrenia is comparable

to modern theoretical conceptualizations of SPD in that it was understood to be a non-psychotic, attenuated, and more prevalent form of dysfunction. Bleuler noted a congenital link between the more chronic schizophrenias and the latent forms in families and even promoted a dimensional framework suggesting that both might be different manifestations of the same disorder. SPD-like disorders would later take on a variety of names such as ambulatory schizophrenia (Zilboorg, 1949), the "as-if" personality (Deutsche, 1942), and pseudoneurotic schizophrenia (Hoch & Polatin, 1949) before being labeled "schizotypal" by Rado (1953).

Sandor Rado (1956) coined the term *schizotype*, or schizophrenic phenotype, to describe the schizotypal personality organization that arises from the interaction between environmental stressors and a schizophrenic genotype, or inherited predisposition towards schizophrenia. This resulting schizotypal personality structure was understood to manifest itself primarily through anhedonia, or a pleasure deficiency, and a proprioceptive diathesis, which is a tendency towards a distorted sense of bodily self-awareness (e.g., body image distortions). Together, anhedonia and the proprioceptive diathesis supposedly triggered a weakening of pleasurable emotions and positive subjective feelings (e.g., affection, love, and pride), a reduction in the capacity for the enjoyment of life, a disruption of the self's sense of confidence in the social milieu, an attenuation of affect-laden cognition, and an enervation of the central core of self-awareness, or action-self, thus giving rise to thought disorder.

According to Rado (1956), schizotypal individuals compensated for the aforementioned deficiencies via schizoadaptation, or a set of maladaptive mechanisms such as over-dependence and over-intellectualization. The success of these mechanisms

was thought to depend on both the nature of the schizotype's environment and the strength of the schizophrenic predisposition.

Building on Rado's (1956) earlier work, Meehl (1962) sought to further illuminate the etiology of schizophrenia using an interactional diathesis-stress model. He coined the term schizotaxia to refer to an inherited genetic predisposition to schizophrenia that becomes manifest in neural structural anomalies, thus contributing to an integrative neurological deficit (i.e., hypokrisia, or a synaptic dysfunction). This deficit was thought to interact with social environmental stressors and polygenic potentiators (e.g., excessive anxiety and hypohedonia), resulting in two possible outcomes: schizotypy or schizophrenia.

In Meehl's research (1962), schizotypy was understood to be an indicator of a latent genetic vulnerability to schizophrenia characterized by the gradual development of sub-psychotic features such as cognitive slippage, social withdrawal, and anhedonia. Taken together, these signs were seen as constituting the underlying genetic condition, or single major locus (SML), that put individuals at a heightened risk for schizophrenia. Some empirical support has been garnered for this *diathesis-stress* model of illness. For example, it has been demonstrated that persons deemed genetically predisposed to schizophrenia tend to display a greater likelihood of developing schizophrenia when environmental stressors (e.g., familial instability, birth complications) are present (Tyrka, Haslam, & Cannon, 1995).

Dimensional and Categorical Approaches to Schizophrenia and SPD

In regards to the relationship between SPD and schizophrenia, three central perspectives have pervaded the clinical literature (Siever et al., 2002). They are: (a) the

two disorders share few similarities and are distinct, isomorphic entities, (b) SPD and schizophrenia are different expressions of the same underlying disorder, and (c) both disorders are etiologically and genetically very similar yet share critical differences that distinguish them (e.g., acute psychosis). The first view translates to a categorical model, the second can be described as a fully dimensional view, and the third is quasi-dimensional.

The categorical, or typological model of schizophrenic illnesses has its origins in the writings of Meehl (1962), who posited that schizotypy was a taxon, or discrete, latent diagnostic entity arising from a single gene, or schizogene. Both SPD and schizophrenia were viewed as unconnected, mutually exclusive entities although they were conceptualized as sharing a similar genetic basis. Thus, a discontinuity was thought to exist among normality, schizophrenia, and schizotypy. It is noteworthy that the current diagnostic system outlined in the *DSM-IV-TR* (APA, 2000) is conducive to a categorical model of illness since SPD is a dichotomous entity that is either applied or suspended as a diagnosis and cannot be diagnosed with schizophrenia simultaneously.

Rather than being concerned with differences of type, the dimensional approach is wholly focused on differences of intensity or degree (Widiger & Sanderson, 1995). This model was defended by Eysenck (Eysenck & Eysenck, 1976), who largely ignored symptom discontinuity and saw psychotic disorders as endpoints on a continuous spectrum containing both normal and abnormal behaviors. That is, the differences between normality, SPD, and schizophrenia were simply a matter of degree or severity of expressed symptomatology. Schizophrenia was placed at the extreme endpoint on a spectrum with SPD being a less severe manifestation of the underlying pattern.

It is worthwhile to mention that contemporary approaches to personality disorders (viz., SPD), such as those emphasized by Widiger and Sanderson (1995), have embraced more dimensional perspectives due to shortcomings of the medical categorical models (e.g., poor diagnostic inter-rater reliabilities, emphasis on clinical lore rather than empirical findings, and arbitrary distinctions between presence and absence of illness). Dimensional orientations have also gravitated towards viewpoints that are less extreme and more flexible than Eysenck's (Eysenck & Eysenck, 1976) original contention. For example, Claridge and Beech (1995) have asserted that both continuity and discontinuity are likely possibilities, especially at the extreme ends of the continuum of mental illness.

Genetic Link

The clinical literature is replete with evidence suggesting a genetic link between schizophrenia and SPD. In a study comparing family members of schizophrenic and major depressive twins, SPD was significantly more common among relatives of identical and fraternal schizophrenic twins combined with a higher incidence of odd behaviors and speech, high social anxiety, and inappropriate affect (Torgersen, Onstad, Skre, Edvardsen, & Kringlen, 1993). However, it should be noted that only 20% of identical twins of schizophrenic parents in this study were found to phenotypically express SPD symptoms.

Further reinforcing this putative genetic link, research also demonstrates that the family members of individuals diagnosed with schizophrenia may be at a higher risk for SPD. Evidence for this lies in a series of Danish American adoption studies by Kety, Rosenthal, Wender, and Schulsinger (1968; 1994) where the mental health history of families of both schizophrenic and non-schizophrenic Danish adoptees was investigated.

The biological relatives of participants diagnosed with schizophrenia had a significantly higher incidence of the non-psychotic, or latent form of schizophrenia described by the authors. Since these relatives did not live in the same family environment as the adoptees, latent schizophrenia was largely attributed to genes. The percentage of family members with latent schizophrenia (14.8%) was more than double the percentage of relatives with chronic schizophrenia (5.6%), suggesting a strong link between chronic schizophrenia and latent schizophrenia. Only 0.9% of biological relatives of the control group were found to have latent schizophrenia (Kety et al., 1968; Kety et al., 1994).

Follow-up studies applying *DSM-III* SPD criteria to the aforementioned medical histories found very similar SPD prevalence percentages in first degree relatives of schizophrenic patients (Baron et al., 1985). Further studies have supported a strong genetic link between schizophrenia, SPD, and sometimes paranoid personality disorder, but no repeated connection has been found between schizophrenia, affective disorders, anxiety disorders, and schizoid personality disorder (Kendler, Masterson, Ungaro, & Davis, 1984). In a later family study, SPD prevalence among relatives of schizophrenic probands (6.9%) was significantly higher than among family members of control (1.4%), paranoid personality (1.4%), schizoid personality (1.0%), and avoidant personality disorder (2.1%) participants (Kendler et al., 1993).

It is also possible that relatives of people diagnosed with SPD may be at a higher risk for developing SPD or schizophrenia. One study found the morbid risk for schizophrenia spectrum disorders among family members of SPD diagnosed participants to be 17.9% (Siever et al., 1990). Another study discovered a 4.6% schizophrenia risk in

first degree relatives of SPD participants compared to 0.6% in a psychiatric control group (Battaglia et al., 1991).

Developmental Trajectory

Since the inclusion of SPD as an axis II diagnosis in the *DSM-III* (APA, 1980), individuals displaying SPD symptoms have been studied to gain insight into the schizophrenic developmental trajectory (Diforio, Walker, & Kestler, 2000). Although an exact percentage of patients with SPD who later develop schizophrenia is not yet clear (Stone, 1993), results from retrospective research on the premorbid history of schizophrenic adults point to a higher incidence of schizotypal symptoms earlier in the developmental track, which suggests that individuals with SPD are a high-risk group for schizophrenia spectrum disorders (Ambleas, 1992). One finding supporting the notion that SPD-like symptoms precede the onset of schizophrenia indicated that 67% of participants who later developed schizophrenia presented with at least three features of SPD at the time of initial hospital assessment (Fenton & McGlashan, 1989).

