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MAKING MEANING IN THE PRESENCE OF SUB-THRESHHOLD PSYCHOTIC SYMPTOMS: AN INVESTGATION OF METACOGNITIVE CAPACITY IN PSYCOMETRIC SCHIZOTYPY

For the degree of Master of Science

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MAKING MEANING IN THE PRESENCE OF SUB-THRESHOLD PSYCHOTIC  
SYMPTOMS: AN INVESTIAGTION OF METACOGNITIVE CAPACITY IN  
PSYCHOMETRIC SCHIZOTYPY

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For my mother.

## TABLE OF CONTENTS

	Page
LIST OF TABLES .....	iv
LIST OF FIGURES .....	v
ABSTRACT .....	vi
INTRODUCTION .....	1
Review of Literature .....	2
Schizophrenia .....	2
Schizotypy .....	3
Conceptualizations of Schizotypy .....	4
Metacognition .....	8
Metacognition in At-Risk Populations .....	11
Purpose of Study .....	11
METHODS .....	12
Participants .....	12
Measures .....	14
Analyses .....	18
RESULTS .....	21
Demographic Characteristics .....	21
Group Comparisons .....	22
Within-group Analyses .....	23
Post Hoc Analyses .....	25
DISCUSSION .....	27
REFERENCES .....	34

## LIST OF TABLES

Table	Page
Table 1. Demographic characteristics of sample .....	22
Table 2. Group comparisons of metacognition .....	23
Table 3. Hierarchal regression with social and metacognition predicting social functioning .....	24
Table 4. Correlations between metacognition, social cognition, and social functioning.....	25
Table 5. Chi square comparing attainment of complex metacognition between groups.....	26

## LIST OF FIGURES

Figure	Page
Figure 1. Diagram of Meehl's model of the developmental path of schizotypy .....	4
Figure 2. Flow chart of recruitment process for sample .....	14
Figure 3. Graph showing group totals for level of mastery achieved .....	26

## ABSTRACT

Davis, Beshawn J. M.S., Purdue University, May 2016. Making Meaning in the Presence of Sub-threshold Psychotic Symptoms: An Investigation of Metacognitive Capacity in Psychometric Schizotypy. Major Professor: Kyle S. Minor.

Schizophrenia is a complex and debilitating mental disorder characterized by a myriad of symptoms that affect multiple aspects of functioning. Metacognition, or the ability to form complex notions of oneself and others, has been evidenced to be deficient in schizophrenia. As such, one burgeoning line of research has sought to elucidate the role of metacognitive capacity on functional outcome across the schizophrenia spectrum. Although there is a substantial body of evidence about the role of metacognition in clinical manifestations of the disorder, few studies to date have explored whether similar deficits can be seen in individuals at risk for schizophrenia. One such at risk group is that of schizotypy wherein individuals demonstrate attenuated trait-like characteristics resembling less severe versions of those seen in psychosis. The aim of the current study was to investigate metacognitive capacities in this group. To that end, 67 participants were recruited (schizotypy= 34, control= 33) and two primary hypotheses were developed: 1) Individuals with schizotypy will exhibit significantly worse metacognition than a non-schizotypy group; and 2) Metacognition will account for additional variance above and beyond social cognition in predicting social functioning. Contrary to our hypotheses, group differences a metacognition and its subdomains were not significant.

Further, inconsistent with studies in chronic schizophrenia, metacognition did not significantly predict social functioning. Our findings suggest that metacognition is preserved in schizotypy



## INTRODUCTION

Schizophrenia is a complex and debilitating mental disorder characterized by a myriad of symptoms that affect multiple aspects of functioning. These symptoms can be divided into three clusters: 1) positive (e.g., hallucinations, delusions); 2) negative (e.g., anhedonia, avolition); and 3) disorganized (e.g., disorganized speech, disorganized behavior) (Liddle, 1987). Multiple domains of cognition are also affected in this schizophrenia (e.g., deficits in neurocognition, social cognition, and metacognition). Metacognition, or the ability to form complex notions of oneself and others, has been evidenced to be deficient in individuals with this illness (Lysaker et al., 2007). As such, one burgeoning line of research has sought to elucidate the role of metacognitive capacity on functional outcome across schizophrenia spectrum disorders. Although there is a substantial body of evidence about the role of metacognition in clinical manifestations of schizophrenia (Lysaker et al., 2010; Vohs et al., 2014; Minor et al., 2015), few studies to date have explored whether similar deficits can be seen in individuals at risk for the disorder. One such group at risk group is that of schizotypy wherein individuals demonstrate attenuated trait-like characteristics resembling less severe versions of those seen in psychosis. The aim of the current study is to investigate metacognitive capacities in this group

A thorough review of the literature will be presented to provide context for the current study. First, background information on schizophrenia will be shown. This will be followed by an overview of schizotypy and the ways it has been conceptualized. Next, a literature review of metacognition and its relation to other aspects of cognition and functioning will be conducted. Lastly, rationale for the current study of metacognitive capacity in schizotypy will be presented.

## Review of Literature

### Schizophrenia

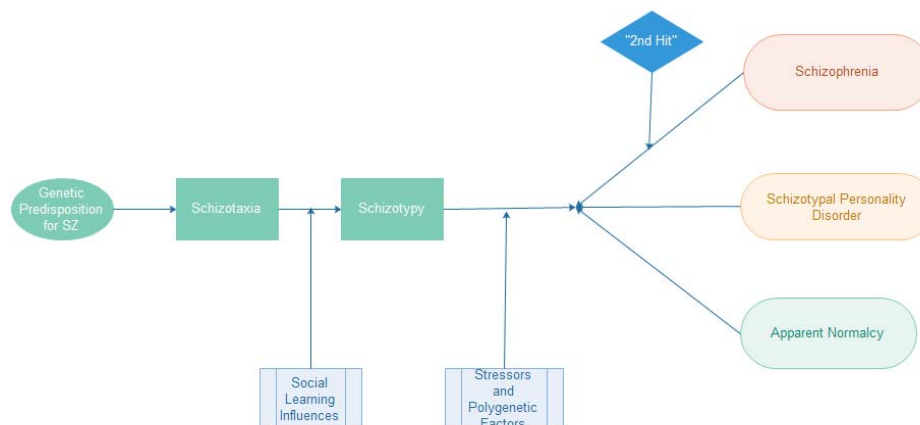
Schizophrenia is a complex and debilitating psychiatric disorder that affects around 1% of the population (American Psychological Association, 2000). The pathology of the illness is represented by three symptom clusters: positive, negative, and disorganized and has a wide variety of clinical manifestations (Liddle, 1987).

