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MEASUREMENT OF NEGATIVE AFFECTIVITY IN PSYCHOMETRICALLY DEFINED
SCHIZOTYPY USING FACIAL ELECTROMYOGRAPHY

by

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A thesis submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the Department of Psychology
in the College of Sciences
at the University of Central Florida
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ABSTRACT

Schizotypy is a sub-threshold syndrome associated with schizophrenia. Much of the research on schizotypy concerns its component features, one of which being blunted or constricted affect. While several investigations have addressed this common “negative” symptom within the context of schizophrenia, few have focused on schizotypy directly, and none have utilized psychophysiological measurement to examine affective constriction. The present investigation uses facial electromyography (EMG) to measure patterns of affective expression within a psychometrically defined schizotypal population when presented threatening and distressing pictures from the IAPS. Twenty-eight individuals with elevated schizotypal features and 20 healthy controls were recruited for this investigation. The participants observed the series of pictures and provided self-report ratings of affective valence and arousal while their physiological responses were recorded. The protocol used here closely matched that used by Bradley and Lang (2007) and produced a similar pattern of results across all participants on self-reported ratings and physiological measures. Results further suggest that those with schizotypal features did not differ from control participants in self-reported ratings of negative affect or autonomic arousal. A three-way interaction in facial EMG measurement revealed that while schizotypic males demonstrated the expected pattern of blunted facial affective expression, schizotypic females displayed the opposite pattern. That is, females with psychometrically schizotypy demonstrated significant elevations in negative facial affective expression while viewing distressing pictures. We argue that these findings reflect unidentified sex differences in affective expression in schizotypy, and we discuss implications for assessment and diagnostic procedures among individuals with personality disorders.

Dedicated to Josephine

ACKNOWLEDGMENTS

My thanks and appreciation is offered first to my colleague, Ms. Kathleen Ragsdale, for her efforts and collaboration in the subject recruitment and data collection for this project.

I am also grateful to my committee members, Drs. Jeffrey Bedwell, Deborah Beidel and Jeffrey Cassisi, for their valuable and dependable feedback. Special appreciation is due to Jeff Cassisi who has been instrumental in refining and focusing my work.

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LIST OF ACRONYMS

ANOVA	Analysis of Variance
ANS	Autonomic Nervous System
BAI	Beck Anxiety Inventory
BPM	Beats per Minute
ECG	Electrocardiography
EDA	Electrodermal Activity
EMG	Electromyography
HR	Heart Rate
IAPS	International Affective Picture Systems
μS	Microsiemens
μV	Microvolts
MANOVA	Multivariate Analysis of Variance
SAM	Self-Assessment Mannequin
SCL	Skin Conductance Level
SCR	Skin Conductance Response
SEM	Structural Equation Modeling
SOA	Stimulus Onset Asynchrony
SPD	Schizotypal Personality Disorder
SPQ	Schizotypal Personality Questionnaire

CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

Schizotypy, a latent personality construct consisting of a constellation of traits associated with social and interpersonal deficits, odd or unusual beliefs, and disorganized behavior, is thought to lie along a continuum (Cochrane, Petch & Pickering, 2012) ranging from relatively normal behavior to severe psychosis (i.e., schizophrenia). Recent focus on affective experience (e.g., affective valance, expression, and arousal) in schizotypic psychopathology indicates that a unique relationship exists among these processes and clinical emotional disturbance (Kerns, 2006; Kerns, Docherty, & Martin, 2008). Few studies, however, have utilized psychophysiological measurement when addressing the affective components of schizotypy. The purpose of the present study is to clarify the relationship between self-reported affective valance and objective affective expression in response to emotionally charged images within a schizotypic population using facial electromyography (EMG).