Furthermore, numerous studies have reported schizotypy to be a fairly stable entity over the course of development. For example, it was found that 75% of schizotypal children (mean age = 10 years) who entered into a psychiatric hospital met *DSM-III* criteria for SPD by 27 years of age (Wolff, Townshend, McGuire, & Weeks, 1991). Results from the New York High-Risk longitudinal study reinforced such findings by revealing that 70% of participants who had developed schizophrenia and/or had retained SPD-like symptoms at 25 years of age evidenced a minimum of four SPD-related features nine years earlier (Squires-Wheeler, Skodol, & Erlenmeyer-Kimling, 1992).

Follow-up studies have shown schizotypy to be stable between the ages of 15 and 39 (Tyrka, Haslam, & Cannon, 1995).

Taken together, this research points to a longitudinally stable aggregate of signs and symptoms that may precede the onset of schizophrenia-spectrum disorders in genetically vulnerable individuals. SPD symptoms appear to persist over time from childhood to adolescence and may share a genetic link with schizophrenia (Tyrka, Haslam, & Cannon, 1995). However, it is important to note that although SPD may be a precursor of psychosis in some cases, schizophrenia is by no means an unavoidable outcome. The majority of individuals displaying SPD symptomatology do not go on to develop more severe psychopathology as was shown by a recent 10-year follow up study by Kwapil (1998) using the Revised Social Anhedonia (SocAnh) scale, which taps negative schizotypal tendencies. In this study comparing controls with college undergraduates scoring deviantly high on the SocAnh scale at initial assessment, only 24% of the high schizotypy group were diagnosed with schizophrenia spectrum disorders ten years later.

The developmental trajectory of SPD thus remains a nebulous area of inquiry. More research is needed to determine which premorbid signs and symptoms in particular best predict future onset of schizophrenia spectrum disorders (Kwapil, 1998). Nevertheless, many researchers remain confident of a strong link owing to the findings of numerous studies demonstrating an array of neurological and cognitive deficits that arise in early childhood and endure over time (Walker & Gale, 1995).

Psychobiology and Neurocognition

Studies have enumerated various shared abnormal psychobiological and neurocognitive indicators among schizotypal and schizophrenic individuals. These indicators can be roughly organized into three primary categories: biological markers, psychophysiological responses, and neuropsychological indicators (Lencz & Raine, 1995). There are few consistent biological markers, but one repeated find is reduced plasma homovanillic acid (HVA) concentrations in the cerebrospinal fluid (CSF) of both schizophrenic patients (Weinberger, Berman, & Illowsky, 1988) and SPD patients (Amin et al., 1993). These reduced HVA levels are correlated with asociality in schizophrenics (Lindstrom, 1985) and negative symptoms in SPD patients (Amin et al., 1993).

Psychophysiological aspects include eye tracking and the skin conductance orienting response (SCOR). Smooth pursuit eye tracking performance, which is gauged by how well a participant's eyes can follow a slow-moving object, is disrupted by saccadic intrusions in 80% of schizophrenic patients and half of their biological relatives, but not in bipolar disordered patients or their relatives (Holzman, Solomon, Levin, & Waternaux, 1984). The same type of deficit has been noted in both SPD patients (Siever, Kalus, & Keefe, 1993) and among college students with a preponderance of schizotypal traits (Raine, Lencz, & Benishay, 1995).

The SCOR refers to changes in electrical activity in the skin in response to audible tones and reflects how well one attends to and possibly cognitively processes a stimulus (Raine, Lencz, & Benishay, 1995). One study discovered that approximately 50% of schizophrenic participants either did not evidence SCORs at all or showed hyporesponsivity (Dawson & Nuechterlein, 1984). Cluster analyses by Raine et al. (1995) yielded similar aberrant electrodermal responses in SPD participants, especially those

displaying cognitive perceptual deviations such as magical ideation, ideas of reference, and perceptual aberrations. Specifically, schizotypal participants show inconsistent SCORs, meaning they sporadically fluctuate between efficient attentional processing and poor, inefficient processing of incoming information, thus suggesting an inconsistent allocation of attentional resources over time. These atypical response patterns may be due in part to a working memory deficit, but this idea remains uncertain (Raine et al., 1995).

The third category of neuropsychological indicators has been an area of especially intense research focus over the past several decades. Recent studies have repeatedly demonstrated that individuals diagnosed with schizophrenia and schizotypal personality disorder share very similar abnormalities (Cadenhead, Light, Geyer, McDowell, & Braff, 2002; Siever et al, 2002). For instance, damage to frontal lobe tissue of the brain as evidenced by increased volume of the lateral ventricles has been found in both SPD patients (Siever et al., 1995) and schizophrenic patients (Klausner, Sweeney, Deck, Haas, & Kelly, 1992), suggesting an underlying *frontal lobe dysfunction* (FLD). A predisposition towards abnormal prefrontal cortical activity, sometimes referred to as a fontal "lesion" (Weinberger, 1987), often appears in both schizophrenic and schizotypal individuals with concomitant behavioral consequences surfacing in late adolescence (Levin et al., 1991). In regards to explaining the nexus between FLD and schizophrenia-like symptoms, it has been proposed that with the neuromaturation of the frontal lobes both structurally and functionally, such symptoms come about (i.e. during adolescence) as the result of a stable, underlying frontal dysfunction. These symptoms in turn have a detrimental impact on both behavior and cognition (Walker, 1994).

The previously mentioned psychophysiological aberrations, such as poor eye tracking and deviant SCOR responses, have been argued to buttress support for an underlying prefrontal cortical dysfunction (Raine, Lencz, & Benishay, 1995). In particular, reduced SCORs have been strongly associated with both significantly decreased metabolism of glucose in the frontal lobes of schizophrenia patients (Hazlett, Dawson, Buchsbaum, & Neuchterlein, 1993) and structural reductions in prefrontal cortical areas detected with magnetic resonance imaging (MRI) technology (Raine, Reynolds, & Sheard, 1991). However, this contention remains highly speculative (Raine et al., 1995).

Stronger empirical support for a frontal lobe neurological aberrance lies in studies utilizing the Wisconsin Card Sorting Task (WCST), a neuropsychological assessment tool sensitive to FLD (Siever, 1995). The WCST requires examinees to categorize cards with a number of colored shapes in response to feedback from the examiner (e.g. vocalizations of "correct" or "incorrect"). Underlying the correct response pattern is a sorting principle known only by the examiner; it is the examinee's objective to quickly learn the rule. The sorting patterns are changed (e.g. from color to number to shape) after a certain number of correct responses (Lezak, 1980). Since the WCST involves sorting cards to constantly changing rules, participants must be able to inhibit previously correct response patterns and adapt to changes in the rules.

Generally speaking, schizophrenic patients tend to commit significantly more perseverative errors on the WCST than healthy controls (Weinberger, 1987). In regards to a link to specific symptomatology, one particular study detected a connection between negative schizophrenia spectrum symptoms and frontal lobe dysfunction as evidenced by

strong associations between decrements in WCST performance and ratings of social awkwardness, physical anhedonia, and speech peculiarities, but found no association between positive, psychotic symptoms and WCST deficits (Siever, Kalus, & Keefe, 1993). It has also been reported that undergraduates scoring high on schizotypy measures derived from diagnostic interviews and several Minnesota Multiphasic Personality Inventory (MMPI) scales committed significantly more perseverative errors on the WCST than controls (Lyons, Merla, Young, & Kremen, 1991). Moreover, Social Anhedonia scores in particular have a significant positive correlation with the number of these errors (Siever, 1995).

Other studies have examined blood flow to the frontal lobes while participants were engaged in the WCST. For instance, Weinberger, Berman, and Zec (1986) observed that whereas cerebral blood flow to the dorsolateral prefrontal cortical areas increased while healthy participants took the WCST, blood flow to these same areas was significantly reduced while schizophrenic patients were taking the test. This decreased blood flow is hypothesized to interfere with executive, or higher order functioning, which refers to a set of cognitive activities devoted to self-regulation (e.g. motivation, emotional expression regulation, remembering goals, ignoring distracting stimuli) and has its seat in the frontal lobes (Siever, 1995).

Executive functioning is likewise impaired in individuals with SPD as evidenced by poor WCST performance (Trestman et al., 1995), although such deficits tend to be less severe than those observed in schizophrenic patients (Diforio, Walker, & Kestler, 2000). For instance, it has been shown that college students identified as schizotypal with high scores on the Perceptual Aberration-Magical Ideation (PerMag) and Social

Anhedonia (SocAnh) scales perform significantly worse than low scoring controls on the WCST due to significantly more perseverative errors and especially poor performance in the areas of working memory and inhibitory control (Gooding, Kwapil, & Tallent, 1999). Verbal and memory deficits also become apparent in SPD patients on measures such as the California Verbal Learning Test, or CVLT (Voglmaier, Seidman, Salisbury, & McCarley, 1997) although results are mixed in terms of whether or not a general intellectual functioning deficit is present (Trestman et al., 1995).

