Deficits in Emotional Experience, Perception, and Clarity in Pre-Schizotypal Individuals

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Deficits in Emotional Experience, Perception, and Clarity in Pre-Schizotypal Individuals

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A Thesis presented to the Graduate Faculty of the College of William and Mary in Candidacy for the Degree of Master of Arts

Department of Psychology

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Master of Arts

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Individuals with elevated levels of schizotypy display deficits in multiple facets of emotion processing. Deficits in emotion perception, experience, and clarity were examined in control participants (n=28) and individuals with elevated levels of schizotypy (n=23), as measured by the Magical Ideation Scale (pre-schizotypal participants). In this experiment, pre-schizotypal participants displayed heightened heart rate (BPM) in response to negatively and positively arousing film clips. This heightened sensitivity demonstrated differential emotion experience for pre-schizotypal individuals. Additionally, pre-schizotypal individuals displayed deficits in working memory capacity in response to arousing film clips. Deficits in information processing in the presence of emotional information are indicative of abnormal emotion perception. Finally, through examining discrepancies between self-reported arousal and physiological measures of arousal, pre-schizotypal participants demonstrated a lack of clarity for self-reported negative affect for the negatively-arousing film clips. Overall, it appears that pre-schizotypal participants display a heightened attention to emotional stimuli, causing depletion in working memory capacity.
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Deficits in Emotional Experience, Perception, and Clarity in Pre-Schizotypal Individuals

Schizophrenia spectrum disorders are defined as a group of psychiatric diagnoses that are grouped by several clinical features, generally involving distortions of reality. According to the *Diagnostic and Statistical Manual of Mental Disorders-IV* (American Psychological Association, 2000), each is a separate disorder with a distinct set of diagnostic criteria. One such schizophrenia spectrum disorder is schizotypal personality disorder. Schizotypal personality disorder (SPD) is characterized as having more subsyndromal and less severe features of schizophrenia (Heckers, 2009). Individuals suffering from SPD are usually referred to as schizotypal individuals.

Despite its name and classification as a schizophrenia spectrum disorder, SPD is an Axis II Personality Disorder, according to the DSM-IV. Researchers have grouped the features of SPD into three main categories: cognitive-perceptual, interpersonal, and disorganized traits. The cognitive-perceptual traits include paranoid ideation, ideas of reference, magical thinking, and unusual perceptual experiences. The interpersonal schizotypal traits include constricted affect, lacking close friends, and excessive social anxiety. Finally, the disorganized traits are composed of odd behavior and bizarre speech (Raine, 2006). A diagnosis of SPD is warranted when at least five of the previously listed features are met. Consistent with Axis II disorders, symptoms must arise in early adulthood, and endure across contexts and circumstances (American Psychiatric Association, 1994). While these symptoms have been found to some extent in healthy individuals, taken together, these traits form schizotypal personality disorder (SPD).
While categorically SPD is considered a distinct diagnosis, its description belies its similarities to schizophrenia. 

Supporting this idea is an emerging hypothesis that schizophrenia spectrum disorders are neuroanatomically, biochemically, and cognitively related and it is hypothesized that these disorders may represent separate but related points along a continuum (Kaczorowski, Barrantes-Vidal, & Kwapił, 2009). In this continuum, normal functioning is at one end of the continuum, and schizophrenia at the final and most severe endpoint. In accordance with this hypothesis, researchers have indicated that psychotic symptoms, or schizotypal traits, are found in healthy individuals to a certain extent (Johns & van Os, 2001). Thus, individuals with schizotypal personality disorder (SPD) can be conceptualized as being somewhere between healthy individuals and schizophrenics on this continuum. 

This continuum of vulnerability to schizophrenia is organized by an impairment known as schizotypy, or the personality trait of experiencing ‘psychotic symptoms’ (Claridge, 1997). Therefore, schizotypy is often conceptualized as the predisposition to schizophrenia at the level of personality (Vollema & van den Bosch, 1995). Evidence for this predisposition to schizophrenia comes from empirical studies showing that individuals who have elevated scores on schizotypy scales may show symptoms that overlap with schizophrenic symptoms (Meehl, 1990). To compound this evidence, research has indicated that individuals with elevated schizotypy who encounter sufficient life stressors, in addition to the genetic vulnerability to schizophrenia, can develop schizophrenia (Meehl, 1962; Zubin & Spring, 1977). Meehl and others believe that
cognitive slippage (a somewhat vague descriptor of tendencies to illogical attributions and thought) is the key characteristic of schizotypal individuals; however, less than 5-10% of individuals with such features are thought to be at risk for psychosis. Yet the similarity of symptoms of elevated schizotypy and schizophrenia has led researchers to categorize the symptoms of both disorders in a similar fashion.

Similar to schizophrenia spectrum disorders, symptoms of schizotypy are organized into positive and negative symptom clusters. These positive symptoms of schizotypy include unusual perceptions, as well as magical ideation, and negative symptoms include physical and social anhedonia (Vollema & van den Bosch, 1995). Due to the diagnostic and empirical evidence that schizotypy organizes the continuum of schizophrenia spectrum disorders, researchers interested in identifying the endophenotypes of schizophrenia often value studies of individuals with elevated levels of schizotypy (psychometrically-measured schizotypes or individuals diagnosed with schizotypal personality disorder). An important advantage of studying schizotypy is that these experiments typically do not have the same confounds as studies with schizophrenic patients, such as medication usage, social isolation, and recurrent hospitalization.

Recent studies have indicated that individuals diagnosed with elevated levels of schizotypal characteristics perform significantly worse than healthy controls on numerous measures. These measures include assessments of general intellectual functioning, verbal working memory and recognition, attention, cognitive inhibition, and abstract reasoning (Cadenhead et al., 1999; Cannon et al., 1994). However, individuals with elevated
schizotypy do tend to fare better on cognitive tasks than individuals diagnosed with schizophrenia (Cadenhead et al., 1999), supporting the idea that the deficits associated with elevated schizotypy fall somewhere in between the deficits of schizophrenia and healthy controls. In addition, individuals with characteristics of SPD exhibit deficits in recognizing and processing emotion (Mikhailova et al., 1996; Streit et al., 2001). These difficulties in processing and recognizing emotion, taken together with the cognitive deficits, can result in devastating impacts on the social and occupational lives of individuals elevated levels of schizotypy.

**Emotion Processing and SPD**

Previous research has indicated that in order for proper emotion processing to occur, individuals must be able to have adequate access to and awareness of one’s own feelings, have the ability to discriminate amongst these feelings, and be capable of accurately labeling one’s feelings (Bagby, Taylor, & Parker, 1994). Deficits in any or all of these facets of emotion processing could result in devastating consequences for understanding one’s own emotions, as well as related deficits in understanding the emotions of others. In addition, cognitive functions such as perception and attention have been shown to be adversely influenced by deficits in processing negative affect (Asarnow et al., 1978).

Without the ability to accurately process emotion, meaningful social interactions are difficult if not impossible. Mistakes in reading emotional cues can compound other social abnormalities, making it difficult to interpret the beliefs and intentions of others. Schizotypal personality disorder is often associated with deficits in interpreting social
cues and executing social interactions (Meehl, 1990). Therefore, for individuals with SPD, emotion processing deficits can have distressing consequences for both cognitive and social functioning.