Deficits in multiple domains of cognition (i.e., social cognition, metacognition, and neurocognition) have also been evidenced among individuals with schizophrenia and are often the targets of psychotherapeutic intervention (Lysaker et al., 2011; Bell & Lysaker, 1997; Corcoran et al., 1995; Keefe et al., 2004). In this context, neurocognition refers to the complex array of mental skills used in everyday functioning such as working memory and processing speed (Keefe et al., 2004). Social cognition refers to the integrative process of synthesizing information from multiple cognitive processes (i.e., theory of mind, emotional processing, and attributional bias) required for social interaction and perception (Corcoran et al., 1995; Lysaker et al., 2011; Bell & Lysaker,

1997). The ability to form complex ideas about oneself and others, referred to as metacognition, is also integral in social functioning, and deficits therein could contribute to both the etiology and maintenance of psychopathology (Lysaker et al., 2011; Lysaker et al., 2005).

### Schizotypy

Schizotypy is an at-risk personality structure with trait-like positive, negative and disorganized symptoms akin to those seen in chronic psychosis but at a less severe level. Meehl (1962) was the first to conceptualize schizotypy, postulating that these individuals possessed a genetic predisposition for developing schizophrenia. Further, individuals with schizotypy have been shown to demonstrate similar, albeit attenuated, deficits as those with schizophrenia on a variety of social and neurocognitive measures (Lenzenweger, 2006; Meehl, 1962, 1990). Meehl also proposed that there were three potential outcomes for individuals with schizotypy: 1) the development of schizophrenia due to the interaction between a genetic predisposition and environmental factors, 2) a non-psychotic schizotypal state (e.g., schizotypy or schizotypal personality disorder), or 3) 'apparent normalcy' due to the presence of protective factors (Figure 1). This at-risk model of psychosis was a precursor to the diathesis-stress models that have dominated the field of schizophrenia research for the past four decades.



*Figure 1. Diagram of Meehl's model of the developmental path of schizotypy.*

### Conceptualizations of Schizotypy

Many different conceptualizations of this at risk phenotype have emerged since Meehl originally proposed his theory. One such example is that of familial risk methods of identification. These methods are based upon the notion that there is a genetic component which contributes to the etiology of schizophrenia and schizotypy. This claim is widely supported in the literature through twin studies, and through familial studies of individuals with schizophrenia (Kety et al., 1968; Kety et al., 1975; Kety et al., 1994; Ingraham, 1995). The results of several twin studies found higher levels of schizotypal personality disorder and schizotypy in relatives of twins with schizophrenia (Torgersen, 1984). Familial studies have evidenced an increased risk for the development of schizotypy and schizophrenia in relatives of people with schizophrenia when compared to a control group (Ingraham, 1995). However, it is important to note that familial methods of identification are not without flaws. The most crucial of which is that they do not

account for the estimated 40-50% of individuals that display attenuated psychosis symptoms that do not have a family history of psychosis (Chapman et al., 1994).

One model which accounts for individuals without a family history of schizophrenia is that of clinical high risk; a period where individuals experience attenuated psychosis symptoms accompanied by a marked decline in social functioning and subsequent help-seeking behaviors. There is significant empirical support for this at risk model of psychosis (Yung et al., 2003; McGorry et al., 2013; Fusar-Poli et al., 2014), with some calling for the creation of a new DSM diagnosis called attenuated psychosis syndrome (APS; Fusar-Poli et al., 2014). In spite of evidence that people identified as clinical high risk are more likely to develop psychosis, there are some crucial limitations to this method. One such limitation is the time cost associated with the use of clinical interviews such as the Structured Interview for Psychosis Risk Syndromes (SIPS; Miller et al., 2003), the gold standard for identifying individuals with APS. Another limitation is that this method fails to capture people who do not engage in help-seeking behaviors, as is the case in psychometric schizotypy.

Another method of identifying individuals at risk for psychosis is the use of psychometric measures which were developed based on schizotypal personality disorder criteria. Psychometrically defined schizotypy has commonly been assessed using the Chapman Scales which divide schizotypal symptoms into five categories: impulsive nonconformity, magical ideation, perceptual aberration, physical anhedonia, and social anhedonia (Chapman et al., 1994). A longitudinal study using these scales found that deviant scores on magical ideation scale and/or elevations on the social anhedonia scale were predictive of schizophrenia, bipolar disorder, and psychosis NOS at ten year follow-

up (Chapman et al., 1994). Subsequent studies revealed that subjects with elevations on both of these scales were at an increased risk for developing mental disorders (Kwapli et al., 1997). Although the results of the two aforementioned studies are promising, it is important to note that the Chapman scales are lacking in specificity regarding which mental disorders will later be developed by individuals with abnormal scores. Moreover, only two of the five scales have been found to be associated with a future diagnosis of schizophrenia. Finally, administering these scales is more time consuming than other screening measures such as the Schizotypal Personality Questionnaire (Raine et al., 1991).

The Schizotypal Personality Questionnaire (SPQ) is another commonly used measure used for schizotypy screening. It consists of 74 self-report items and adheres to a three factor model of schizotypy consisting of positive, negative, and disorganized traits akin to the three clusters of symptoms seen in schizophrenia (Liddle, 1987). This three factor model of schizotypy has been used ubiquitously in the field of psychometric schizotypy and has been confirmed by several factor analytic studies (Kerns et al., 2006; Bentall et al., 1989). Due to its brevity the SPQ allows researchers to quickly screen large samples for schizotypal traits. Further, since it does not require any formal training to administer, the SPQ can be given by virtually anyone in a community setting.