In one study by Cadenhead, Perry, Shafer, & Braff (1999), SPD diagnosed participants performed significantly worse than healthy controls on assessments of general intellectual functioning, verbal working memory and recognition, attention, cognitive inhibition, and abstract reasoning. However, they performed better than the schizophrenic group, suggesting that schizotypal individuals have a form of cognitive impairment that is less severe than that observed in schizophrenia. SPD diagnosed participants were separated from both the normal and schizophrenic groups in performance by moderate to large effect sizes.

Interestingly, many relatives of individuals diagnosed with schizophrenia also have what can be described as an intermediate phenotypic expression of the same cognitive deficits found in schizophrenia. They too are observed as having attenuated abnormalities in the areas of language, learning, attention, and abstract reasoning ability (Cannon et al., 1994; Goldberg et al., 1995). It has previously been suggested that cognitive deficiencies of this sort may result due to an ineffective inhibitory mechanism, which in turn impairs the ability to filter out extraneous internal and external stimuli (Lencz, Raine, Benishay, Mills, & Bird, 1995).

Cognition

Similar performance deficiencies in schizotypal and schizophrenic individuals on cognitive tasks have also surfaced in studies using the Continuous Performance Test (CPT). The CPT requires participants to focus on a target stimulus while ignoring other irrelevant stimuli that are all presented in rapid succession. Specifically, participants must respond to certain number sequences embedded in a long series of numbers by pushing a button (Lencz, Raine, Benishay, Mills, & Bird, 1995). Positron Emission Tomography (PET) scans have revealed higher rates of glucose consumption in the frontal hemispheric lobes and temporoparietal areas among mentally healthy individuals engaged in the CPT but abnormally lower rates of glucose metabolism within these same regions in schizophrenics (Buchsbaum et al., 1990). Specific performance deficits in attention on the CPT have also surfaced among schizophrenic participants (Cornblatt & Keilp, 1994).

Similar cognitive perceptual aberrances have been noted in SPD patients engaged in the CPT, in particular, attentional vigilance deficits and poor understanding of grammatical constructions (Condray & Steinhauer, 1992). SPD-prone individuals also tend to show impaired performance on the Span of Apprehension (SOA) test, which is a test similar to the CPT that requires examinees to rapidly select target letters briefly presented among a field of distractor letters (Lencz, Raine, Benishay, Mills, & Bird, 1995). Results from one study demonstrate that those with poor SOA performance scored significantly higher on Magical Ideation (MagId), an MMPI schizophrenia scale, and other sub-psychotic schizotypal indicators, perhaps due in part to underlying cognitive-perceptual abnormalities (Asarnow, Nuechterlein, & Marder, 1983). Evidence of this type points to the possibility of a pre-attentive, automatic informational processing deficit that

may hinder the normal process of filtering out irrelevant incoming stimuli (Lencz et al., 1995).

The inability to filter out irrelevant stimuli, or impaired sensorimotor gating, is well documented in schizophrenics (Dawson, Schell, Hazlett, Filion, & Nuechterlein, 1995). For example, in a study involving schizophrenic patients, Braff and Geyer (1990) reported a dysfunctional startle eye-blink (SEM) reflex in response to a startling stimulus (e.g. a loud burst of white noise). The authors contended that this peculiarity likely reflected a central nervous system inhibition defect, which was linked with cognitive disorganization symptoms. Similar startle reflex deficits have been found in SPD diagnosed patients (Cadenhead, Geyer, & Braff, 1993) as well as among non-clinical samples of psychosis-prone college students scoring high on the Perceptual Aberration Scale (PAS; Chapman, Chapman, & Raulin, 1978), implying an underdeveloped automatic processing mechanism designed to filter out irrelevant stimuli that interfere with sensory information (Simons & Giardina, 1992).

A follow-up study by Dawson, Schell, Hazlett, Filion, and Nuechterlein (1995) found the same type of attentional impairment in college students scoring deviantly high on Per-Mag scales and in age-matched schizophrenic outpatients who were asymptomatic at the time of measurement. Although not necessarily pointing to a definite risk for schizophrenia per se, such findings demonstrate that SPD-like symptoms, especially magical ideation and perceptual aberration, are linked to dysfunctional cognitive processes that putatively underlie a vulnerability common to risk for SPD and schizophrenia. It is also reasonable to infer that the previously discussed cognitive deficits may interfere with inferential processes involved in social cognition.

Social Cognition and Theory of Mind

Social cognition has been defined by Corrigan and Penn (2001) as the cognitive processes that enable us to comprehend, act on, and benefit from our interpersonal environments. Furthermore, social cognition has been parsed into three primary processes: the ability to understand what others are feeling, the ability to recognize certain roles, cues, and expectations that dictate social interaction, and the ability to perceive what other individuals are thinking (Penn, Corrigan, Bentall, Racenstein, & Newman, 1997). One approach to understanding these social cognitive abilities collectively is theory of mind (ToM; Frith, 1992).

The term theory of mind was coined by Premack and Woodruff (1978) and refers to the social cognitive ability of being able to successfully infer and interpret the mental states of others. More specifically, it involves being able to discern the thoughts, beliefs, and intentions of others through social knowledge of interpersonal situations and through outwardly manifested behaviors despite verbal tone and content, such as body gesticulations, facial expressions, and posture (Sarfati & Hardy-Baylé, 1999). Previous knowledge of social experiences and observed outward manifestations are then cognitively synthesized during social interaction in order to form representations of what is occurring in others' minds. Moreover, ToM involves not only the ability to attribute mental states but also how such states are different from our own (Brunet, Sarfati, Hardy-Bayle, & Decety, 2003). The first researcher to conceptualize deficits in this ToM mechanism (i.e. difficulties in inferring the beliefs and intentions of others) as constituting a specific disturbance in schizophrenia was Frith (1992).

According to a cognitive neuropsychological model of schizophrenia propounded by Frith (1992), social cognitive deficits underlying certain symptom patterns in schizophrenic individuals can be understood within the theoretical framework of ToM. According to this explanation, schizophrenia is a disorder marked by metarepresentational deficits, or second-order representational deficits, which are simply deficient representations of mental states. Frith further specified three central awarenesses that are driven by metarepresentation, namely, awareness of others' intentions, awareness of our own intentions, and awareness of our personal goals. Each of these awarenesses is purportedly linked to a specific set of cognitive abnormalities encountered in schizophrenic individuals, which are disorders of monitoring others' intentions (ToM deficit), disorders of self-monitoring, and disorders of willed action.

According to Frith (1992), an impaired ability to monitor the intentions of others supposedly precipitates disorganized thoughts and behaviors (e.g. incoherent thoughts and speech), persecutory delusions, and formal thought disorder. Problematic self-monitoring is understood to lead to positive symptomatology (e.g. third person auditory hallucinations), and impeded willed action is thought to galvanize negative symptoms (e.g. avolition and alogia). Frith proposed that whereas ToM simply fails to develop in autistic children, it may develop normally in schizophrenic individuals and then somehow become impaired, leading to grossly inaccurate mental representations after the first psychotic episode later in life.

A proposed neurocognitive explanation for the aforementioned meta-representational deficits is the misconnection syndrome, which has been argued to be a special case of dysmetria (Andreasen, Paradiso, & O'Leary, 1998). Andreasen and

colleagues posit that the primary deficit underlying schizophrenia is a severe disturbance in the fluidity and coordination of mental and motor activity known as cognitive dysmetria, or poor mental coordination (Andreasen et al., 1999). The impaired synchrony in cognitive processes is thought to result from disruptions in the neural circuitry in the prefrontal cortex, thalamus, and cerebellum as evidenced by neuro-imaging techniques such as PET scans, Single Photon Emission Computed Tomography (SPECT), and MRI scans (Andreasen et. al., 1998). It is thought that this cognitive inability to process, synthesize, prioritize, and respond to information is responsible for many symptoms found in schizophrenic individuals (Andreasen et. al., 1999).

Theory of Mind and Schizophrenia

Prior to 1995, ToM had not been directly investigated empirically in connection to schizophrenia although previous research is replete with assessments of social competence in individuals with schizophrenia. Previous studies have overwhelmingly demonstrated myriad social impairments in schizophrenic patients ranging from failure to integrate others' points of view (Diamond, 1956) to failing to providing lucid and succinct information in social interactions (Good, 1990) to an overall "social naiveté" as evidenced by poor overall social competency. These deficits have consistently failed to surface in depressed patients and in those with manic psychoses (Cutting & Murphy, 1990).