Research has indicated that individuals with schizophrenia spectrum disorders possess deficits in several facets of emotion processing. In schizophrenia, dysfunctions in emotion processing involve a wide variety of aspects such as dysfunctions in emotional clarity, emotional perception or recognition, and emotional experience (Aleman & Kahn, 2005). One example of deficits in emotional clarity involves difficulties in verbal expression, or alexithymia, a term first introduced by Nemiah and Sifneos (1970) that describes deficits in recognizing, identifying, and describing one's own emotions. Similar difficulties in expressing and perceiving emotions have been found in individuals with elevated schizotypy. Kerns (2005) assessed affect intensity, attention to emotions, and clarity of emotions in individuals with elevated levels of positive schizotypy. This research found that individuals with elevated schizotypy demonstrated a heightened attention towards emotion, but were less clear regarding their emotions than controls. There is also evidence that individuals with elevated schizotypy have an increased responsivity towards emotional stimuli than other individuals, signifying differences in emotion perception and the experience of emotion (Kerns, 2000; Kerns and Berenbaum, 2000). These emotion processing deficits in schizophrenia spectrum disorders compound one another, making the overall understanding of emotion greatly different from that of controls.
Emotional Clarity

One facet of emotion processing in schizotypal individuals that has only recently received attention in the literature is emotional expression. For schizotypal individuals, research in this facet of emotion processing often focuses on emotional clarity, as it refers to how well individuals can identify their feelings (Salovey et al., 1995). Thus, research in emotional clarity examines how clear individuals are at expressing their emotions. Research indicates that low levels of emotional clarity are associated with higher levels of neuroticism (Coffey et al., 2003) and negative affect (Berenbaum & Raghaven, 2002). Both of these constructs have been linked to schizophrenia spectrum disorders, specifically the symptom category of cognitive-perceptual deficits of SPD (Norman, Malla, Cortese, & Diaz, 1998). Furthermore, it has been found that schizotypal individuals with high levels of magical thinking have lower levels of emotional clarity than control participants (i.e., Berenbaum, & Raghavan, 2002). This lack of clarity in expressing emotions found throughout the schizophrenia spectrum has been empirically demonstrated through a variety of measures.

One example of a measure used to show deficits in emotion clarity is an emotion evaluation task. Kerns (2005) found that schizotypal individuals with high levels of positive schizotypy made more errors than control participants on an emotion evaluation task. The researcher took these results to indicate that schizotypal individuals with high levels of magical thinking make more errors in evaluating words in the presence of emotional conflict because of deficits in clearly identifying their emotions. Perhaps one of the more well-replicated findings in the literature on emotional clarity in schizophrenia
is that individuals with schizophrenia are less expressive (both facially and vocally) than individuals without schizophrenia in response to a variety of contexts.

Researchers have utilized stimuli such as film clips, still pictures, cartoons, and music to reveal deficits in emotional clarity (Kring & Moran, 2008). In one such experiment, participants viewed and rated their emotional reactions to thirty emotional images. The researcher discovered that individuals with elevated schizotypy reported less emotional clarity (Brewer, 2008). Although research into the extent of the deficits in emotional clarity for schizophrenia spectrum disorders is still in its early stages, this research points to the importance of emotional clarity in functional emotional processing. In addition, without the ability to communicate one’s emotions, social interactions are difficult for schizotypal individuals.

**Emotional Experience**

Another facet of emotion processing that has received attention in psychological literature is the aberrant emotional experiences of individuals with schizophrenia spectrum disorders. In these disorders, dysfunctional emotional experiences often present themselves in the form of abnormal affect intensity. Affect intensity is associated with the strength of an emotional reaction to both positive and negative stimuli (Larsen, Diener, & Emmons, 1986). Deviant affect intensity is associated with interpretations of emotional stimuli that produce greater personalizing as well as greater affect towards such stimuli.

Within the context of schizophrenia spectrum disorders, researchers have found that schizotypal individuals display greater emotional reactivity. One study found that in regards to emotional images, there was an overall increase in self-reported arousal.
towards both positive and negative stimuli in schizotypal individuals as compared to controls (Brewer, 2008). This heightened reactivity to emotion, or emotionalizing, might be expected in schizotypal individuals, as increases in emotional responsivity have been associated with the onset of positive symptoms in schizophrenia spectrum disorders (Delespaul et al., 2002). Recent research indicates that in the face of arousing stimuli, individuals with schizophrenia spectrum disorders report increased levels of aberrant emotional experiences (Globisch et al., 1999; Kring & Neale, 1996).

The research regarding affective intensity in schizophrenia spectrum disorders has focused on using physiological measures such as heart rate and skin conductance responses in order to quantify the emotional responses of these individuals. In general for arousal measures, responses tend to be greatest for unpleasant stimuli (Bradley & Lang, 2000). Similarly, skin conductance responses tend to be heightened for arousing images (both positively-and-negatively arousing images) (Globisch et al., 1999). Moreover, for individuals suffering from schizophrenia, higher skin-conductance responsivity to emotional stimuli has been reported (Kring & Neale, 1996). Therefore, the research appears to indicate that in both self-report as well as direct measures of arousal, individuals with elevated levels of schizotypy appear to exhibit an increased reactivity to emotion.

In addition, studies of first degree relatives of individuals with schizophrenia have found that these individuals also display aberrant affective intensity. Many studies of children of schizophrenics have shown heightened skin conductance responsivity to arousing tone stimuli (Salzman & Van, 1998). Research has even suggested that it is
possible that increased autonomic responding to aversive stimuli is an endophenotype of schizophrenia (Venables, 1993). In support of this research, Iacono et al. (1999) found that heightened electrodermal activity (EDA), a term synonymous with skin conductance, may be an indicator of genetic risk to schizophrenia, specifically for positive symptoms of schizophrenia. Although this research is by no means conclusive, heightened emotional sensitivity might not be merely a deficit associated with schizophrenia, but also a biomarker for the disorder.

However, several researchers have found exceptions to the idea that all individuals with elevated levels of schizotypy experience heightened emotional sensitivity. Gruzelier and Doig (1996) examined sex differences in measures of arousal in schizotypal individuals and found that while women exhibited extreme arousal responses, men actually were characterized by an absence of heightened reactivity to emotional stimuli. In addition, multiple studies have found that schizotypal individuals actually display a pattern of reduced skin conductance orienting in response to emotional stimuli (Raine et al., 1999). In fact, even schizophrenia has been associated with both increased and decreased skin conductance orienting responses (Gruzelier & Venables, 1972). Volz et al. (2003) found that heart rate and skin conductance responses were greatest when schizophrenics and controls viewed emotionally arousing images, but found no significant differences between the two groups. One plausible explanation for these mixed responses is that differences in skin conductance orientating is symptomatic of a combination of differences in schizophrenia symptoms and gender. Therefore, it is
possible that only females with high levels of schizotypy display increased skin conductance responses, as compared to controls.

Further evidence for dysfunctional emotion experiences in schizophrenic individuals is derived from research on the quantity of negative emotions in schizophrenia. In response to daily stressors, individuals with schizophrenia tend to experience less positive emotions and more negative emotions (Myin-Germeyns et al., 2001). This finding suggests that in addition to subjective and physiologically-measured deviations in emotional experiences, individuals with schizophrenia also experience discrepancies in the intensity of emotion experienced as compared to controls. Taken together, this research indicates that individuals with schizophrenia spectrum disorders are unable to experience emotion as controls do. However, due to the mixed results in arousal ratings for schizophrenia spectrum disorders, it is clear that further research is needed in order to shed light on deviations in emotional experience in schizotypy.