Although psychometric schizotypy measures have been developed based on schizotypal personality disorder's DSM criteria, it is important to note that psychometric schizotypy is not synonymous with schizotypal personality disorder. SPD and schizotypy are characterized by similar symptoms (i.e., cognitive or perceptual distortions, odd speech or thinking, ideas of reference, etc.); however, in contrast to schizotypy, SPD is a

formal DSM diagnosis. Evidence of SPD's linkage to schizophrenia is tenuous at best, as it has also been found to be related to depression, borderline personality disorder, bipolar disorder, and atypical psychosis (McGlashan et al., 2000). Due to the opacity of the nature of the relationship between SPD and schizophrenia, researchers have been reluctant to use SPD criteria in studies of individuals at risk for formal psychosis. This method of identification also requires a formal clinical interview in order to diagnose SPD. As such, researchers tend to prefer psychometric schizotypy or clinical high risk methods for time and empirical support considerations, respectively.

The use of psychometric measures to identify individuals at risk for the development of psychosis allows researchers to capture a wider range of symptomatology and to intervene earlier on the developmental path of psychosis than familial or clinical high risk methods. Further, a recent study found that at least 77% of individuals identified as at-risk using psychometric schizotypy measures reported at least one clinically significant psychotic-like experience according to a gold standard clinical high risk interview (Cicero et al., 2014). This finding supports the notion that there is significant overlap between the individuals identified with these two methods of identification. Lastly, psychometric schizotypy measures allow researchers to reliably screen large populations in a relatively short period of time. It is for these reasons that we chose to use the SPQ to screen for schizotypy instead of measures associated with the clinical high-risk literature or the DSM V criteria for schizotypal personality disorder.

### Metacognition

Metacognition can broadly be defined as awareness of and insight into one's own cognitive processes ( i.e., thinking about thinking). There is some debate in the literature over whether this definition of the construct is comprehensive enough, with some simply defining it as the process of thinking about thinking (Thielsch, Andor, & Ehring, 2015), and others adding an additional layer of complexity and conceptualizing it as insight into one's own cognitive processes and emotions (Barkus et al., 2005).

While both of these definitions are adequate, neither takes into account the role of these insights in developing coping skills and in social interactions. Simply being aware of one's own patterns of thinking and feeling inevitably changes the way one interacts with others and their environment, ultimately leading to the development of compensatory behaviors (i.e., coping strategies). These coping strategies can vary greatly in complexity and efficacy, ranging from simple avoidance to changing the way one thinks about a situation (Lysaker et al., 2005). Another limitation of these conceptualizations is that they fail to consider the social cognitive process of theory of mind, which is understanding the intentions and emotions of others as well as how they perceive oneself (Corcoran et al., 1995). This process requires a fair amount of empathy and awareness that other viewpoints exist than one's own. Lastly, while these models of metacognition are sufficient for high functioning individuals they fail to account for factors that hinder this capacity in psychotic spectrum disorders such as schizophrenia. One such example is that of ego-centrism which is the failure to understand that events in the world occur independent of oneself and that other viewpoints exist than one's own.



The model of metacognition which was used in the present study encompasses both of the definitions mentioned previously, and adds social cognitive and coping components.

This multi-faceted model of metacognition is essentially a gestalt of social cognition, insight, ego-centrism, and coping skills. As such, it is divided into four distinct domains: self-reflectivity (the awareness and understanding of one's mental states), awareness of others' mental states (theory of mind), decentration (understanding that others' interests and motives are independent of oneself), and metacognitive mastery (ability to integrate knowledge of both others and one's own mental states to respond to psychological distress (Lysaker et al., 2005).

Deficits in each subdomain of metacognitive capacity have been evidenced across the schizophrenia spectrum (Vohs et al., 2014; Lysaker et al., 2005; Hamm et al., 2012; Minor & Lysaker, 2014). Self-reflectivity has been shown to be associated with other assessments of awareness of mental illness and cognitive insight such as the Scale to Assess Unawareness in Mental Disorder (SUMD; Lysaker et al., 2005; Lysaker et al., 2008). It has also been shown to be predictive of job performance in work placements over a six month period, even after controlling for the effects of neurocognition (Lysaker et al., 2010). Metacognitive mastery has been linked with a variety of factors such as coping strategies, self-esteem, and functional capacity (Lysaker et al., 2011). Recent evidence suggests that mastery may mediate the effect of neurocognitive impairments on social functioning (Lysaker et al., 2010) so it may be a useful target for therapeutic intervention. This notion is further supported by another recent study which found that mastery was predictive of therapeutic alliance (Davis et al., 2011).

Other studies in patients with chronic schizophrenia suggest that deficits in metacognition may have a trait like structure. In particular, global metacognition and metacognitive mastery have been shown to be stable over six and five month periods, respectively (Hamm et al., 2012; Lysaker et al., 2011). These deficits have also been demonstrated in the period shortly after the first episode of psychosis (FEP; Vohs et al., 2014). The results of this study also suggest that metacognitive abilities, specifically awareness of others and decentration, are more impaired in FEP than chronic psychosis.

Although this model of metacognition has proven to be predictive of a myriad of factors which contribute to functional outcome in schizophrenia (e.g., social functioning, quality of life, self-esteem, etc.), its relationship with other domains of cognition (i.e., neurocognition and social cognition) have only recently begun to be explored.

Metacognition and social cognition have proven to be separate, albeit related, constructs that equally contribute to social functioning. Evidence for this comes from a recent study which utilized principle component analysis and found that these constructs were independent of one another (Lysaker et al., 2013; Lysaker et al., 2014). This study also explored each construct's relationship with clinical outcomes and found that social cognition was highly correlated with negative symptoms while metacognition was linked to social functioning. Lastly, recent findings suggest that the relationship between neurocognition and metacognition may be moderated by disorganized symptoms such as conceptual disorganization (Minor & Lysaker, 2014; Minor et al., in press).