Furthermore, studies have shown that schizophrenics tend to be inaccurate when decoding interpersonal cues in social settings as well as in interpreting facial expressions (Cramer, Weegmann, & O'Neil, 1989). It is also worthwhile to note that a high frequency of ambiguous pronomial referents (e.g., *he*, *she*, and *it*) are often used by schizophrenics

without subsequent elaboration, thus raising the possibility that many schizophrenics believe that the listener shares their own knowledge (Rochester & Martin, 1979). Together, these findings would point to an impaired social inference mechanism since schizophrenic individuals fail to disentangle their own knowledge from that of the listener and are indicative of impairments in ToM.

As an increasing number of studies has directly addressed and operationally defined ToM, similar data have begun to surface and have reinforced previous indications of social cognitive deficits in schizophrenia. For example, the ability to ascribe emotion to voices and faces has been repeatedly demonstrated to be impaired in individuals with schizophrenia, which can have negative social repercussions in terms of not knowing how to respond to others (Green, 2001). Similar findings have also been linked with an overall impoverished sense of social competence (Penn, Spaulding, Reed, & Sullivan, 1996).

More recent studies have begun to further enrich and deepen our understanding of ToM deficiencies in schizophrenia by taking into account specific symptom clusters. For example, schizophrenics suffering from predominantly disorganized symptomatology perform significantly worse than other symptom groups on ToM tasks (Tamasine, Bryson, & Bell, 2004; Sarfati, Hardy Baylé, Brunet, & Widlöcher, 1999; Sarfati & Hardy-Baylé, 1999). To measure ToM, these studies have utilized the Hinting Task (Corcoran, Mercer, & Frith, 1995) in addition to a newer measure called the Character Intention Task (CIT; Sarfati, Hardy Baylé, Besche, & Widlöcher, 1997a), which requires participants to be able to successfully infer the mental states of cartoon characters to select the most appropriate end to a comic strip. It appears that schizophrenics with

disorganized features are less adept at extracting and synthesizing relevant contextual characteristics, thus possibly rendering them more vulnerable to a ToM deficit than other symptom groups (Sarfati et. al. 1997a; Sarfati, Hardy Baylé, Nadel, Chevalier, & Widlöcher, 1997b).

A growing number of contemporary research findings also demonstrate that schizophrenic patients with a preponderance of negative symptoms such as asociality, blunt affect, and poverty of speech perform worse than normal and depressed psychiatric controls on ToM tasks such as the Hinting Task, which involves inferring true intentions behind indirect language in several vignettes (Corcoran, Mercer, & Frith, 1995). Negative feature groups have also been found to perform significantly worse than symptom-free schizophrenic remission groups and "passivity experiences" (e.g. delusions of control, thought broadcasting, and thought insertion) groups.

Theory of Mind and Schizotypy

In light of the many findings indicating cognitive similarities between schizophrenia and schizotypy, there has been a call for further research probing the nature of theory of mind in people evidencing SPD-like symptoms given the paucity of studies directly addressing this topic (Barnacz, Johnson, Constantino, & Keenan, 2004). Disturbances in visual-cognitive perspective taking (i.e. imagining how arrangements of colored blocks would appear from other perspectives) have been noted in studies involving individuals scoring high on schizotypy measures, suggesting a poor ToM ability (Langdon & Coltheart, 2001). Also, contagious yawning, or yawning triggered by seeing someone else yawn, was found in a recent study to negatively correlate with high Schizotypal Personality Questionnaire (SPQ) scores in a non-clinical college student

population. This finding was taken as evidence of an impaired mental state attribution ability in the higher scoring participants, possibly reflecting a faulty ToM ability (Platek, Critton, Myers, & Gallup, 2003). However, the use of combinations of more sophisticated and comprehensive ToM sensitive measures is warranted.

Present Study

Given the similarities in cognitive deficiencies between schizophrenia and SPD, it can be hypothesized that individuals scoring high on measures tapping distorted reality perception (e.g. Magical Ideation Scale) and attenuated social pleasure (e.g. Revised Social Anhedonia Scale) will perform worse on ToM measures (e.g. the CIT and Reading the Mind in the Eyes Test) than those scoring lower on such measures. In regards to the potential utility of the present findings, Shean and Wais (2000) note how identifying cognitive deficits present in individuals who may be at risk for later developing schizophrenia spectrum disorders is useful from both a research and clinical standpoint. Through this type of research, it is possible to achieve further insight into the etiology of spectrum disorders, which enables the identification of vulnerability markers and precursors to more marked clinical symptoms. Armed with a heightened etiological understanding, clinicians would then able to develop more effective preventative treatment strategies.

Method

Participants

A total of 146 undergraduate volunteers from the College of William and Mary in Williamsburg, Virginia, participated in the present study, 51 of which were males and 95 of which were females. Participants were between the ages of 18 and 24, and the mean

age was 18.7 years (*SD* = 1.10). In regards to ethnicity, the present sample consisted of 117 Caucasians (80%), 12 African Americans (8.2%), 7 Asians (4.8%), 5 Hispanics (3.4%), and 5 other (3.4%). Informed consent was obtained from all research volunteers (see Appendix A). Those who completed the research tasks were offered one research credit hour as compensation for their time.

Materials

Abbreviated 10-item versions of the Magical Ideation scale (MagId; Eckblad & Chapman, 1983) and the revised Social Anhedonia scale (SocAnh; Eckblad, Chapman, Chapman, & Mishlove, 1982) were used as measures of schizotypy in mass testing due to limitations on allowable questionnaire length (see Appendix B for the abbreviated scale items). Full versions of the scales were also utilized with roughly one tenth of the participants in order to compare overall group scores with published normative data. The MagId consists of 30 true-false items inquiring about physically impossible and magical cause-and-effect belief structures (e.g., extra-sensory perception, superstitions, ideas of reference, paranormal phenomena) embedded in participants' interpretations of personal experiences. It shares a strong positive correlation with the Perceptual Aberration Scale (PerAb; Chapman, Chapman, & Raulin, 1978), which asks about experiences of distorted bodily perception and general perceptual disturbances.

The revised SocAnh scale (Eckblad, Chapman, Chapman, & Mishlove, 1982) is composed of 40 true-false items designed to reveal indifferent attitudes towards interpersonal relationships. In contrast to the original Social Anhedonia scale (Chapman, Chapman, & Raulin, 1976), which was found to be a poor predictor of psychotic and schizotypal symptoms and contained a surplus of items tapping social anxiety, the revised

scale contains more items inquiring about social withdrawal. This has resulted in a more sensitive measure of schizotypal tendencies such as asociality (Kwapil, 1998). Both the revised SocAnh and MagId scales demonstrate sufficient intra-item reliability ($\alpha = .79 - .89$) and satisfactory test-retest reliability ($\alpha = .75 - .84$) using college student samples (Chapman, Chapman, & Miller, 1982; Mishlove & Chapman, 1985).

The CIT (Sarfati, Hardy Baylé, Besche, & Widlöcher, 1997a) and the revised version of the adult Reading the Mind in the Eyes Test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) were used to tap ToM ability. The CIT consists of 28 brief comic strip scenarios made up of three illustrated pictures that tell a story. These stories involve characters performing simple actions. Each scenario is followed by three possible endings, one of which is the most logical conclusion. Each correct ending most accurately reflects the comic characters' intentions whereas the two incorrect answer choices reflect either (a) absurd conclusions or (b) appropriate, socially familiar actions unrelated to the story context. Thus, the CIT reportedly captures an individual's social cognitive ability to identify intentions behind simple actions, an ability thought to be linked to mentalizing (Sarfati, Hardy Baylé, Besche, & Widlöcher, 1997a). This measure has been used with hospitalized schizophrenic patients but has not been employed in research with college student populations.

The revised adult Eyes Test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) is comprised of 36 photographs of the eye regions of anonymous individuals (18 male eye regions and 18 female). Each photograph is presented with four response options, one of which is the correct mental state reflected in the eyes and three of which are foils. This measure has been described by the authors as an advanced theory of mind

test that is sensitive to subtle differences in the ability to attribute relevant mental states to others and has been used with both normal adults and patients diagnosed with Asperger syndrome. The revised version eliminates the problems encountered with the original Eyes test (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997), such as too few response choices and unsatisfactory sensitivity to individual differences.

Procedure

All research participants were selected from the William and Mary Introduction to Psychology mass testing pool using the abbreviated versions of the MagId scale and the Revised SocAnh scale. Only those individuals who completed all of the schizotypy items were allowed to participate. The rationale for using mass testing in the selection process was twofold: (a) to obtain a broad range of scores so that adequate samples of high, medium, and low scoring MagId and SocAnh individuals could be selected to participate in the theory of mind tasks and (b) to eliminate the possibility of acquiring an artifactual sample (i.e., a sample consisting only of volunteers scoring low on schizotypy).

All participants were recruited from two separate mass testing sessions, one in the Fall semester and one in the Spring. After mass testing scores were collected in both instances, mass email invitations were sent to potential participants notifying them of several opportunities to complete the second phase of the project involving the ToM tasks. Low and mid-scoring students on both scales were recruited randomly while higher scoring individuals were selected on the basis of their scores.