**Emotion Perception**

The last facet of emotion processing described in this study is emotion perception. As with emotional experience and emotional clarity, research reveals that individuals with elevated schizotypy display aberrant emotional perception. Emotional perception, or the encoding of emotional stimuli, has often been associated with emotional attention in schizophrenia research. This reasoning for such research is that individuals in schizophrenia spectrum disorders tend to have an attentional bias for threat-related stimuli (Epstein et al., 1999). This attentional bias also lends a hand to support the evidence for aberrant emotional experiences in schizophrenia. If schizophrenics have an
attentional bias for arousing stimuli, it would be understandable that they are more aroused by such stimuli.

Research on emotion perception in schizophrenia spectrum disorders has often employed a task of basic emotional processing, the emotional Stroop task. In individuals who devote greater attentional resources to arousing stimuli (such as individuals with schizophrenia), there tends to be greater interference for threat-related stimuli, as compared to neutral stimuli (Coffey et al., 2003). This greater interference appears to be due to the fact that threatening stimuli has the capacity to produce intrusive cognitions.

A study employing the emotional Stroop task for individuals with schizophrenia found that only those individuals with active psychosis displayed significant inference for threat-related words (Epstein et al., 1999). However, other studies have shown support for the notion that only individuals with increased positive symptoms display an attention bias for emotional stimuli. A study by Kerns and Berenbaum (2000) discovered that in the context of a word pronunciation task, individuals who had high levels of peculiar beliefs were more strongly influenced than the control participants by the emotional valence of prime words. In addition, Mohanty et al. (2005) found that individuals with high levels of magical thinking were more strongly influenced by the emotional content of a Stroop task. These results tend to indicate that schizotypal individuals with high levels of schizotypy tend to pay more attention to their emotions.

Other evidence for differential perception of emotional stimuli for individuals with schizophrenia spectrum disorders comes from imaging studies. Individuals with elevated levels of schizotypy show elevated right dorsolateral prefrontal cortex (DLPFC)
activation during distraction from negative stimuli (Nitschke et al., 2000). One explanation for this, provided by Mohanty et al. (2003), is that schizotypals exaggerated attention to negative stimuli is the source of this DLPFC activation, since the right prefrontal cortex has been implicated in response to threats.

In addition to research into threat-related stimuli, recent research has also looked into how schizotypal individuals process the nonverbal affect of others. One study revealed that schizotypal individuals have deficits in facial affect recognition for negative emotions. However, these deficits were only in schizotypal individuals with high levels of negative symptoms, not with high levels of positive symptoms (Williams, Henry, & Green, 2007). This would indicate that it is the individuals with high levels of social anxiety and interpersonal deficits that have difficulties processing affect (at least facial affect). In contrast, a recent study by Shean, Bell, and Cameron (2001) demonstrated that schizotypal individuals with high levels of magical thinking display deficits in processing affective postural cues. The researchers further theorized that these difficulties make it harder for schizotypal individuals to form close relationships. The research appears to indicate that although schizotypal individuals pay more attention to affective stimuli, these individuals still display deficits in processing such stimuli.

It appears that this attentional bias for affective stimuli creates cognitive intrusions, and therefore longer processing times. Research involving the influence of affect on cognition shows that cognitive functions, such as perception and attention, are negatively influenced by negative affect (Docherty et al., 1994; Burbridge & Barch, 2002). Recent research has provided empirical evidence that emotional stimuli modulate
cognitive performance in individuals with schizophrenia. Multiple studies have concluded that deficits in emotion perception may be attributed to more neurocognitive abilities (Green et al., 2000). One study indicated that vocal affect recognition errors were associated with deficits in rapid visual processing for individuals with schizophrenia (Kee et al., 1998). These results corroborate the idea that there is a link between cognitive and emotional deficits seen in schizophrenia spectrum disorders.

An influential aspect of cognitive function that is impaired in individuals with schizophrenia spectrum disorders is selective attention (Lubow & Gewirtz, 1995). This interaction between negative affective stimuli and attention is believed to worsen positive symptoms of schizophrenia (Freeman et al., 2002). To explain the link between selective attention and emotion perception, Feinberg et al. (1986) has implied that emotion perception involves scanning and being attentive regarding emotional stimuli. Difficulties in emotion perception may derive from an inability to disregard irrelevant stimuli. In addition, some measures of perception of emotion appear to involve working memory. Thus, individuals must be capable of storing relevant emotional information in order for functional emotion processing to occur. Schneider et al. (1995) provided support for this idea by showing that schizophrenic patients’ performance on an emotion perception task was related to aspects of memory. In addition, a study by Bryson et al. (1997) showed that the best predictor of emotion recognition performance was working memory, as assessed by digit span. Research regarding emotion perception and information processing appears to indicate that these two constructs are linked, in that without basic functioning neurocognitive components, emotion perception is difficult at best.
In support of this idea, researchers have begun researching the extent to which general information processing deficits influence emotion processing in schizophrenia. Becerril and Barch (2010) investigated whether the cognitive system in schizophrenia is affected by the emotional content of stimuli. Using a working memory task, they found that emotional arousal challenged attentional control systems, resulting in reduced performance on a working memory task. Thus, individuals with schizophrenia have dysfunctional attentional systems in the face of emotional stimuli, reducing the individuals’ ability to adequately process emotion.

The Current Study

The purpose of the current study is to examine the links between emotional perception, clarity, and experience in individuals who evidence sub-clinical levels of schizotypal features (pre-schizotypal individuals). Although current research has begun to delve into the connections between these three facets of emotion processing, all have done so using emotion processing tasks or arousing images. Furthermore, presently there are disagreements as to whether pre-schizotypal individuals’ display increased or decreased physiological arousal in the presence of emotionally evocative stimuli.

This study will examine whether individuals with elevated levels of magical thinking display deficits in emotion processing. In order to test whether these individuals display aberrant emotion perception, this study will use positively-arousing, negatively-arousing, and neutral film clips to assess whether arousing film clips will decrease the working memory capacity of pre-schizotypal individuals. In addition, the study will evaluate the correspondence between arousal measures (heart rate in BPM, IBI range
scores, and skin conductance) and self-reported arousal in response to these film clips, in order to assess whether pre-schizotypal individuals display aberrant emotional clarity. The study will also test whether pre-schizotypal individuals’ display heightened arousal to arousing film clips, in order to determine whether these individuals report increased levels of aberrant emotional experiences. Finally, the study will assess whether pre-schizotypal individuals significantly differ from controls in measures of arousal, working memory, and self-reported arousal.

If emotion processing significantly impacts working memory for pre-schizotypal individuals, then this should be conveyed in decreased capacity of working memory, compared to controls, as measured by the Backwards Digit Span Task (adapted from the WAIS-R) in response to arousing film clips. In addition, if pre-schizotypal individuals display a heightened sensitivity for emotional stimuli, they should display larger heart rate and skin conductance responses as compared to controls for emotional stimuli. Lastly, if pre-schizotypal individuals have reduced clarity of their emotions, then this should be reflected in a discrepancy between arousal measures and self-reported measures of affect for pre-schizotypal individuals.

Method

Participants

Fifty undergraduate students participated in the study. There were 28 control participants (53.6% women) and 23 schizotypal participants (52.2% women). The groups did not significantly differ in age, \( F(1, 49) = 0.02, p >0.05 \), or SAT score, \( F(1, 49) = 0.01, p >0.05 \). We recruited participants from the William and Mary Research Participation
Pool after completing the Magical Ideation Scale (MI Scale) during mass testing. Participants were asked to participate in the study if their score was 1.5 SD above or below the mean mass testing score on the MI Scale. Means and standard deviations for all demographics variables are presented in Table 1. Informed consent was obtained from all participants before collecting data, and all participants received course credit in exchange for their participation. This research was approved by the Institutional Review Board for research with human subjects.