### Metacognition in At-Risk Populations

Few studies to date have examined whether metacognitive deficits are present in individuals at risk for the development of psychosis. Further, studies of metacognition in this population have typically utilized a more generic conceptualization of the construct. One such example is the definition used by Barkus and colleagues (2005) in a study comparing schizotypy and clinical high risk groups to one another on metacognition and distress tolerance, “Metacognitive processes can be defined as the awareness of, and internal commentary on, thoughts, feelings, and experiences both internally and within the social world.” This definition embodies the “self-reflectivity” and “awareness of others” components of the construct, but fails to incorporate the application of this knowledge (i.e., “mastery”). Another weakness of other studies of metacognition in schizotypy is that they rely solely on self-report measures of metacognition (Cartwright-Hatton & Wells, 1997). The use of such measures assumes that all subjects are high in insight and fails to take into account the potentially confounding effects of social desirability bias. This was the first schizotypy study to address these concerns by relying on clinician ratings of metacognition utilizing a well validated scale of metacognitive capacity known as the Metacognition Assessment Scale-Abbreviated (MAS-A; Lysaker et al., 2005).

### Purpose of Study

Due to the dearth and limitations of previous studies, the aim of this study was to elucidate the nature of the relationship between metacognition and schizotypy. To that end, we developed two hypotheses based off of prior literature: 1) Individuals with

schizotypy will exhibit significantly worse metacognition than a non-schizotypy group;

2) Similar to chronic schizophrenia, we predict metacognition to account for additional variance above and beyond social cognition in predicting social functioning. Two exploratory hypotheses were also investigated: a) Within the schizotypy group, metacognitive deficits would be associated with disorganized, but not positive or negative traits; b) Decentration and awareness of others would be the domains of metacognition most strongly associated with social cognition and functioning

## METHODS

### Participants

A sample of first year college undergraduates (n=904) completed a screening survey online as a part of the research requirement for their introductory psychology course. Students could also participate in the study to obtain extra credit for other courses. Of this initial sample, participants who score 1.65 standard deviations above the mean on the positive, negative, or disorganized subscales on a psychometric schizotypy measure were recruited for the schizotypy group, and those that score below the mean on the overall scale were recruited for the non-schizotypy group (Figure 2). Similar strategies have been shown to be effective in previous schizotypy studies (Chapman et al., 1994; Cohen, Morrison, Brown, & Minor, 2012; Kwapil et al., 1997; Minor & Cohen, 2010). Upon study completion, 34 schizotypy and 33 non-schizotypy participants completed all parts of testing and were included in the final sample (see Figure 2).

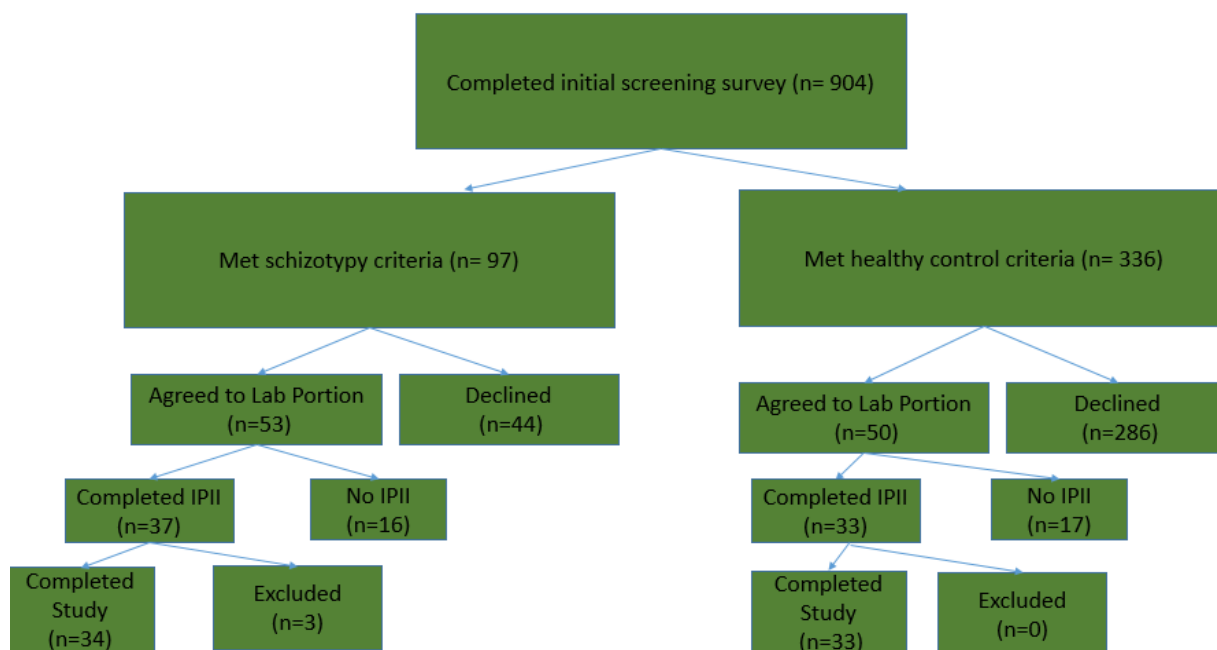


Figure 2. Flow chart of recruitment process for sample.

## Measures

### Schizotypy

The Schizotypal Personality Questionnaire was used to assess schizotypy in our sample. It consists of 74 items and is divided into nine categories which map onto the DSM-IV diagnostic criteria for schizotypal personality disorder (American Psychiatric Association, 1994; Raine et al., 1991). These nine categories are ideas of reference, odd beliefs, odd or eccentric behavior, excessive social anxiety, unusual perceptual experience, no close friends, odd speech, constricted affect, and suspiciousness. These

nine categories map onto three subscales: disorganized (odd or eccentric behavior and odd speech), negative (no close friends and constricted affect), and positive traits (ideas of reference, odd beliefs, suspiciousness, and unusual perceptual experiences). We omitted social anxiety from the calculations for negative traits to avoid identifying people for whom social anxiety was the driving factor for their scores. (Cohen & Matthews, 2010). A total score is calculated by summing scores from each subscale. The SPQ has demonstrated high internal consistency among items (0.91), strong test-retest reliability (0.82), and has demonstrated both convergent and discriminant validity (Raine et al., 1991). We administered the SPQ in a five point Likert scale format with responses ranging from 1 (“strongly disagree”) to 5 (“strongly agree”) as opposed to the traditional forced-choice format to capture a continuum of symptom expression.