Students with a raw score of 6 (SD = 1.64) or higher for the abbreviated MagId scale and a raw score of 6 (SD = 1.90) or higher for the abbreviated SocAnh scale were selected as high scorers. These cutoff values approximated scores considered deviant in

past research (Kwapil, Miller, Zinser, Chapman, & Chapman, 1997). In addition, a broad range of lower scoring controls was selected. Due to the lack of participation of individuals scoring 6 or above on both scales, the initial cutoff scores were lowered to 5, which translates to a standard score of 1.14 for the abbreviated MagId scale and a standard score of 1.34 for the abbreviated SocAnh scale.

Lower scoring students who chose to participate were able to sign up for one of several available time slots displayed on the *Sona Systems* research participation website for the College of William and Mary. Information was provided on the website about specific participation times and locations along with a brief description of the study. The higher scoring participants were able to sign up for one of several available time slots that were password protected to prevent other students from gaining access.

The second phase of the study began with student volunteers arriving at a classroom in groups of 10-20 each. The classroom was equipped with an IBM computer, a projector, and a large projection screen. Once seated, participants were handed the informed consent forms, which were collected after being signed and dated. Next, the CIT recording sheets were distributed, and the CIT verbatim instructions (see Appendix C) were read aloud by the experimenter. Participants then viewed the CIT comic strip stories on the projection screen using Microsoft Powerpoint slideshow format and circled on their answer sheets the letter of what they thought was the most logical ending to each story. Each comic strip scenario was presented for approximately 15 seconds.

After the CIT was completed and the answer sheets were collected, the Reading the Mind in the Eyes Test recording sheets and word glossaries were distributed. The glossaries were provided to ensure that participants were able to look up the definitions of

any unfamiliar words they might encounter on the test. Next, verbatim instructions were read (see Appendix D). Participants then viewed the Eyes Test eye regions on the projection screen using Powerpoint and circled on their answer sheets the emotion that they thought the eyes were reflecting. Each eye region slide was presented for approximately 18 seconds. The CIT and Eyes tests combined took approximately 45 minutes to complete. Upon completion of the theory of mind tasks, participants were debriefed on the nature of the study using a verbatim debriefing script (see Appendix E).

Results

Outliers were first examined using the criteria suggested by Hair, Anderson, Tatham, and Black (1998, chap. 2). Cases with unusually large Mahalanobis D^2 values ($D^2>7$) for either the CIT or Eyes measure were excluded from the analyses described below. This reduced the total number of participants included in data analysis from 146 to $N = 142$.

Abbreviated MagId and SocAnh scales were used in mass testing due to practical limitations on questionnaire length allowed. To assess the validity of the abbreviated MagId and revised SocAnh scales, Pearson correlations were computed between the abbreviated scores and total scale scores obtained from 13 participants. The correlation of the abbreviated MagId scale scores with the total MagId scale scores ($M = 10.54$, $SD = 4.31$) was significant, $r(11) = .69$, $p < .05$. The relationship between the abbreviated and total SocAnh scores ($M = 13.69$, $SD = 5.78$) was also significant, $r(11) = .79$, $p < .05$. Thus, both abbreviated scales correlated well with the full questionnaires. Previously reported undergraduate student sample means and standard deviations for the total SocAnh scale (Eckblad, Chapman, Chapman, & Mishlove, 1982), total MagId scale

(Eckblad & Chapman, 1983), Eyes Test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), and CIT (Sarfati, Hardy Baylé, Besche, & Widlöcher, 1997a) closely resembled the present data. Refer to Table 2 for the means, standard deviations, skewness, standard error of skewness, and intercorrelations for the CIT, Eyes Test, and schizotypy scales.

To assess whether or not a significant difference in ToM scores existed between the group of participants with MagId scores of five and those with a MagId scores of six or higher, two separate independent samples t-tests were conducted. No significant differences emerged between the two MagId groups on Eyes scores or CIT scores. This suggests that the lowered cutoff score for MagId was still meaningful.

Coefficient alpha was also computed for all scales and tests used in the current study to obtain an internal consistency estimate of reliability. The Cronbach's alpha values for each measure were all satisfactory with the exception of the Eyes Test: MagId, $\alpha = .67$; Revised SocAnh, $\alpha = .79$; CIT, $\alpha = .66$; and Eyes Test, $\alpha = .48$. The low intra-scale reliability for the Eyes Test revealed inconsistency in accuracy across participants' responses. Because low reliability reduces the likelihood of detecting significant relationships with other variables, this finding was investigated further. Separate Eyes Test emotion subscales were created based on scoring criteria, and a principal components analysis was run on all Eyes items.

Eyes Test Subscales

Two subscale scores were derived from the Eyes Test: a positive emotions score and a negative emotions score. The positive emotions score included summed correct answers for eye regions reflecting the following positively valenced emotions: playful,

friendly, interested, and flirtatious. Over 67% of the participants answered correctly for all of the positive items. The negative emotions score included summed correct answers for eye regions showing the following negatively valenced emotions: upset, worried, uneasy, despondent, regretful, accusing, defiant, hostile, and distrustful. Over 73% of the participants answered correctly for all of the negative items.

Principal Components Factor Analyses

The dimensionality of the 10 items from the abbreviated MagId scale was analyzed using principal components factor analysis. The scree test indicated that the hypothesis of unidimensionality was incorrect; therefore, the Varimax rotational method was employed. The rotated solution yielded three interpretable factors (see Table 3 for summary of items and factor loadings and Table 4 for eigenvalues and cumulative percentages of variance for factors), and rotation converged in five iterations. The first factor (occult ideas; MagId items 8, 9, 24, and 27) accounted for 21.9% of the item variance, the second factor (non-realism; MagId items 4, 15, and 30) accounted for 15.4% of the variance, and the third factor (New Age ideas; MagId items 13, 10, and 18) explained 13.8% of the variance. An oblique factor analysis resulted in essentially the same factors.

Principal components analysis was also used to assess the dimensionality of the 10 items from the abbreviated SocAnh scale. Varimax rotation yielded three factors with one item loading onto more than one factor (see Table 5 for summary of items and factor loadings and Table 6 for eigenvalues and cumulative percentages of variance for factors). The first factor accounted for 17.6% of the item variance, the second factor accounted for 16.2% of the variance, and the third factor accounted for 13.8% of the variance. Given

that (a) less than 50% of the variance was accounted for by all three factors together and (b) differentiation of content between SocAnh factors was ambiguous given the similar factor content, separate analyses using these factors were not conducted.

Principal components factor analyses were also attempted for the Eyes Test and the CIT. Results for these analyses are not reported since (a) no coherent factor matrix emerged from the Eyes Test and (b) there was not enough variance in the CIT items to successfully run a factor analysis. Rotation failed to converge in 25 iterations for the Eyes Test.

Primary Multiple Regression Analyses

Two separate standard multiple regression analyses were conducted to determine how well the schizotypy measures predicted ToM ability. Total scores on the abbreviated MagId and revised SocAnh measures served as the predictor variables in both regressions. The CIT total score was the dependent variable in the first analysis. The linear combination of the abbreviated MagId and revised SocAnh scores was not significantly related to CIT scores, $R^2 = .022$, adjusted $R^2 = .008$, $F(2, 139) = 1.56$, $p = .213$ (see Table 7 for unstandardized coefficients and standard errors). A likely explanation for these non-significant results is that the CIT was too easy for the undergraduate student population, which left little room for variation in the scores. Thus, the observed ceiling effects (see Figure 1 for the CIT score distribution) contributed to a loss of power to detect individual differences.

The Reading the Mind in the Eyes total score served as the criterion in the second analysis (see Figure 2 for the Eyes Test score distribution). Here, the abbreviated MagId and SocAnh scores were significantly related to the Reading the Mind in the Eyes scores,

$R^2 = .091$, adjusted $R^2 = .078$, $F(2, 139) = 6.99$, $p = .001$. In regards to the individual predictor variables, MagId made a significant contribution to the prediction equation, $t(139) = -3.00$, $p = .003$ ($\beta = -.25$), but SocAnh was found to be non-significant, $t(139) = -1.31$, $p = .194$ ($\beta = -.11$). See Table 8 for unstandardized coefficients and standard errors.

Additional Multiple Regression Analyses

Two additional sets of multiple regression analyses including the MagId and SocAnh factors as independent variables were also conducted to assess variance accounted for in positive Eyes Test and negative Eyes Test emotions. In the first set of analyses, abbreviated MagId and SocAnh scale scores were again used as predictors. Together, abbreviated MagId and SocAnh were significantly related to Eyes negative emotions, $R^2 = .066$, adjusted $R^2 = .053$, $F(2, 139) = 4.94$, $p = .008$. A significant negative relationship was found between MagId and Eyes negative emotions, $t(139) = -2.34$, $p = .021$ ($\beta = -.20$). Thus, the more magical beliefs the participants endorsed, the less proficient they were in identifying negative emotions reflected in eye regions.