**Stimuli**

Each participant viewed a total of twelve film clips. These film clips included four negatively arousing, four positively arousing, and four neutral clips. The neutral clips were included to provide a comparison against which the effect of the negatively- and positively arousing film clips could be contrasted (Piferi, Kline, Younger, & Lawler, 2000). Each film clip was edited to be approximately three minutes in length, although small disparities in the length of the film clips were admitted to make sure the thematic content was understandable. These film segments were selected from a large number of clips on the basis of affective ratings obtained when piloting the film clips, as well as from the criteria recommended by Gross and Levenson (1995). Each chosen film was chosen based on the emotion elicited and arousal ratings.

Using a procedure for piloting film clips from Gross and Levenson (1995), film clips were chosen based on target emotions and arousal ratings. These target emotions included amusement, anger, contempt, delight, disgust, fear, happiness, interest, sadness, and tension. These emotions were then averaged into two categories: positive affect
(amusement, delight, happiness, and interest), and negative affect (anger, contempt, disgust, fear, and sadness). We then demonstrated with paired t-tests that each film clip displayed significantly more of the targeted affect (positive or negative affect) as compared to the non-target affect (positive or negative affect). In addition, we used paired t-tests to show that the arousal ratings of each positively- and negatively-arousing film clip significantly differed from the average arousal ratings of neutral film clips. Results from pilot testing can be seen in Table 2. All positively- and negatively-arousing film clips chosen had a mean target affect and arousal rating of 4.00 or higher on an 8-point Likert Scale. For the neutral film clips, the clips chosen elicited an average rating of 2.0 or fewer on the eight-point Likert scale for positive affect, negative affect, and arousal rating.

Positively arousing film clips were chosen based on themes of camaraderie, amusement, and a lack of negative imagery. Positively arousing film clips included scenes from *Waitress* (Shelly, 2007), *Saved by the Bell* (Engle, 1989), an *SNL* sketch (Michaels, 2001), and *Cat Antics* (Guoap, 2002). Negatively arousing films were chosen on the basis of involving themes of immediate bodily harm or confrontation. Scenes from films included *Carnal Knowledge* (Nichols, 1971), *Falling Down* (Shumacher, 1993), *Kingdom of Spiders* (Cardos, 1977), and *Black Hawk Down* (Scott, 2001). Neutral clips were chosen based on a lack of arousing images, while still including human figures. These scenes depicted a street outside an apartment complex. These film clips were then presented to the participant using SuperLab. To avoid order effects on emotion elicitations, two different orders of film presentation were created. In the second film clip
condition, the film clips were ordered in the opposite order of the first film clip presentation. In each variation, positively arousing, negatively arousing, and neutral film clips were ordered in such a way that a film clip of one condition neither preceded nor followed a film clip of the same condition.

Measures

Behavioral Task. Immediately following each film clip, each participant completed the backwards digit span task (BDST). Participants saw digit sequences appear on a computer screen, one number at a time, with each digit appearing on the screen for 1000 milliseconds. At the end of the number sequence, participants were prompted to type in the number sequence in backwards order. Sequences were four to seven digits in length and were presented in increasing length. In total, participants completed ninety-six trials of the BDST, or eight trials per film clip. Correct sequences were scored independently of sequence length, with a maximum score of eight (four digit lengths, with two repetitions of each length). The backwards digit span task was included as a test of information processing, in that participants must move items in and out of there attentional focus (Cowan, 2001), thus utilizing working memory.

Questionnaires. Following the experiment, participants completed the MI Scale (MIS) again and also the Brief Schizotypal Personality Questionnaire (SPQ-B). Both questionnaires were included as separate measures of schizotypy. The Magical Ideation Scale is a 30-item, true-false self report questionnaire generally thought to measure psychosis proneness (Eckblad & Chapman, 1983; Chapman, Chapman, & Kwapil, 1995). The Schizotypal Personality Questionnaire was developed in order to measure all nine
traits of SPD. The SPQ has excellent internal and test-retest reliability (Raine, 1991). The Brief Schizotypal Questionnaire was subsequently developed in order to assess schizotypy using only the three main features of schizotypy, according to Raine: cognitive-perceptual deficits, interpersonal deficits, and disorganized deficits (Raine & Benishay, 1994). The SPQ-B contains 22 yes-or-no questions, and is considered self-report measure of schizotypal personality disorder traits. Participants were given untitled SPQ-B and MI questionnaires following the stimulus presentation.

In addition, at the beginning of the experiment, and following each video scene, the participant completed the Post Film Questionnaire (Rottenburg & Gross, 2007). On this rating form, participants complete a modified PANAS scale (Appendix) on which they indicated the greatest amount of each emotion felt during the preceding film, using both discrete emotion (specific) and dimensional (pleasant vs. unpleasant) terms. Each emotion is rated on a 9-point Likert scale (0-8). In addition, the questionnaire asks if the participant looked away during the film, or if the participant has seen the film before.

**Heart rate and skin conductance acquisition and analysis.** Heart rate (HR) and skin conductance (EDA) were continuously recorded during each film clip, and during a baseline period. Electrocardiogram (ECG) was recorded using disposable Ag/AgCl electrodes, which were placed on the wrist of the participants’ non-dominant hand, and on the backs of each of the calves, with the ground electrode on the back of the right calf. The experimenter placed skin conductance electrodes on the first and middle fingers of the participants’ nondominant hand. Physiological data was collected with a Biopac
encoder unit (MP150) and AcqKnowledge 3.9 software (Biopac Systems, Goleta, CA), with a sampling rate of 200 samples per second.

For heart rate, data was stored as beats per minute (BPM), and for EDA, data was stored as the average amplitude in microsiemens (µS). Then the raw EDA data was log transformed, as recommended by Venables and Christie (1980). In addition, EDA responses were only included in analyses if responses were greater than 0.00 (Robinson & Demaree, 2009). For both measures, the data was visually inspected for detection and removal of artifacts. For the IBI range scores, we found the largest inter-beat interval (in milliseconds) and subtracted it from the smallest inter-beat interval. Inter-beat intervals are a reference to the time interval between individual beats of the heart.

We analyzed the mean levels of HR in BPM, the inter-beat interval (IBI) range, and amplitude of EDA responses during a baseline period, which included one minute prior to the onset of experimental stimuli. For the arousal measures during the film clips, we analyzed the middle one-minute section of each film clip. Due to technical difficulties, we excluded four participants’ heart rate and EDA data. All arousal measures (IBI range, HR, EDA), were analyzed with repeated measures ANOVAs, with group (pre-schizotypal vs. controls) as between-subjects variables and condition (baseline, positively-arousing, negatively-arousing, and neutral) as within subjects variables. In addition, gender was included as a between-subjects variable.

**Procedure**

Participants were randomly assigned to one of the two film clip presentation conditions. Data recording was conducted individually for each participant. Participants
were seated upright in a chair, in a separate room from the experimenter, to allow for a semblance of privacy. Following instructions, the physiological electrodes were attached. After that, participants were asked to find a comfortable position, and to try not to move during the experiment. In addition, participants were asked to stay alert during all film clips. Participants were provided with the questionnaires, which were placed by the side of their dominant hand. In addition, participants were given a set of headphones.

After the onset of the experiment, participants were given three practice trials of the backwards digit span task. Following the backwards digit span, participants were prompted to fill out a modified PANAS-State Trait scale to assess how they were feeling ‘right then’. Then participants started viewing the series of twelve film clips. Immediately following each film clip, the participant was given eight trials of the backwards digit span task. Following this, the participant was given a moment to fill out the Post Film Questionnaire scale (Rottenberg, Ray, & Gross, 2007). After the participant filled out the twelfth Post Film Questionnaire (after the twelfth film clip), the participant was disconnected from the monitoring devices, filled out the Magical Ideation Scale and the SPQ-B, debriefed, and dismissed.