### Metacognition

The Metacognition Assessment Scale-Abbreviated was used to assess metacognitive capacity in our sample. It is a rating scale used to identify an individual’s ability to form complex and integrated concepts of oneself and others (i.e., metacognition). It was originally developed to detect metacognitive growth across therapy sessions (Semerari et al., 2003), but has been adapted to assess metacognition using narrative transcripts (Lysaker et al., 2005). The MAS-A consists of four scales which are rated in a Likert scale format: 1) “self-reflectivity” which is the ability to understand one’s internal mental states; 2) “understanding of others’ minds” which is the ability to infer and understand others’ mental states; 3) “decentration” which represents the understanding that others’ interests and motives are independent of oneself; 4)

“mastery” which measures the ability to use metacognitive knowledge about oneself and others to cope with psychological distress. Raters indicated whether participants have demonstrated a particular level of functioning for each scale in a hierarchical manner. Fully demonstrating a particular level of functioning grants a score of “1” while partial or equivocal presence is given a “.5” or “0”. The highest score for each scale varies: 9 for “self-reflectivity”; 7 for “understanding of others’ minds”; 3 for “decentration”; 9 for “mastery.” Total score values range from 0 to 28, with higher scores being reflective of more complex notions of oneself and others and the ability to apply this knowledge appropriately. The subscales and total score of the MAS-A have evidenced significant intraclass correlations ranging from  $r=0.61$  for decentration to  $r=0.93$  for total score (Lysaker et al., 2007). The measure also has significant test retest reliability for each with values ranging from 0.70 to 0.88 for each subscale (Lysaker et al., 2007). To our knowledge, this is the first study to assess metacognition using the MAS-A in a schizotypy sample.

The Indiana Psychiatric Illness Interview was used as the basis for MAS-A ratings of metacognitive capacity. It is a semi-structured clinical interview originally developed to assess how individuals understand their experience with mental illness (Lysaker et al., 2002). However, it is currently used as the basis for the assessment of metacognition using the Metacognition Assessment Scale- Abbreviated. Due to the unique characteristics of our sample (i.e., no prior history of mental illness) a modified version of this measure was developed; wherein, participants were asked to describe a traumatic or stressful life event that occurred within the past two years. All subsequent questions referenced this period of distress. The IPII is divided into five sections: 1) initial rapport



is established as participants are asked to tell the detailed story of their lives, beginning with their earliest memory; 2) participants are then asked to describe a period of psychological distress that occurred within the past two years, and how this event influenced different aspects of their lives; 3) participants are then asked the degree of control this illness has over their lives and what efforts they take to control it; 4) participants are asked how their condition affects and is affected by others; 5) participants are asked about their future expectancies. These interviews typically took between fifteen to forty minutes to complete and were audio-recorded and administered by trained graduate students.

### Social Cognition

The Bell Lysaker Emotion Recognition Task consists of 21 video clips and is designed to measure participants' ability to recognize positive, negative, and neutral affect (Bell et al., 1997). Individuals are presented with each video clip and asked which of seven emotions (disgust, fear, no emotion, happiness, sadness, anger, and surprise) the actor is portraying based off of vocal tone and facial expression. Participants earn a score of one for each emotion that is correctly identified, and no points for those that are incorrect. The BLERT has been used in prior research on social cognition in schizotypy and has demonstrated strong test-retest reliability over a five month period ( $r=0.76$ ; Bell & Lysaker, 1997).

The Hinting Task was used to assess theory of mind (i.e., the ability to understand the mental states of others) in our sample. It consists of ten brief vignettes where participants are asked to make judgments about the implicit intentions of one of the

characters in the story based on hints embedded in the story (Corcoran et al., 1995). A score of two is earned if the participant identifies the implicit intention on the first try and a score of one is earned if the correct answer is given after an explicit hint. Scores on this task can range from 0 to 20 with higher scores reflecting better theory of mind. This task has good face validity and has been used to measure theory of mind in schizophrenia and schizotypy (Corcoran, 2003; Fernyhough et al., 2008).

### Quality of Life

The World Health Organization Quality of Life-BREF (WHOQOL-BREF; WHOQOL Group, 1998) is a 26 item measure that was used in this study to examine current functioning. It assesses four domains of functioning: physical health, mental health, social relationships, and environment. The questions use a 5 point Likert scale format and scores for each domain range from 0-100 with higher score indicating higher quality of life. Cronbach's alpha values for each domain are generally high, ranging from 0.68 for social relations and 0.82 for physical health (Skevington et al., 2004).

### Analyses

#### Group Comparisons

To determine if any demographic variables must be controlled for in subsequent analyses, group comparisons of age, sex, race, ethnicity, and years of education were completed prior to the main analyses. Group differences on age and years of education were compared using independent *t*-tests; sex, race, and ethnicity differences were explored

using a chi squared test. If significant differences on any of these factors are observed, they were controlled for to remove their potentially confounding effects on later analyses.

### Statistical Analyses

Hypothesis I: Metacognition would be lower in the schizotypy group.

To test this hypothesis, I conducted an independent *t*-test comparing total MAS score for the schizotypy and control groups. Based on prior literature, I expected that the schizotypy group will demonstrate lower metacognition, on the order of a small to medium effect size, compared to the non-schizotypy group.

Hypothesis II: Metacognition will account for additional variance, above and beyond social cognition, in predicting social functioning.

This hypothesis was tested using a hierarchal regression; wherein, social cognition (i.e., BLERT and Hinting task scores) was entered in at the first step, and metacognition (i.e., MAS-A ratings) was entered in at the second step. I anticipated that both the  $\Delta R^2$  value and  $\beta$  value for metacognition would be significant in the second step.

Hypothesis III : Within the schizotypy group, metacognition would be associated with disorganized but not positive or negative traits.