The second set of analyses included all three MagId factors as independent variables. Together, the MagId factors were significantly related to Eyes negative emotions, $R^2 = .135$, adjusted $R^2 = .117$, $F(3, 138) = 7.21$, $p = .000$. Significant negative relationships were detected between MagId factor 2 (non-realism) and Eyes negative emotions, $t(138) = -3.80$, $p = .000$ ($\beta = -.31$), and between MagId factor 3 (New Age ideas) and Eyes negative emotions, $t(138) = -2.90$, $p = .004$ ($\beta = -.24$). Thus, non-realistic reality assessments and New Age ideas coincided with impaired ability to read negative eye emotions but not positive eye emotions.

MagId factors were also significantly related to CIT total scores, $R^2 = .065$, adjusted $R^2 = .045$, $F(3, 138) = 3.21$, $p = .025$, but only the second factor (non-realism) shared a significant negative relationship with CIT scores, $t(138) = -2.93$, $p = .004$ ($\beta = -.25$). Therefore, the more non-realistic the reality assessment, the lower the success in inferring the cartoon characters' intentions on the CIT measure.

Additionally, MagId factors were significantly associated with the total Eyes score, $R^2 = .116$, adjusted $R^2 = .097$, $F(3, 138) = 6.06$, $p = .001$. Significant negative correlations emerged between MagId factor 2 (non-realism) and Eyes total score, $t(138) = -3.58$, $p = .000$ ($\beta = -.29$), as well as between MagId factor 3 (New Age ideas) and Eyes total score, $t(138) = -2.21$, $p = .028$ ($\beta = -.19$). Thus, as non-realism scores and New Age ideas scores increased, the ability to read eye emotions decreased.

Discussion

The hypothesis that participants scoring high on magical ideation and social anhedonia would perform worse on ToM measures than lower scoring MagId and SocAnh participants was partially supported. Neither MagId scores nor SocAnh were significantly related to CIT scores. However, the regression model containing MagId and SocAnh predicted Eyes scores, and MagId shared a significant negative relationship with the Eyes scores, suggesting that high scoring MagId participants evidenced a mild ToM deficit. That decreased motivation and/or attention could have accounted for this negative relationship is possible, but this is not a compelling argument in light of the nearly perfect scores for virtually all participants on certain measures (i.e. the CIT). Participants were clearly engaged in the tasks at hand as evidenced by a preponderance of correct responses although fatigue effects may have set in towards the end of the Eyes Test.

That MagId alone was found to share a significant negative relationship with the total Eyes scores ($\beta = -.25$) and negative eye emotions ($\beta = -.20$) warrants discussion. The conceptual significance of these results can be understood via an analogy to Frith's (1992) idea of the deficient inference mechanism in patients diagnosed with schizophrenia. Frith suggested that ideas of reference and persecutory delusions may result from faulty inferences about the intentions of others. That is, people experiencing ideas of reference inaccurately view certain events or messages as imbued with personal significance while those experiencing persecutory delusions incorrectly believe that they are being watched or conspired against.

Although high scoring MagId participants in the current sample most likely do not suffer from these types of delusions, a tenable explanation would be that they are prone to milder forms of anomalous experiences, odd belief structures, and tendencies for illogical modes of thinking stemming from underlying difficulties in correctly inferring and interpreting the feelings and intentions of others. Consequently, these individuals may exhibit an impaired ToM mechanism for internally replicating the thoughts and feelings of others (Charlton & McClelland, 1999). Thus, they are slightly less adept at interpreting the mental states conveyed in the Eyes Test photographs, especially negatively valenced emotional expressions since negative emotions reflect interpersonal difficulties and conflict.

Along similar lines, difficulties in inferring and interpreting others' emotions have been associated with a predominance of negative symptoms such as social anhedonia, withdrawal, and avolition (Corcoran, Mercer, & Frith, 1995). One explanation for this find is that reduced social contact stemming from negative symptoms contributes to poor

emotion interpretation abilities, such as facial affect recognition (Frith, 1992). However, there is currently scant direct evidence linking specific emotion recognition deficits to sub-clinical schizotypal features.

In reference to the factor analysis, the MagId scale yielded interpretable factors, which were (a) occult ideas, (b) non-realism, and (c) New Age ideas. Occult ideas items reflected various esoteric beliefs such as numerology (e.g., certain numbers having special powers), astrology (e.g., horoscopes), the use of rituals to ward off negativity, and the ability of spirits to influence the living. Non-realism items included perceptual oddities such as doubting that dreams are products of the mind, déjà vu, and the ability to harm others psychically by thinking bad thoughts about them. Items revealing New Age ideas reflected beliefs in reincarnation, government conspiracies (e.g., UFOs), and the ability to influence reality with thoughts. Using these factors as predictor variables in subsequent analyses revealed significant relationships that were not evident using the total MagId scores.

Non-realistic assessments of reality as reflected by the second MagId factor (non-realism) were associated with deficient performance in reading eye emotions (i.e. negative emotions) and character intentions. Perhaps more pronounced difficulties in disentangling inner subjective states from outer objective reality existed among participants with higher scores on the non-realism factor, which may aid in explaining the observed inaccuracies in labeling character intentions and certain eye emotions. A higher endorsement of New Age ideas was also linked to an impaired ability to read eye emotions (i.e. negative emotions). That certain individuals endorsing odd beliefs would be less adept at decoding negative emotions as opposed to positive emotions is also a

noteworthy find. Perhaps these individuals felt uneasy when presented with eye regions reflecting negative affect, which could have interfered with mental state inferences, but this issue will need to be more closely examined in future research.

No coherent factor structure emerged for the Eyes Test, most likely due to the wide range of emotional expressions included in response options. Similarity was noted among some of the emotions. For example, a "thoughtful" grouping was observed (thoughtful, contemplative, pensive, and reflective) along with a "worried" cluster (worried, uneasy, preoccupied, concerned) and a "suspicious" cluster (suspicious, skeptical, doubtful). However, the vast majority of response options were unrelated (e.g., flirtatious, nervous, despondent, regretful, accusing, defiant, playful, confident, serious, etc.), thus creating a hodgepodge of complex emotions, none of which could be meaningfully categorized using multivariate statistics.

This overly broad range of eye expressions resulted in substantial within-subject variance, which contributed to the incoherent factor matrix. In the development of future scales of this nature, it is suggested that emotional expressions be simplified and grouped under several basic emotion constructs (e.g., happy, sad, angry). This would facilitate the identification of a clearer factor structure and would allow researchers to investigate the possibility of differences in recognizing particular emotions.

In regards to the null results of analyses including the abbreviated SocAnh total as a predictor variable and the CIT as a dependent variable, there are several possible interrelated influences that may account for these findings. First, those participants who displayed truly deviant schizotypy scores ($SD \geq 1.96$) as defined in previous research (Kwapil, Miller, Zinser, Chapman, & Chapman, 1997) constituted an extremely small

percentage of the obtained mass testing sample. This resulted in limited high scorer recruitment options. Moreover, very few of the existing deviant scorers responded to email invitations and volunteered to participate, which forced the experimenter to lower the cutoff values. Lowering these established cut-points could have contributed to overly restricted variance on the dependent variables. Thus, an overall loss of power to detect meaningful differences between normal scorers and truly deviant scorers may have occurred.

Another cause for concern is the observation of strong ceiling effects on the CIT measure for the majority of participants, which contributed to loss of statistical power due to lack of variability in the scores. It is clear from the current results that the social inference items on the CIT may be too easy for normal college student populations. Thus, the CIT may not qualify as a sufficiently sensitive ToM measure in this particular context, especially given that the CIT was developed for use in clinical populations. Nonetheless, it is important to bear in mind the previously described limited recruitment options. Had there been a sufficient number of participants included scoring unusually high on the schizotypy measures ($SD \geq 1.96$), the CIT results may have been different.

In future studies, the validity of the Eyes Test and other existing ToM measures should be further assessed in both normal and high schizotypy populations. Additional cognitive assessments (i.e. IQ measures) should also be utilized. The present study did not measure general intellectual functioning or emotional intelligence, which may have accounted for a portion of variance in the dependent variables (i.e., the CIT and Eyes Test, respectively).

The stability of ToM ability should also be assessed over time with longitudinal studies. It may be the case that some people scoring high on schizotypy measures may go on to develop more severe psychopathology later (e.g. Kwapil, 1998), which may have a detrimental impact on social cognitive processes that may have otherwise remained intact. But it is also possible that a slightly impaired ToM ability may present itself early in the developmental process and become more impaired in those who transition into schizophrenia spectrum disorders. Such hypotheses should be tested in future research.