Results

Pre-schizotypal participants ($M = 12.30, SD = 2.51$) scored significantly higher than controls ($M = 6.32, SD = 2.40$) when retested on the Magical Ideation scale, $F(1, 49) = 75.09, p < .05$. In addition, one-way ANOVAs revealed that pre-schizotypal participants also scored higher than controls on the cognitive-perceptual facet, $F(1, 49) = 17.61, p < .05$, and overall score, $F(1, 49) = 10.45, p < .05$, of the SPQ-B. However, there were no
significant differences between the groups on the interpersonal facet, $F(1, 49) = 3.56, p > .05$, or the disorganized facet, $F(1, 49) = 0.05, p > .05$, of the SPQ-B (See Table 1 for a summary of these results). Furthermore, there was a strong positive correlation between the scores of the initial Magical Ideation scale, and the scores of the post-experiment Magical Ideation scale, $r(50) = .80, p < .05$. There was also a moderate correlation between the scores of the MI and the SPQ-B, $r(50) = .45, p < .05$. The distribution of the SPQ-B scores was consistent with previous studies from undergraduate samples (Dagnall & Parker, 2009; Reeder, Rexhepi-Johansson, & Wykes, 2009). One-way ANOVAs showed that men and women did not significantly differ when retested with the MI Scale, the SPQ-B total, or SPQ-B factor scores (all $p > 0.10$).

**Group Differences in Physiological Measures for Film Clips**

In order to test our first hypothesis that pre-schizotypal participants would have heightened arousal responses for positively- and negatively-arousing film clips as compared to controls, we conducted repeated-measures ANOVAs. These repeated measures ANOVA were performed with group (pre-schizotypal vs. control) x gender (male vs. female) x condition (positive, negative, neutral, and baseline), for each physiological measure [heart rate data (in BPM and IBI range scores) and EDA scores]. For the ANOVA on heart rate (measured as beats per minute), there was a significant main effect of group, $F(1,45) = 8.40, p < .05, \eta_p^2 = 0.16$, with pre-schizotypal participants ($M = 84.43, SE = 1.94$) having a significantly higher BPM than control participants ($M = 77.27, SE = 1.70$). The main effect of condition was not significant, $F$
(3, 132) = 1.02, \( p > .05 \), \( \eta_p^2 = 0.02 \). However, the group x condition interaction was significant, \( F (3, 132) = 4.42, p < .05, \eta_p^2 = 0.09 \). In addition, there was not a significant main effect of gender, \( F (1,45) = 1.56, p > .05, \eta_p^2 = 0.04 \). The gender x condition interaction was also not significant, \( F (3,132) = 0.05, p > .05, \eta_p^2 = 0.00 \).

Simple contrasts provided further clarification of these findings. These tests revealed that pre-schizotypal participants had a higher heart rate as compared to controls for the negatively-arousing condition, \( F(1,45) = 9.96, p < .05 \), and positively-arousing condition, \( F(1,45) = 10.98, p < .05 \), but there was no significant difference between the groups for the neutral condition, \( F(1,45) = 2.60, p > .05 \), and baseline, \( F(1,46) = 0.23, p > .05 \). (See Table 3 for means and standard deviations). Figure 1 shows a depiction of the differences in heart rate across film clip conditions for both groups. In addition, paired t-tests revealed that participants had a significantly lower heart rate for the neutral condition \( (M = 76.80, SD = 10.45) \) as compared to the positive condition \( (M = 81.17, SD = 14.23) \), \( t(46) = 2.459, p < .05 \), and the negative condition \( (M = 86.68, SD = 14.22) \), \( t(46) = 4.82, p < .05 \). There were also significant differences between the positively-arousing and negatively-arousing conditions, \( t(46) = 3.36, p < .05 \). However, there was no significant difference between the baseline condition \( (M = 77.02, SD = 9.91) \) and the neutral condition, \( t(46) = 0.29, p > .05 \).

The IBI range scores were analyzed in order to get a better idea of the variability of our inter-beat interval scores. Therefore, we conducted a repeated measures ANOVA with group (pre-schizotypal and controls) x gender x condition (positive, negative,
neutral, and baseline) for the IBI range scores. For the ANOVA on IBI range scores (measured in milliseconds), there was a significant main effect of group, $F(1, 44) = 6.18$, $p < .05$, $\eta_p^2 = 0.12$, with pre-schizotypal participants ($M = 27.68, SE = 1.71$) having a significantly smaller IBI range than control participants ($M = 33.39, SE = 1.53$). The main effect of condition approached significance, $F(3, 132) = 2.19$, $p = .09$, $\eta_p^2 = 0.05$. In addition, the group x condition interaction was not significant, $F(3,129) = 2.02$, $p > .05$, $\eta_p^2 = 0.04$. Lastly, there was not a significant main effect of gender, $F(1,44) = 1.81$, $p > .05$, $\eta_p^2 = 0.04$. The gender x condition interaction was also not significant, $F(3,132) = 1.10$, $p > .05$, $\eta_p^2 = 0.03$.

Figure 2 depicts the differences between the groups across conditions for the IBI range scores. Simple contrasts showed that pre-schizotypal participants had a lower IBI range as compared to controls for the negatively-arousing condition, $F(1,48) = 6.06$, $p < .05$. However, the differences between the groups for the positively-arousing, neutral, and baseline conditions were not significant (all $p$-values were $>.10$) (See Table 3 for means and standard deviations). Yet there were significant differences between the conditions. Paired $t$-tests revealed that participants had a significantly lower IBI range for the baseline condition ($M = 27.25, SD = 12.20$) as compared to the positive condition ($M = 35.86, SD = 16.41$), $t(47) = -2.87$, $p < .05$, and the negative condition ($M = 34.35, SD = 17.58$), $t(47) = -2.28$, $p < .05$. There were no significant differences between the baseline and neutral conditions, or the positively-arousing and negatively-arousing conditions (both $p$-values were $>.10$).
In addition, we tested our hypothesis that there would be differences in EDA scores between controls and pre-schizotypal participants, using repeated measures ANOVA. For EDA scores, there was not a significant main effect of group, $F(1,44) = 1.91, p > .04, \eta^2_p = .04$. In addition, there was not a significant main effect of condition, $F(3, 132) = 0.87, p > .05, \eta^2_p = .02$. The group x condition interaction was not significant, $F(3,132) = 1.24, p > .05, \eta^2_p = .03$. In addition, there was not a significant main effect of gender, $F(1,44) = 0.00, p > .05, \eta^2_p = 0.00$. The gender x condition interaction was also not significant, $F(3,132) = 0.36, p > .05, \eta^2_p = 0.01$.