This hypothesis was tested by calculating Pearson product-moment correlations which measures the linear relation between variables. I anticipated that there would be a significant inverse relationship between total metacognition and disorganized schizotypy traits.

Hypothesis IV: Decentration and awareness of others would be the domains of metacognition most strongly associated with, social cognition, and functioning.

This hypothesis was also tested by calculating Pearson product-moment correlations. I expected that there would be significant positive relations between decentration and awareness of others with functioning and other aspects of cognition.

Post hoc Analyses: Group would differ in rates of higher level metacognition.

Post hoc analyses were analyzed using chi-squared tests to compare group proportions in achieving higher order metacognition on the self-reflectivity, awareness of others, and mastery subscales of the MAS-A. I expected that the non-schizotypy group would achieve higher order metacognition more often than the schizotypy group.

#### Power Analysis

Power analyses were conducted for each of the primary analyses using G\*Power 3.1.9.2. The results of which suggest that the amount of subjects we had in each group (n=34, n=33) allowed for the detection of medium to large effect sizes for hypotheses I and II (t tests: Means: difference between two independent means, two tailed,  $\alpha=.05$ ,  $\beta=0.80$ ; Linear multiple regression:  $R^2$  deviation from zero,  $\alpha=.05$ ,  $\beta=0.80$ , predictors= 3) and large effect sizes for hypotheses III and IV (Correlation: Bivariate normal model,  $\alpha=.05$ ,  $\beta=0.80$ ).

## RESULTS

### Demographic Characteristics

Groups were compared on highest level of education achieved, race, ethnicity, sex, and age to determine similarity and to prevent the potentially confounding effects of demographic features on subsequent analyses. Groups did not significantly differ on level of education achieved ( $X^2_{(5)}= 4.93, p =0.42$ ), race ( $X^2_{(5)}= 7.24, p= 0.20$ ), ethnicity ( $X^2_{(5)}= 0.15, p= 0.69$ ), sex ( $X^2_{(1)}= 0.971, p= 0.32$ ) or age ( $t_{(66)}= -1.89 p= 0.06$ ). Since no significant group difference were observed, demographic variables were not controlled for. A more thorough breakdown of demographic characteristics can be found in Table 1.

Table 1. Demographic characteristics of sample

Characteristic		Schizotypy	Non-schizotypy
		N=34	N=33
<b>Average Age (+/-SD)</b>		20.09(1.96)	19.32(1.29)
<b>Sex</b>			
	Male	53%	64%
	Female	47%	36%
<b>Hispanic/Latino</b>			
	Yes	12%	9%
	No	88%	91%
<b>Race</b>			
	Non-Caucasian	30%	12%
	Caucasian	70%	88%
<b>Level of education completed</b>			
	<One year of college	34%	49%
	≥One year of college	66%	51%

#### Group Comparisons

Hypothesis I: Metacognition will be lower in schizotypy.

An independent samples *t*-test was conducted to compare groups on levels of metacognition. The results revealed no significant differences between schizotypy,  $M(SD)= 14.42(3.19)$ , and non-schizotypy,  $M(SD)= 15.09(4.36)$  groups on total metacognition score,  $t_{(67)}= 0.713, p= 0.47$ . Follow-up analyses revealed that there weren't any differences between groups on the self-reflectivity,  $t_{(65)}= -0.15, p= 0.87$ , awareness of others,  $t_{(65)}= 1.01, p= 0.31$ , decentration,  $t_{(65)}= 0.60, p= 0.54$ , or mastery,  $t_{(65)}= 1.12, p= 0.26$ , subscales (Table 2). Thus, hypothesis I was not supported.

Table 2. Group comparisons of metacognition.

Schizotypy		Non-schizotypy		
		M	SD	
<b>Self-Reflectivity</b>		5.47	1.41	5.49 1.69 NS
<b>Awareness of Others</b>		3.36	0.78	3.59 1.01 NS
<b>Decentration</b>		0.79	0.49	0.89 0.82 NS
<b>Mastery</b>		4.79	1.32	5.19 1.6 NS
<b>Total Metacognition</b>		14.42	3.19	15.09 4.36 NS

#### Within-group analyses

Hypothesis II: Metacognition will account for additional variance above and beyond social cognition in predicting functioning in the schizotypy group.

A hierarchal regression was performed to evaluate whether metacognition would predict social functioning above and beyond social cognition. Emotion recognition and theory of mind were entered in at step 1 followed by total metacognition score at step two (Table 3). The results of this analysis revealed that none of these variables significantly predicted social functioning either individually or collectively. Therefore, there was not sufficient evidence to support hypothesis II.

Table 3. Hierarchical regression with social and metacognition predicting social functioning

Social Functioning		B	SE	R <sup>2</sup>	p-value
<b>Model 1</b>				0.02	
	Emotion Recognition	0.097	1.944		0.96
	Theory of Mind	2.149	2.725		0.436
<b>Model 2</b>				0.034	
	Emotion Recognition	0.101	1.961		0.959
	Theory of Mind	2.168	2.75		0.437
	Total Metacognition	-0.768	1.136		0.505

Hypothesis III: Within the schizotypy group, metacognition will be most strongly related to disorganized traits

A correlation matrix was generated to compare the relations of metacognitive domains with schizotypy traits in the schizotypy group. The predicted relationship between metacognition and disorganized traits was not observed ( $r = -0.08, p > 0.05$ ); however, there was a significant relationship between awareness of others and negative schizotypy ( $r = -0.40, p = 0.019$ ) and a trend level relationship between decentration and negative schizotypy ( $r = -0.33, p = 0.05$ ). Based on these findings, hypothesis III was not supported.

Hypothesis IV: Within the schizotypy group, decentration and other awareness will be related to social cognition and functioning.

Pearson correlations were calculated to explore the relationships between the sub-domains of metacognition and social functioning and cognition. Since no significant



relations were detected between any of the components of metacognition and social functioning (Table 4), Fishers  $r$  to  $z$  tests were not conducted. Thus, hypothesis IV was not supported.