With a steady accumulation of improvements in measuring social cognition and ToM over time, it is hoped that the relationships between cognitive deficits and spectrum disorders will be solidified. It is incumbent upon researchers to understand the types of cognitive impairment observed in certain illnesses, for these deficits may stymie progress made in cognitive behavioral therapeutic interventions (Kerr, Dunbar, & Bentall, 2001). It is important to bear in mind that the degree of ToM impairment in certain forms of mental illness remains a controversial topic and depends on a wide array of interrelated factors that we are only now beginning to understand (Brüne, 2003).

TABLE 1

ABBREVIATED DIAGNOSTIC CRITERIA FOR SCHIZOTYPAL PERSONALITY DISORDER

Criteria
1. Ideas of reference (excluding delusions of reference).
2. Odd beliefs or magical thinking that influence behavior and are inconsistent with subcultural norms (e.g., superstitiousness, belief in clairvoyance, telepathy).
3. Unusual perceptual experiences, including bodily illusions.
4. Odd thinking and speech (e.g., vague, circumstantial, metaphorical).
5. Suspiciousness or paranoid ideation.
6. Inappropriate or constricted affect.
7. Behavior or appearance that is odd, eccentric, or peculiar.
8. Lacks close friends or confidants other than first-degree relatives.
9. Excessive social anxiety that does not diminish with familiarity and tends to be associated with paranoid fears rather than negative judgments about self.

TABLE 2

MEANS, STANDARD DEVIATIONS, SKEWNESS, STANDARD ERROR OF SKEWNESS, AND INTERCORRELATIONS FOR THE CHARACTER INTENTION TASK, THE ADULT READING THE MIND IN THE EYES TEST, AND THE SCHIZOTYPY PREDICTOR VARIABLES

Dependent Variable	*M*	*SD*	Skewness	*SE* Skewness	1	2
CIT	25.22	2.34	–1.97	.20	–.15	–.02
Eyes Test	28.85	3.17	–.36	.20	–.28**	–.18*
Predictor Variable						
1. Abbreviated MagId	3.20	2.15	.31	.20	--	.28**
2. Abbreviated SocAnh	3.08	1.87	.15	.20	.28**	--

Note. $N = 142$.

** $p < .01$ (two-tailed). * $p < .05$ (two-tailed).

TABLE 3

SUMMARY OF ITEMS AND FACTOR LOADINGS FOR VARIMAX ORTHOGONAL THREE-FACTOR SOLUTION FOR THE ABBREVIATED MAGICAL IDEATION SCALE (N = 142)

Item	Factor loading		
	1	2	3
9. At times, I perform certain little rituals to ward off negative influences.	**.802**	.047	.036
27. Horoscopes are right too often for it to be a coincidence.	**.715**	.120	.142
8. I have wondered whether the spirits of the dead can influence the living.	**.672**	.050	.013
24. Numbers like 13 and 7 have no special powers.	**.507**	.023	.101
4. I have never doubted that my dreams are the products of my own mind.	.209	**.708**	–.076
30. When introduced to strangers, I rarely wonder whether I have known them before.	–.074	**.688**	–.058
15. It is not possible to harm others merely by thinking bad thoughts about them.	.010	**.654**	.257
18. The government refuses to tell us the truth about flying saucers.	–.123	.092	**.833**
10. I have felt that I might cause something to happen just by thinking too much about it.	.259	.048	**.536**

TABLE 3 CONTINUED

13. If reincarnation were true, it would explain some unusual experiences I have had.	.434	−.322	**.536**

TABLE 4

EIGENVALUES, PERCENTAGES OF VARIANCE, AND CUMULATIVE PERCENTAGES FOR FACTORS OF THE ABBREVIATED MAGICAL IDEATION SCALE

Factor	Eigenvalue	% of variance	Cumulative %
1	2.45	24.45	24.45
2	1.52	15.17	39.62
3	1.15	11.49	51.11

TABLE 5

SUMMARY OF ITEMS AND FACTOR LOADINGS FOR VARIMAX ORTHOGONAL THREE-FACTOR SOLUTION FOR THE ABBREVIATED REVISED SOCIAL ANHEDONIA SCALE ($N = 142$)

Item	Factor loading		
	1	2	3
10. People sometimes think that I am shy when I really just want to be left alone.	**.753**	.022	–.163
27. I am usually content to just sit alone, thinking and daydreaming.	**.594**	.187	.197
1. Having close friends is not as important as many people say.	**.560**	–.194	.417
16. hen things are bothering me, I like to talk to other people about it.	.121	**.695**	–.066
24. I feel pleased and gratified as I learn more and more about the emotional life of my friends.	–.030	**.567**	.030
11. When things are going really good for my close friends, it makes me feel good too (cross-loading).	–.114	**.542**	**.501**
17. I prefer hobbies and leisure activities that do not involve other people.	.480	**.506**	.082
15. Just being with friends can make me feel really good.	–.020	–.045	**.809**

TABLE 6

EIGENVALUES, PERCENTAGES OF VARIANCE, AND CUMULATIVE PERCENTAGES FOR FACTORS OF THE ABBREVIATED REVISED SOCIAL ANHEDONIA SCALE

Factor	Eigenvalue	% of variance	Cumulative %
1	2.24	22.41	22.41
2	1.43	14.35	36.75
3	1.08	10.77	47.52

TABLE 7

REGRESSION ANALYSIS FOR SCHIZOTYPY VARIABLES

PREDICTING CHARACTER INTENTION TASK PERFORMANCE

Variable	*B*	*SE B*	β
Abbreviated MagId	–.17	.10	–.15
Abbreviated SocAnh	.03	.11	.02

Note. $N = 142$.

TABLE 8

REGRESSION ANALYSIS FOR SCHIZOTYPY VARIABLES PREDICTING THE ADULT READING THE MIND IN THE EYES TEST PERFORMANCE

Variable	*B*	*SE B*	β
Abbreviated MagId	–.37	.12	–.25*
Abbreviated SocAnh	–.19	.14	–.11

Note. $N = 142$.

* $p < .01$ (two-tailed).