However, paired t-tests revealed that participants had significantly higher EDA scores for the negatively-arousing condition ($M = 0.03, SD = 0.02$) as compared to the baseline condition ($M = 0.02, SD = 0.01$), $t(47) = -2.74, p < .05$. Participants also had significantly higher EDA scores for the negatively-arousing condition as compared to the positively-arousing condition ($M = 0.02, SD = 0.02$), $t(47) = -2.40, p < .05$, as well as compared to the neutral condition ($M = 0.02, SD = 0.02$), $t(47) = 3.45, p < .05$. There were significant differences between the groups for the baseline condition, with pre-schizotypal participants ($M = 0.03, SD = 0.02$) having significantly higher EDA scores than the control participants ($M = 0.02, SD = 0.01$), $F(1,48) = 6.71, p < .05$. There were no significant differences between the groups for any of the other conditions (all p-values were $> 0.10$)(See Table 3 for means and standard deviations). Figure 3 graphically depicts these non-significant differences between the groups across film clip conditions.
Differences between Controls and Schizotypal Participants in Backwards Digit Span Performance

In order to test our hypothesis that pre-schizotypal individuals would perform significantly worse as compared to controls across film clip condition we performed a repeated-measures ANOVA, with group (pre-schizotypal and controls) x gender x condition (positively-arousing, negatively-arousing, and neutral). Our first prediction was that pre-schizotypal individuals would in general perform worse than controls on the Backwards Digit Span Task (BDST). There was a significant main effect of group, $F(1, 42) = 13.37, p < .05, \eta^2_p = 0.24$. Pre-schizotypal participants ($M = 4.34, SE = 0.33$) performed significantly worse than control participants ($M = 5.94, SE = 0.28$). The main effect of condition was not significant, $F(2, 84) = 2.23, p > .05, \eta^2_p = 0.05$. However, there was a significant interaction between group and condition, $F(2, 84) = 14.24, p < .05, \eta^2_p = .25$. Lastly, was not a significant main effect of gender, $F(1,42) = 0.03, p > .05, \eta^2_p = 0.00$. However, the gender x condition interaction was significant, $F(2, 84) = 4.32, p < .05, \eta^2_p = 0.09$.

Again, simple contrasts were conducted in order to clarify these results. There were significant differences between the groups for BDST scores following the positively-arousing film clips, $F(1,45) = 15.60, p < .05$, as well as the negatively-arousing film clips, $F(1,45) = 31.69, p < .05$ (Figure 4). However, there were no significant differences between the groups for the neutral film clips, $F(1,43) = 1.48, p > .05$ (See Table 4 for means and standard deviations). Overall, there were no significant differences
between males and females for any of the conditions (all p-values were > .10). However, there was a trend towards women \((M = 5.34, SD = 1.52)\) scoring higher on the BDST than men \((M = 5.21, SD = 2.01)\). Furthermore, there were no significant differences between the positively-arousing condition \((M = 5.31, SD = 1.73)\), negatively-arousing condition \((M = 5.16, SD = 1.81)\), and/or the neutral condition \((M = 5.36, SD = 1.77)\) (all p-values were > .10).

**Discrepancies between Physiological Responses and Self-Report in Schizotypal Participants**

We performed linear regressions to test our next prediction that for control participants there would be a relationship between physiological responses and self-reported arousal ratings, while for pre-schizotypal participants there would be no relationship between these measures. Due to the fact that the EDA scores were not significant, we only used the heart rate measure (BPM) in these regressions. For each condition (positive, negative, and neutral, and baseline), separate linear regressions were performed for both pre-schizotypal and control participants to determine if self-report significantly predicted participants’ heart rate. For neutral and baseline conditions, separate regressions were performed with both positive and negative affect, in order to reveal whether either affect significantly predicted participants’ heart rate.

Contrary to predictions, self-report did not consistently predict heart rate for either group. For control participants, there was a relationship between negative affect report and average heart rate (BPM) for negatively-arousing film clips that approached
significance, $F(1, 24)= 3.41, p = .08$ (Figure 7). Furthermore 12.4% of the variability in heart rate was predicted by the self-reported negative affect. In comparison, for pre-schizotypal participants, there was not a significant relationship between physiological response (BPM) and self-report for the negatively-arousing film clips, $F(1,22)= 1.57, p > .05$ (Figure 8). Only 8.0% of the variability in heart rate was predicted by self-report for pre-schizotypal participants. However, besides negatively-arousing film clips, there were no other significant relationships between arousal responses and self-report for any other condition, for controls or schizotypal participants (all p-values were >.10). Yet control participants $(M = 4.92, SD = 1.37)$ did report significantly more negative affect than pre-schizotypal participants $(M = 3.09, SD = 1.19)$, for the negatively-arousing film clips, $F(1,45)= 23.02, p < .05$ (See Table 5 for a summary of results). Figure 5 depicts the differences in positive affect between the groups across film clip conditions, while Figure 6 shows the differences in negative affect between the groups.

Lastly, to ensure that there were significant differences in the amount of positive and negative affect reported across conditions, we conducted paired t-tests. There were significant differences between conditions for self-reported affect scores. Significant differences in self reported negative affect scores were found between the negative $(M = 4.10, SD = 1.57)$ and neutral $(M = 0.43, SD = 0.66)$ film clips, $t(46) = 13.77, p < .05$, as well as between the negative and positive $(M = 0.27, SD = 0.44)$ film clips, $t(45) = -16.73, p < .05$. In addition there were significant differences self-reported positive affect between the neutral $(M = 1.21, SD = 0.81)$ and positive $(M = 4.34, SD = 1.30)$ film clips,
\( t(45) = 16.15, p < .05 \), as well as between the negative \((M = 1.35, SD = 1.00)\) and positive film clips for positive affect, \( t(45) = 12.12, p < .05 \).

**Discussion**

While this study focused on deficits in emotion processing, at the core of this study is the fundamental difference between control participants and pre-schizotypal participants. Thus, finding a significant difference between control participants and pre-schizotypal participants was important to the integrity of the study. This issue was also one of the main concerns, given the potentially questionable reliability of identifying subjects through scores on mass testing on a college campus. While the cognitive-perceptual factor was the only SPQ—B factor to reach significance, both the interpersonal and disorganized factors approached significance. The correlation between the two questionnaires was 0.45, indicating that these two measures were appropriate to use together in this study. This significant correlation indicates that the use of the SPQ—B was not detrimental to the integrity of the data in the present study. Therefore, it is fair to indicate that the controls participants and the pre-schizotypal participants represent two significantly different groups in this study.

While the previous research indicates that individuals with elevated schizotypy display deficits in emotional clarity, we found mixed results. Our results indicated that for neutral and positively-arousing film clips, there was not a significant relationship between self-report and arousal responses (for both controls and pre-schizotypal participants). Yet there was a discrepancy between self-report and arousal responses for
negatively-arousing stimuli. For negatively-arousing stimuli, control participants reported feeling more negative affect than pre-schizotypal participants. However, pre-schizotypal participants had higher heart rate for negatively-arousing film clips than controls. In addition, control participants’ BPM better predicted self-report than for pre-schizotypal participants. Therefore, for negatively-arousing film clips, pre-schizotypal participants demonstrated a lack of accuracy regarding the intensity of their reaction, by not reporting more negative affect.

The lack of a significant relationship between self-reported affect and BPM for positively-arousing film clips could be due to the increased variance in the heart rate for these film clips (as evidenced by the IBI range scores). With more variation in the heart rate it is less likely that there would be a strong relationship between heart rate and self-report, because the heart rate fluctuates more and therefore it is less likely that there would be a strong correspondence between the two measures. It is also possible that for the positive and neutral film clips, participants experienced a broader range of emotions, as compared to the negatively-arousing film clips. Although multiple studies (Kerns, 2005; Brewer, 2008) have documented this inability to clearly identify emotions in schizotypal individuals, this does not necessarily dictate that in all contexts (such as with positively-valenced stimuli), individuals with elevated schizotypy deviate from controls participants in emotional clarity.