*Table 4. Correlations between metacognition, social cognition, and social functioning.*

Construct	1	2	3	4	5	6	7
<b>1. Self-reflectivity</b>	X						
<b>2. Awareness of Others</b>	0.26	x					
<b>3. Decentration</b>	0.29	0.61**	X				
<b>4. Mastery</b>	0.66**	0.37**	0.42*	x			
<b>5. Social Functioning</b>	-0.32	0.16	0.17	-0.09	x		
<b>6. Emotion Recognition</b>	0.08	-0.07	-0.18	0.03	-0.002	x	
<b>7. Theory of Mind</b>	0.01	-0.08	0.06	0.03	0.14	-0.08	x

\* $p < 0.05$ , \*\* $p < 0.01$

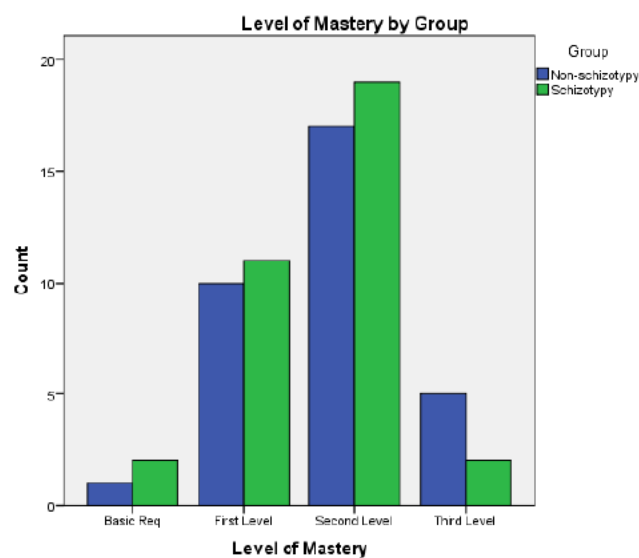
#### Post-Hoc Analyses

In light of the lack of support for our hypotheses, post hoc analyses were conducted to explore group differences in metacognition. There appeared to be a higher number of individuals in the non-schizotypy group who demonstrated higher levels of metacognitive mastery, awareness of others, and self-reflectivity so I recoded the each of these variables based on Semerari's (2002) definitions of levels of metacognition. Once this was completed, I ran chi squared tests of independence to assess whether group differences existed in terms of the proportion of individuals attaining higher levels of metacognition. Self integration was defined as having a score of greater than six on the self-reflectivity subscale of the MAS-A, Other integration was defined as a score of greater than 4, and higher order master was greater than six. The results of these analyses

exhibited no significant differences for any of the subdomains (Table 5). There did appear to be a higher proportion of individuals in the non-schizotypy group that achieved the highest level of mastery, nevertheless, these differences did not reach the level of significance (Figure 3).

*Table 5. Chi square comparing attainment of complex metacognition between groups.*

Variable	Chi-square	DF	P
Self Integration	0.029	1	0.866
Other Integration	1.089	1	0.297
Higher order Mastery	1.763	3	0.623



*Figure 3. Graph showing group totals for level of mastery achieved.*

## DISCUSSION

This was the first study to date to explore the relationship between metacognition and psychometric schizotypy using the conceptualization proposed by Semerari et al (2003). We sought to extend previous findings of diminished metacognitive capacity found in chronic and early psychosis (Lysaker et al., 2007; Vohs et al., 2014) to schizotypy, a group known to be at risk for the development of schizophrenia. Contrary to our hypotheses, college students with schizotypy did not differ from a non-schizotypy group in terms of total metacognition or any of its subdomains. Additionally, subsequent analyses exploring metacognition's ability to predict social functioning produced null findings. Surprisingly, inconsistent with our third hypothesis (i.e., metacognition being most strongly related to disorganized traits), the awareness of others and decentration subscales of metacognition were significantly related to negative (but not positive or disorganized) schizotypy traits. We also found that our hypothesis regarding metacognition's relationship with social cognition and functioning was not supported. Lastly, post hoc analyses exploring if a ceiling effect was present in the schizotypy group yielded null results as well.

Our results are inconsistent with other studies which have explored the relationship between metacognition and schizotypy (Chan et al., 2015; Stirling et al., 2007); however, this may be due to differing conceptualizations of metacognition used in

the literature. Our perspective, which views metacognition as a holistic process which encompasses the integration of interpersonal and intrapersonal knowledge to aid in coping with distress (Semerari et al., 2005), seems to be more intact in this population. Perspectives viewing metacognition simply as the awareness of and appraisal of one's own thoughts appear to be deficient in schizotypy (Barkus et al., 2005; Chan et al., 2015). Though these constructs share the same name, it seems likely that they occur independently of one another in schizotypy. Based on the literature, it appears that the ability to evaluate and assign value to one's thoughts deteriorates earlier in the development of psychosis, and that one's notions of self and other remains intact until their first episode of psychosis. One additional explanation for differences in the deterioration of these abilities could relate to the measures being used to assess metacognition using these diverse perspectives. Studies that have used the appraisal model of metacognition typically use the Metacognitions Questionnaire (MCQ; Cartwright-Hatton & Wells, 1997), a self-report measure which assesses beliefs about thoughts and worry by asking questions related to superstition, cognitive self-consciousness, and the uncontrollability of thoughts. Based on the fact that each of the subscales of SPQ tap into related constructs (i.e., excessive social worry, odd beliefs, and suspiciousness), it isn't surprising that people high in schizotypy would endorse traits that relate to the appraisal model. Conversely, while awareness of one's own thoughts is a component of our model of metacognition, high self-reflectivity is generally viewed as positive and likely has an inverse relationship with schizotypy traits. Furthermore, the SPQ and the MCQ both rely on self-report and as such studies using these methods are

susceptible to common method variance, whereas the use of the interview rated MAS-A circumvents this issue.

The deterioration of metacognition likely occurs further along the schizophrenia spectrum, perhaps shortly after the first episode of psychosis as suggested by Vohs and colleagues (2014). This suggests that decline in this capacity occurs precipitously rather than in a gradual and insidious manner like many other symptoms of schizophrenia. This notion is further supported by the fact that our schizotypy group's total metacognition scores were much higher than those typically found in first episode and chronic psychosis (Vohs et al., 2014; Lysaker et al., 2011). This is likely due to any one of the myriad of well-documented neurological changes (e.g., decreased white matter, abnormal activation, etc.) that occur after the first episode.