FIGURE 1

SAMPLE DISTRIBUTION FOR THE CHARACTER INTENTION TASK TOTAL SCORES

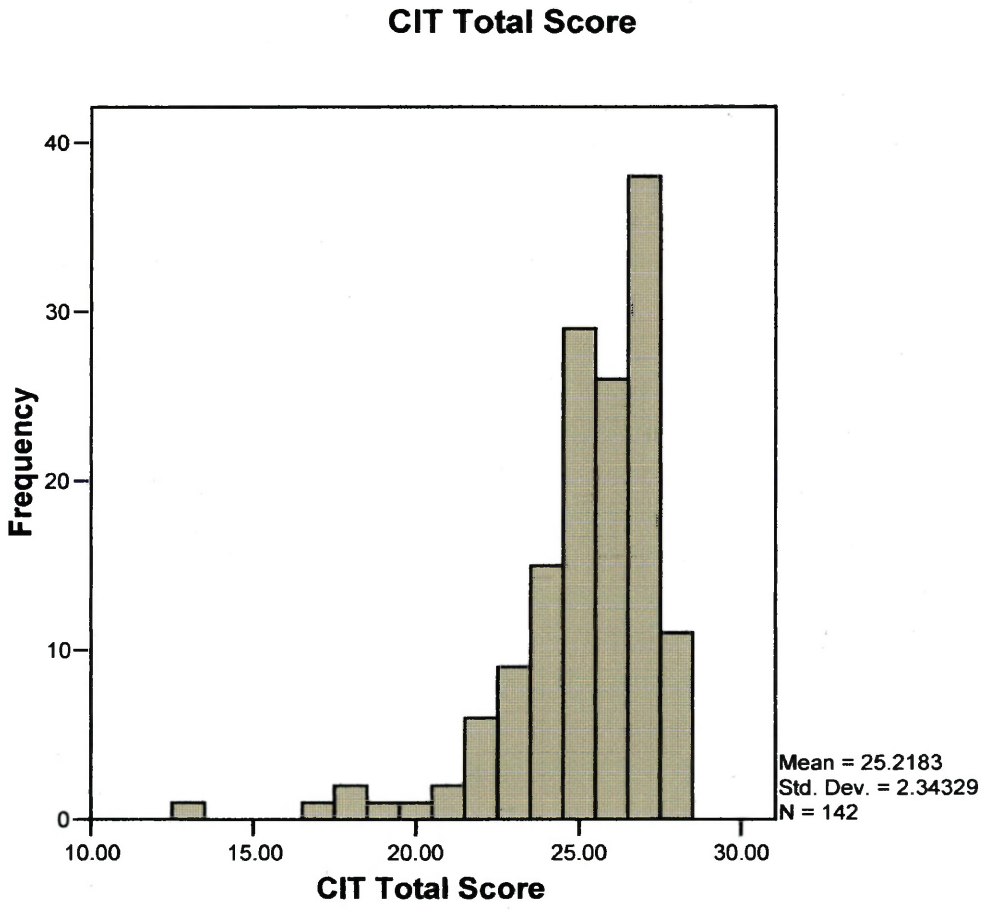
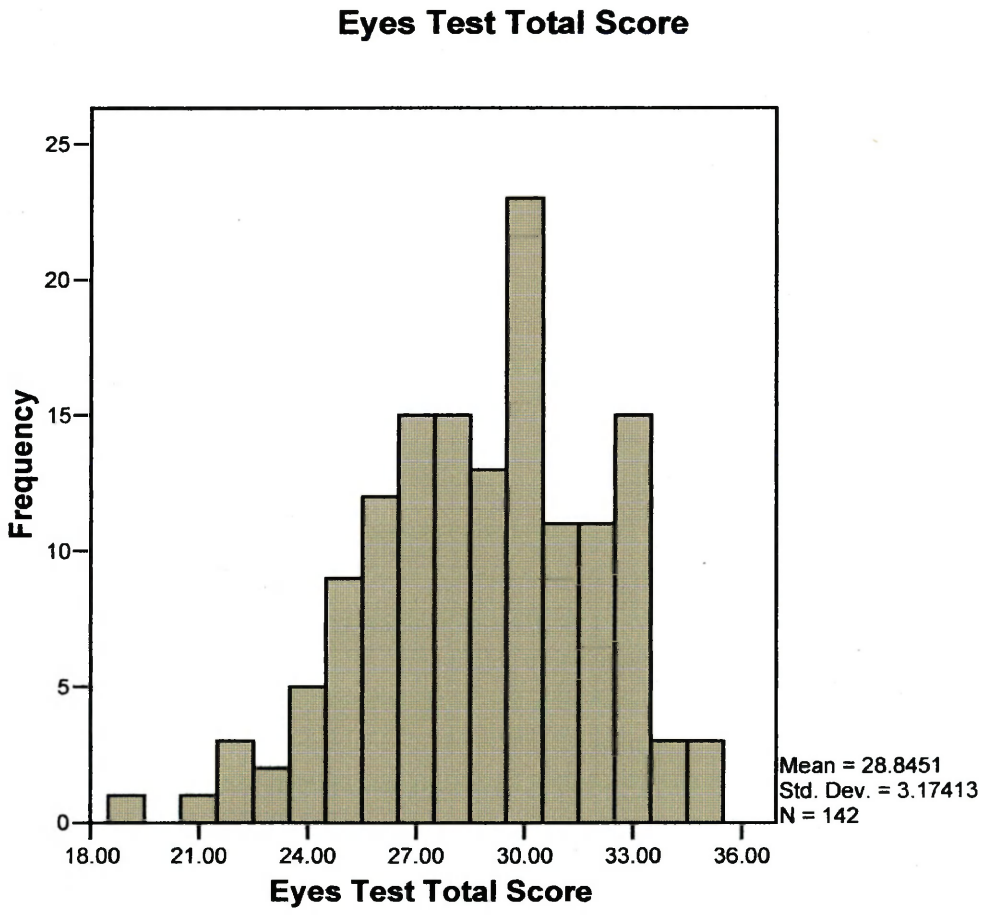


FIGURE 2

SAMPLE DISTRIBUTION FOR THE ADULT READING THE MIND IN THE EYES TEST TOTAL SCORES



APPENDIX A

INFORMED CONSENT

I, _____, hereby agree to participate in a research project conducted by Dr. Glenn Shean and his research assistant Joseph Meyer to investigate the nature of social cue perception in individuals scoring high and low on measures of ideation and social pleasure. I understand that all information obtained by or about me will be held in strict confidence and no information will be given that will identify me.

I understand that during this study, I will be first asked to view a series of short Powerpoint comic strip stories and to record what I think is the logical ending to each story. Next, I will be asked to view a series of Powerpoint slides with pictures of the eye regions of anonymous individuals and to record the emotion that I think the eyes are reflecting. These two tasks combined should take approximately one hour. I understand that participation in this study will have no risks, discomforts, or inconveniences to me as a participant and that there is no cost to this study other than my time.

I understand my participation in this research project is entirely voluntary. I may withdraw at any time during the session, and, if I have any questions, I may ask them at any time during the study. There will be no consequences for ceasing to participate at any time.

I understand that I will receive 1 research credit for my participation in this study.

I agree to participate in the study with full knowledge of the information presented above. I understand that I may withdraw at any time and that any questions I have will be answered by the researcher(s). I understand if I have any questions or problems about these procedures, I can direct them to Dr. Glenn Shean, Professor of Psychology at the College of William and Mary (office phone number: 221-3886 or email: gdshea@wm.edu).

Name (please print): _____ **Date:** _____
Signature: _____

APPENDIX B

ABBREVIATED MAGICAL IDEATION AND REVISED SOCIAL ANHEDONIA SCALE ITEMS

Instructions:
Please answer each item true or false. Please do not skip any items. It is important that you answer every item, even if you are not quite certain which is the best answer. An occasional item may refer to experiences that you have had only when taking drugs. Unless you have had the experience at other times (when not under the influence of drugs), mark it as if you have not had that experience. Answer each item individually, and don't worry about how you answered a somewhat similar previous item.

1. I have felt that I might cause something to happen just by thinking too much about it. (MagId 10)
2. Having close friends is not as important as many people say. (SocAnh 1)
3. When things are bothering me, I like to talk to other people about it. (SocAnh 16)
4. Numbers like 13 and 7 have no special powers. (MagId 24)
5. It's fun to sing with other people. (SocAnh 18)
6. When things are going really good for my close friends, it makes me feel good too. (SocAnh 11)
7. Horoscopes are right too often for it to be a coincidence. (MagId 27)
8. Just being with friends can make me feel really good. (SocAnh 15)
9. If reincarnation were true, it would explain some unusual experiences I have had. (MagId 13)
10. I am usually content to just sit alone, thinking and daydreaming. (SocAnh 27)
11. The government refuses to tell us the truth about flying saucers. (MagId 18)
12. It is not possible to harm others merely by thinking bad thoughts about them. (MagId 15)
13. Although I know I should have affection for certain people, I don't really feel it. (SocAnh 22)
14. When introduced to strangers, I rarely wonder whether I have known them before. (MagId 30)
15. People sometimes think that I am shy when I really just want to be left alone. (SocAnh 10)
16. I have never doubted that my dreams are the products of my own mind. (MagId 4)
17. I feel pleased and gratified as I learn more and more about the emotional life of my friends. (SocAnh 24)
18. I prefer hobbies and leisure activities that do not involve other people. (SocAnh 17)

19. I have wondered whether the spirits of the dead can influence the living. (MagId 8)
20. At times I perform certain little rituals to ward off negative influences. (MagId 9)

Note. Scale name and original scale item number noted in parentheses after each item.

APPENDIX C

VERBATIM INSTRUCTIONS FOR THE CHARACTER INTENTION TASK

"For each story appearing on the screen, choose the most logical ending. In the upper half of the screen will appear three images of comic strips which constitute a small story. They are read, as in a book, from left to right. In the lower half of the screen are three other images from which you will choose the best answer. Only one of them is the best logical ending to the story. You will have 15 seconds to choose the most logical answer. Do not attempt to make a humorous or complicated ending to the stories."

APPENDIX D

VERBATIM INSTRUCTIONS FOR THE ADULT READING THE MIND IN THE EYES TEST

"For each set of eyes, choose and circle on your answer sheet which word best describes what the person in the picture is thinking or feeling. You may feel that more than one word is applicable, but please just choose one word, the word you consider to be most suitable. Before making your choice, make sure that you have read all four words. You will have 18 seconds to respond to each slide. If you really don't know what a word means, you can look it up in the definition handout."

APPENDIX E

VERBATIM DEBRIEFING FORM

"I would like to thank everyone for their participation in this study. This research project is being conducted to investigate the nature of the relationships between personality characteristics dealing with how you perceive reality, the degree of pleasure that you experience in your social relationships, and your perception of social cues. The data are being aggregated and analyzed as group data and are thus anonymous, so I will not be able to provide anyone with individual feedback. However, if anyone would like a copy of the statistical results or final article, please give me your email and I will contact you after the project is completed. Thank you all again for your time."

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VITA

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Joseph Francis Meyer, III was born in Richmond, VA on May 18, 1980. He graduated from Frank W. Cox High School in Virginia Beach, Virginia in June 1998. Joseph Meyer graduated magna cum laude from the University of Richmond in Richmond, VA in May 2002 with a B.A. in Psychology and minored in Spanish.

In August 2003, the author entered the College of William and Mary as a graduate student in the Department of Psychology. Joseph Meyer defended his thesis in May of 2005. He plans to work for a year as a research assistant at Yale Medical School before pursuing a doctoral degree in Clinical Psychology.