Another aspect of emotion processing investigated by this study is the emotional experience of individuals with elevated levels of magical ideation. We hypothesized that pre-schizotypals would display a heightened reactivity in response to the arousing film
clips, and we found varied results. Similar to the research of Volz et al. (2003), we found heightened heart rate (BPM) in pre-schizotypal individuals with regard to arousing film clips, but not to neutral clips. These results are exactly what one would expect if pre-schizotypal individuals do indeed have heightened responsivity to emotional stimuli. In addition, this heightened heart rate was significantly different from that of controls. Thus, our experiment indicates a differential emotional experience for individuals with elevated schizotypy, in that they experienced an exaggerated autonomic response in reaction to both positively- and negatively- arousing stimuli.

For the IBI range scores, there were differences between the groups. For the negatively-arousing film clips, pre-schizotypal participants had significantly smaller ranges than control participants. These smaller IBI ranges mean that there was less variance in the time between the heart beats of these pre-schizotypal participants. Taken together with the evidence that pre-schizotypal participants appear to have higher BPMs for negatively-arousing film clips, this appears to indicate that pre-schizotypal participants were generally more consistently aroused during these video clips. These participants had higher heart rates, as well as smaller inter-beat intervals.

However, we did not find such results with regards to EDA responses. There were no significant differences between controls and pre-schizotypal individuals for positively-arousing, negatively-arousing, or neutral film clips. Although this might confound our theory that emotionally evocative stimuli universally affect autonomic arousal in individuals with elevated levels of magical ideation, research into skin conductance responses in schizotypy has found mixed results. While some experimental conditions
schizotypal individuals display an increased skin conductance orienting responsivity, there are other studies, like ours, that have found no differences between controls and individuals with elevated schizotypy in skin conductance response (Gruzelier & Venables, 1972). While the possibility exists that the lack of difference in skin conductance responses is due to our use of a sub-clinical population, it is also possible that individuals with elevated schizotypy do not differ from control populations on certain measures of autonomic arousal (such as skin conductance).

Lastly, we tested whether this heightened sensitivity towards emotional stimuli distorts the ability of working memory to process information. Previous research has indicated that schizotypal individuals demonstrate interference in working memory during emotional processing tasks. Becerril and Barch (2010) found that in the face of emotional arousal, schizotypal individuals display decreased capacities of working memory. Likewise, we found that pre-schizotypal individuals differed significantly from controls on a working memory task following the positively-and negatively-arousing film clip conditions. However, we did not find any significant differences between control participants and individuals with elevated levels of schizotypy for the neutral condition. These results support the notion that emotionally evocative stimuli produce a temporary information processing deficit for pre-schizotypal individuals. Thus, the arousal by these stimuli negatively influenced the working memory capacity in pre-schizotypal individuals more so than control participants.

This experiment indicates that in general, pre-schizotypal individuals display difficulties in various facets of emotion processing while faced with arousing stimuli. We
have demonstrated that when these individuals watch arousing film clips, they display heightened reactivity towards the emotional stimuli. However, unlike studies indicating that schizotypal individuals only display such difficulties for threat-related stimuli (Schneider et al., 1995), it appears that pre-schizotypal individuals display deficits for both positively- and negatively-valenced stimuli. Yet this does not affect the explanation for this emotion processing disturbance. As pre-schizotypal individuals encounter arousing stimuli, deficits in perception of emotion cause these individuals to dedicate more attentional resources towards processing emotional stimuli. These increased resources cause a heightening in attention to emotion, and thus emotional arousal. In addition, they cause a reduced capacity to process other stimuli, as evidenced by a diminished working memory capacity following emotional stimuli.

Experiments researching the emotion processing of schizophrenia spectrum disorders have many real world implications for the processing of emotional information and social interactions. As explained by Meehl (1996), individuals with elevated schizotypy evidence difficulties interpreting emotional cues. In the context of this experiment, heightened attention to emotion might lead to unusual interpretations of emotional stimuli. This in turn could lead to difficulties interpreting others facial expressions, nonverbal affect, and social cues. Furthermore, difficulties in correctly interpreting social cues might lead to social awkwardness and few meaningful friendships. Thus, difficulties in emotion processing have wide-ranging implications for the processing of emotional information in real-world contexts.
Although this study is a step in further clarifying the relationship between schizotypy and emotion processing, it is not without its limitations. One such limitation is the use of dichotomous questionnaires to assess schizotypy. Although this is a common practice for assessing schizotypy, an assessment of schizotypy with continuous variables might provide a more accurate index of schizotypy. In addition, although standardized videos were available, we chose to create emotional video clips in order to ensure that the video clips were relatable to current students, and well as ensure that each video clip was approximately three minutes in length. However, this choice also means that it is possible that these video clips did not elicit arousal as well as standardized video clips would have. Likewise, discrepancies in procedures for handling skin conductance might have complications the results regarding skin conductance scores. Creating a standardized way of handling such physiological measures would most likely decrease discrepancies in research for skin conductance responses.
References


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Table 1

*Characteristics of Pre-Schizotypal and Control Groups*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pre-schizotypal (N=28)</th>
<th>Control (N = 23)</th>
<th>Test statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>20.61±2.31</td>
<td>20.71±3.57</td>
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<tr>
<td>Gender</td>
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<td></td>
<td>0.01</td>
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<tr>
<td>Male</td>
<td>11 (47.83%)</td>
<td>13 (46.43%)</td>
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<tr>
<td>Female</td>
<td>12 (52.17%)</td>
<td>15 (53.57%)</td>
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</tr>
<tr>
<td>SAT score</td>
<td>1869.57±210.53</td>
<td>1875.36±285.20</td>
<td>0.01</td>
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<td>Initial MI Score</td>
<td>16.74±0.69</td>
<td>11.61±0.57</td>
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</tr>
<tr>
<td>Re-test MI Score</td>
<td>12.30±2.51</td>
<td>6.32±2.40</td>
<td>75.09*</td>
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<tr>
<td>SPQ-total</td>
<td>9.17±3.21</td>
<td>6.43±2.85</td>
<td>10.45*</td>
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<tr>
<td>Cognitive-Perceptual</td>
<td>4.09±1.73</td>
<td>2.18±1.52</td>
<td>17.61*</td>
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<td>Disorganized</td>
<td>2.00±1.09</td>
<td>1.93±1.12</td>
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<tr>
<td>Interpersonal</td>
<td>3.09±1.35</td>
<td>2.32±1.52</td>
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* p < .05.
Table 2