Interestingly enough, other studies that have explored metacognition in older samples of healthy controls have reported higher levels of metacognition than we observed in the non-schizotypy group (Laadegaard et al., 2014; Hasson-Ohayon et al., 2014). The ability to form complex and integrated ideas about oneself and others likely develops in tandem with the process identity formation that occurs throughout adolescence and emerging adulthood. Since the majority of our sample is in this crucial period, it seems possible that metacognition is still in its nascent stages due to a variety of neurobiological factors. One potential neurological structure that may be implicated in the development of metacognition is the pre-frontal cortex (PFC) since it is associated with complex thought and reasoning (Frascarelli et al., 2015). The PFC is not thought to be fully developed until the age of 25 (Dosenbach et al., 2010), which may contribute to the lower metacognition we observed in our younger sample.

The fact that metacognition did not predict social functioning in schizotypy was surprising considering this connection has been well-documented in chronic and early psychosis (Hamm et al., 2012; Vohs et al., 2014). Although social functioning was found to be deficient in our sample (see Luther et al., In Press for more details), this finding suggests that metacognition is not as integral in social functioning in schizotypy as it is further along the schizophrenia spectrum. This may be related to our sample's unusually high emotion recognition and theory of mind scores—these individuals can manage to be socially adept due to their social cognition being relatively intact. This is in stark contrast to schizophrenia wherein both metacognition and social cognition are impaired. Furthermore, as stated previously, groups did not differ in terms of metacognition, so it seems likely that metacognition isn't as integral in social functioning at this stage of development. Emerging adulthood is a period where low decentration (i.e., narcissism) is more common and accepted, as people at this stage of development begin to form their adult identities (Lapsley & Woodbury, 2015). So it seems plausible that the relationship between metacognition and social functioning was lacking in this group because low overall metacognition is normative at this age.

Our prediction regarding the relationship between disorganized traits and metacognition was also not supported. Although this relationship has been demonstrated in schizophrenia (Minor et al., 2015), it was virtually non-existent in our schizotypy sample. Thus, it seems plausible that these links do not develop until more severe disorganization does. However, not all of our findings regarding schizotypy traits were inconsistent with prior research. For example, the correlations we found between negative traits and both awareness of others and decentration are similar to the

associations reported between negative symptoms of schizophrenia and awareness of others (Lysaker et al., 2015; Vohs et al., 2014). Recent evidence from chronic schizophrenia samples suggests that metacognition is a strong predictor of future negative symptoms even when controlling current negative symptoms and a variety of other psychosocial factors (Lysaker et al., 2015), so it may be the case that metacognition is following a similar pattern in schizotypy.

Our hypothesis related to awareness of others and decentration being related to social cognition and functioning was not supported. These findings were particularly odd considering these subscales apparent similarity with aspects of social cognition such as theory of mind. However, this may provide further support for the assertion made by Lysaker and colleagues (2007) that metacognition is a separate construct than social cognition. Counter to this study, we did not find that there was a relation between metacognition and social cognition, but that could be due to differences in the cognitive profiles of people with schizotypy and schizophrenia. Perhaps the relationship between metacognition and social cognition and functioning develops as people age, or, alternatively, metacognition becomes more integral in social cognition and functioning due to deficits in neurocognition that emerge in psychosis (Minor & Lysaker, 2014).

Although this study offers knowledge which may further help to elucidate the role of metacognition across the schizophrenia spectrum, there are a few notable limitations. These findings are limited in that our sample was small (schizotypy  $n=34$ , non-schizotypy  $n=33$ ) and underpowered to detect small and medium effect sizes. Thus, it is possible that group differences in metacognition do exist in total metacognition or its subdomains but that we were unable to detect them. This may also be implicated in our

post hoc analyses, specifically our analysis of higher order mastery. The amount of people in our sample who achieved higher order mastery was too low for both groups to be able to fully investigate whether differences exist. Further, the use of a sample of convenience consisting of college students may have impacted our findings due to the fact that college students may be functioning at a higher level than people with schizotypy in the community. Another consideration is the common method variance since our grouping measure (i.e., SPQ) and our measure of social functioning (i.e., WHO-QOL) relied on self-report. Thus, future studies of metacognition in this population should use a larger sample and clinician rated measures of functioning and psychosis risk (e.g., Structured Interview for Schizotypy; Kendler, Lieberman, & Walsh, 1989).

Regardless of these limitations, this study had many strengths and implications. Firstly, this was the first study to date to employ Semerari and colleagues' (2004) novel conceptualization of metacognition in an at risk population. Although our results largely did not reach the level of significance, they add to the growing literature of metacognition across the schizophrenia-spectrum. Another strength is that this study used a more stringent screening criteria (i.e., only using the top 5% of scores) for the schizotypy group than is typically used in psychometric schizotypy studies. This was done in order to increase the generalizability of findings since our sample primarily consisted of college undergraduates. Findings from this study suggest that interventions which seek to develop metacognition aren't necessary in schizotypy. This assumption is primarily supported by the fact that both groups displayed similar levels of metacognition, suggesting that interventions focusing on developing metacognitive skills (as is the case in metacognitive therapy further along the schizophrenia spectrum) aren't necessary for



this population, especially since we did not find a link between metacognition and functioning. Thus, future studies should confirm these results and focus on longitudinal follow-up of people with schizotypy to see if metacognitive deficits do develop in those that go on to develop psychosis spectrum disorders.

In conclusion, our study sought to extend previous findings of metacognitive deficits from chronic schizophrenia to psychometric schizotypy. Although we were unable to detect significant group differences in metacognition, we did observe similar correlations between metacognition (specifically awareness of other and decentration) and negative traits. Our results suggest that metacognition remains relatively intact in this population and that deficits in this capacity develop rapidly following the first episode of psychosis. Future studies should focus on adapting methods used to develop and enhance metacognition in chronic psychosis to the maintenance of this ability in at risk populations.

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