Schizotypy and schizophrenia share a number of features including positive, negative, and disorganized symptoms, all of which are typically less severe in schizotypy. In one prevalence study, Lenzenweger (2006) concluded that the schizotypy taxon is present in approximately 10% of individuals. Schizotypal traits are thought to emerge through genetic predisposition, becoming fully expressed through environmental interactions (Fossati, et al., 2001; Lenzenweger, & Korfine, 1992; Plomin, DeFries, McClearn, & McGuffin, 2008). This hypothesis is fundamental to many theories of psychopathology, but in the case of disorders related to schizophrenia, these etiological features support schizotypy as a prodromal condition implicated in schizophrenia.

In the early 1960's, Paul Meehl first proposed that *schizotaxia*, a neural integrative defect, may be responsible for schizophrenic symptoms. Meehl (1962) argued that this specific defect underlies the development of a personality profile that he labeled schizotypy. In this model, schizotypy comprises four core disturbances: cognitive slippage, anhedonia, ambivalence and interpersonal aversiveness. By Meehl's account, only a small proportion of these schizotypic individuals eventually decompensate into schizophrenia. Though this general theory has been revised over the years (Meehl, 1989, 1990), many subsequent attempts to explain schizotypy utilized Meehl's original dimensional theory as a starting point.

A two-factor model, based on Meehl's original theory, gained attention through the work of Siever and Gunderson (1983) and Widiger, Frances, Warner and Bluhm (1986) who divided the observable symptoms into latent categories of *cognitive/perceptual* and *interpersonal* disturbances. These researchers noted that by utilizing these two orthogonal constructs, the core features of schizotypy are parallel to the positive and negative symptoms of schizophrenia. Kendler and Hewitt (1991) updated this model, altering the latent construct to which some of the schizotypal symptoms belong.

Based on these developments, Raine et al. (1994) proposed a three-factor model of schizotypy, which has received considerable empirical support (Reynolds, Raine, Mellingen, Venables & Mendick, 2000). In addition to the cognitive/perceptual and interpersonal factors, Raine and colleagues' model includes a *disorganized* factor, which more accurately accounts for the odd/eccentric behavior and speech observed in schizotypic psychopathology (Reynolds et al., 2000). Within the Raine et al. model, each of the three factors is thought to reciprocally influence symptom presentation. For instance, cognitive/perceptual dysfunction tends to increase

disorganized behavior, which contributes to diminished interpersonal functioning, leading to additional perceptual or cognitive dysfunction.

In Raine et al.'s (1994) model each of the three superordinate factors is further divided into subordinate components. Whereas the disorganized and cognitive/perceptual factors include psychotic-like symptoms more commonly associated with “full-blown” schizophrenia (i.e., odd thinking, unusual perceptual experiences), the interpersonal factor includes features that tend to be moderate in severity (i.e., social anxiety, lack of close friends). Empirical evidence for this distinction includes the finding that probands of patients with schizophrenia and individuals with schizotypal features exhibit neurological “soft-signs” and affective disturbances that are generally intermediate between individuals with schizophrenia and healthy controls (Barenbaum et al., 2006; Henry et al., 2009). However, on measures of cognitive/perceptual distortions and disorganized behavior, these intermediate groups appear more like healthy controls (Barenbaum, Boden & Baker, 2009; Braff, 1981).

Given these findings, there is reason to believe that tendencies in affective processing are implicated in the maintenance and presentation of schizotypal traits. The interpersonal factor, as defined by Raine et al. (1994), is therefore particularly relevant to the present investigation because it includes affective disturbances and related social deficits that are central to symptom presentation.

Affect and Schizotypy

Inappropriate/constricted affect is a prominent schizotypal characteristic addressed by the theories described above. *Affect* can be defined as the subjective, transient perception of physiological and cognitive features of an emotion (Thompson, Mata, Jaeggi, Buschkeuhl,

Jonides & Gotlib, 2011). An individual's affective state is known to impact cognition and information processing, including attention (Mathews & Wells, 2002) memory (Ellis & Moore, 1999) and judgment (Clore, Gasper, & Garvin, 2001). In the context of schizophrenia spectrum disorders, affect is typically investigated in terms of both subjective experience of the pleasantness of a given emotion (i.e., affective valance) and the reflexive activation of facial musculature (i.e., affective expression). Previous literature suggests a synchrony between these domains (Kring & Neale, 1996).