Means ± SDs for Piloted Film Clips

<table>
<thead>
<tr>
<th>Condition</th>
<th>Positive Affect</th>
<th>Negative Affect</th>
<th>Test statistic</th>
<th>Arousal Rating</th>
<th>Test Statistic</th>
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<td><strong>Positive Film Clips</strong></td>
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<tr>
<td><em>Waitress</em></td>
<td>4.71 ± 1.14</td>
<td>1.23 ± 0.70</td>
<td>21.22 *</td>
<td>4.50 ± 1.21</td>
<td>22.45 *</td>
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<tr>
<td><em>Saved By the Bell</em></td>
<td>4.60 ± 1.16</td>
<td>0.99 ± 0.66</td>
<td>22.55 *</td>
<td>4.70 ± 1.49</td>
<td>18.47 *</td>
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<tr>
<td><em>SNL skit</em></td>
<td>4.62 ± 1.10</td>
<td>1.09 ± 0.57</td>
<td>23.44 *</td>
<td>5.22 ± 1.44</td>
<td>21.97 *</td>
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<tr>
<td><em>Cat Antics</em></td>
<td>5.10 ± 1.06</td>
<td>0.84 ± 0.65</td>
<td>26.66 *</td>
<td>6.25 ± 1.13</td>
<td>33.20 *</td>
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<td><strong>Negative Film Clips</strong></td>
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<tr>
<td><em>Carnal Knowledge</em></td>
<td>1.04 ± 0.62</td>
<td>4.63 ± 1.07</td>
<td>23.31 *</td>
<td>5.80 ± 1.35</td>
<td>28.76 *</td>
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<tr>
<td><em>Falling Down</em></td>
<td>0.85 ± 0.63</td>
<td>4.87 ± 1.08</td>
<td>27.18 *</td>
<td>5.68 ± 1.52</td>
<td>24.20 *</td>
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<tr>
<td><em>Kingdom of Spiders</em></td>
<td>1.20 ± 0.76</td>
<td>4.78 ± 1.07</td>
<td>24.48 *</td>
<td>5.57 ± 1.68</td>
<td>21.83 *</td>
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<tr>
<td><em>Black Hawk Down</em></td>
<td>1.03 ± 0.61</td>
<td>4.71 ± 1.09</td>
<td>22.82 *</td>
<td>6.35 ± 0.95</td>
<td>45.36 *</td>
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<td><strong>Neutral Film Clips</strong></td>
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<td>Neutral 1</td>
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<td>1.12 ± 0.56</td>
<td>-1.61</td>
<td>1.12 ± 0.98</td>
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<td>Neutral 2</td>
<td>1.15 ± 0.64</td>
<td>1.08 ± 0.68</td>
<td>0.51</td>
<td>0.83 ± 0.81</td>
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<td>Neutral 3</td>
<td>1.04 ± 0.70</td>
<td>0.93 ± 0.66</td>
<td>0.84</td>
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<td>Neutral 4</td>
<td>1.33 ± 0.59</td>
<td>0.95 ± 0.80</td>
<td>1.18</td>
<td>0.60 ± 0.64</td>
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* \( p < .05 \).
Table 3

Mean ± SDs for Arousal Measures

<table>
<thead>
<tr>
<th>Condition</th>
<th>Pre-schizotypal (N=28)</th>
<th>Control (N=23)</th>
<th>Test statistic</th>
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<tr>
<td>Baseline</td>
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<tr>
<td>BPM</td>
<td>76.27 ± 7.93</td>
<td>77.62 ± 11.46</td>
<td>0.23</td>
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<tr>
<td>IBI Range</td>
<td>27.67 ± 13.41</td>
<td>26.90 ± 10.86</td>
<td>0.05</td>
</tr>
<tr>
<td>EDA</td>
<td>0.03 ± 0.02</td>
<td>0.02 ± 0.01</td>
<td>6.71*</td>
</tr>
<tr>
<td>Neutral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPM</td>
<td>79.58 ± 8.67</td>
<td>74.66 ± 11.34</td>
<td>2.60</td>
</tr>
<tr>
<td>IBI Range</td>
<td>23.49 ± 10.19</td>
<td>27.51 ± 10.78</td>
<td>1.70</td>
</tr>
<tr>
<td>EDA</td>
<td>0.02 ± 0.01</td>
<td>0.02 ± 0.01</td>
<td>0.51</td>
</tr>
<tr>
<td>Positive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPM</td>
<td>88.60 ± 14.48</td>
<td>75.94 ± 11.72</td>
<td>10.98*</td>
</tr>
<tr>
<td>IBI Range</td>
<td>31.97 ± 15.70</td>
<td>39.14 ± 16.56</td>
<td>2.34</td>
</tr>
<tr>
<td>EDA</td>
<td>0.03 ± 0.02</td>
<td>0.02 ± 0.01</td>
<td>0.48</td>
</tr>
<tr>
<td>Negative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPM</td>
<td>93.34 ± 15.50</td>
<td>81.30 ± 10.59</td>
<td>9.96 *</td>
</tr>
<tr>
<td>IBI Range</td>
<td>27.89 ± 11.69</td>
<td>39.81 ± 19.97</td>
<td>6.06*</td>
</tr>
<tr>
<td>EDA</td>
<td>0.04 ± 0.03</td>
<td>0.03 ± 0.02</td>
<td>0.64</td>
</tr>
</tbody>
</table>

* p < .05.
Table 4
Means ± SDs for Backwards Digit Span Task Scores

<table>
<thead>
<tr>
<th>Condition</th>
<th>Pre-schizotypal</th>
<th>Controls</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>4.99 ± 1.77</td>
<td>5.63 ± 1.76</td>
<td>1.48</td>
</tr>
<tr>
<td>Positive</td>
<td>4.30 ± 1.51</td>
<td>6.06 ± 1.50</td>
<td>15.60*</td>
</tr>
<tr>
<td>Negative</td>
<td>3.83 ± 1.82</td>
<td>6.15 ± 0.98</td>
<td>31.69*</td>
</tr>
</tbody>
</table>

*p < .05.
Table 5

Linear Regressions between Participant’s Heart Rate and Self-Reported Affect

<table>
<thead>
<tr>
<th>Condition</th>
<th>Pre-schizotypal</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>β</td>
</tr>
<tr>
<td>Baseline Film Clips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Affect</td>
<td>3.67 ± 1.71</td>
<td>-0.00</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>0.44 ± 0.37</td>
<td>0.23</td>
</tr>
<tr>
<td>Neutral Film Clips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Affect</td>
<td>1.38 ± 1.12</td>
<td>-0.04</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>0.45 ± 0.49</td>
<td>-0.48</td>
</tr>
<tr>
<td>Positive Film Clips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Affect</td>
<td>4.25 ± 1.29</td>
<td>0.19</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>0.23 ± 0.33</td>
<td>0.02</td>
</tr>
<tr>
<td>Negative Film Clips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Affect</td>
<td>1.51 ± 1.22</td>
<td>-0.10</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>3.09 ± 1.19</td>
<td>-0.38</td>
</tr>
</tbody>
</table>
Figure 1. Average heart rate across film clip conditions for experimental groups. Error bars show standard error of the mean.

Figure 2. Average inter-beat interval range across film clip conditions for experimental groups. Error bars show standard error of the mean.
Figure 3. Average skin conductance (EDA) responses across film clip conditions for experimental groups. Error bars show standard deviation.

Figure 4. Average Backwards Digit Span Task performance across film clip conditions for experimental groups. Error bars show standard error of the mean.
Figure 5. Average self-reported positive affect across film clip conditions for experimental groups. Error bars show standard error of the mean.

Figure 6. Average self-reported negative affect across film clip conditions for experimental groups. Error bars show standard error of the mean.
**Figure 7.** Scatterplot of the relationship between self-reported negative affect and average heart rate for negatively-arousing film clips for control participants.

**Figure 8.** Scatterplot of the relationship between self-reported negative affect and average heart rate for negatively-arousing film clips for pre-schizotypal participants.
Appendix

POST FILM QUESTIONNAIRE

The following questions refer to how you felt while watching the film.

Using the scale above, please indicate the greatest amount of EACH emotion you experienced while watching the film.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all/none</td>
<td>somewhat/some</td>
<td>extremely/a great deal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

____ amusement _____ embarrassment _____ love
____ anger _____ fear _____ pride
____ anxiety _____ guilt _____ sadness
____ confusion _____ happiness _____ shame
____ contempt _____ interest _____ surprise
____ disgust _____ joy _____ unhappiness

Did you feel any other emotion during the film?  O No  O Yes
If so, what was the emotion? __________________________
How much of this emotion did you feel? ______

Please use the following pleasantness scale to rate the feelings you had during the film. Circle your answer:

0  1  2  3  4  5  6  7  8
unpleasant pleasant

Had you seen this film before?  O No  O Yes

Did you close your eyes or look away during any scenes?  O No  O Yes