A number of theories have attempted to explain how these affective tendencies contribute to schizotypic psychopathology. The predominant perspective involves a reciprocal rather than a causal relationship and stems from a theory of affective processing based on the work of Bentall and colleagues (Bentall, Corcoran, Howard, Blackwood & Kinderman, 2001; Bentall, Kinderman & Kaney, 1994). These theorists postulate that many of the positive symptoms in the schizophrenia spectrum (including peculiar perceptions and beliefs) develop through repeated negative attributions, which increase both unfavorable self-representations and the frequency of unpleasant emotions. This process would suggest that at the trait and state levels, individuals with schizotypy will experience increased negative and decreased positive affective valance that are each self-perpetuating, a finding that has been reported in subsequent research (Myin-Germeys, Nicholson, & Delespaul, 2001). Thus, researchers often examine self-reported affect among individuals with schizotypy in an effort to identify the specific emotion processing tendencies that are associated with patterns of affective valance.

Affective Valance in Schizotypy

Affective valance, or subjective hedonic experience, has been a fundamental variable in studies of affective processing in schizotypy. In one prominent investigation, Barenbaum et al., (2006) explored the emotional correlates of schizotypy and provided compelling evidence that certain facets of emotion processing are characteristic of schizotypy and that these facets contribute significantly to changes self-reported affective valance. The authors began by examining each of the three factors proposed by Raine et al., (1994) as they pertain to specific facets of affective processing including attention to emotion, emotion clarity, emotion instability/intensity, and global negative affect. Using two independent samples, one from a collegiate ($N = 247$), and one from a community population ($N = 225$), the authors utilized nested structural equation modeling (SEM) to compare patterns of self-reported affective responses among people with psychometrically defined schizotypy as measured by the Schizotypal Personality Questionnaire (SPQ, Raine et al. 1991). Findings from both the undergraduate and community samples indicated that each of the three schizotypal factors was differentially related to emotion processing and negative affect. Specifically, high levels of interpersonal disturbance (i.e., social anxiety, lack of close friends) were associated with increased negative affective valance, decreased attention to emotion, and decreased clarity of emotion, whereas high levels of cognitive/perceptual disturbances (i.e., i.e., odd thinking, unusual perceptual experiences) were associated only with increased attention to emotion. These findings remained significant after controlling for the shared variance among the dimensions of schizotypy. Moreover, the authors found a significant positive relationship between negative affective valance and affect intensity as well as a significant negative relationship between

negative affective valance and clarity of emotion, suggesting that these domains may interact, increasing the frequency of negative affective valance within the context of schizotypy.

Although this investigation is limited in its lack of control group and exclusive reliance on self-report data, it nonetheless supports the notion that abnormalities in affective valance are essential in the maintenance of interpersonal disturbances in schizotypy.

In a separate investigation, Kerns (2005) concluded that certain tendencies in emotion processing are more prevalent within schizotypy. After identifying individuals with psychometrically defined schizotypy and matched healthy controls, Kerns collected responses on the Trait Meta Mood Scale (TMMS; Salovey et al., 1995), and examined responses to a behavioral affective priming task among collegiate sample. The task is based on Klauer and Musch's (2003) stimulus asynchrony priming paradigm in which respondents are presented with an emotionally valanced prime word and then asked to make a judgment as to whether an emotionally valanced target word is good (positive) or bad (negative). Onset of the target word (stimulus) varies from short to long, with short stimulus onset asynchrony (SOA) and prime-target valance congruence related to faster reaction times in the general population (congruence effect). At a long SOA, most individuals exhibit faster reaction times when the prime and target words have a different valance (contrast effect). At a group level, an initial series of comparisons indicated that those with high schizotypal features reported both increased state negative affect and attention to emotion. These individuals were also more likely to be classified as emotionally *overwhelmed* (i.e., experience high emotion intensity, high attention to emotion, and low emotion clarity; Gohm, 2003). During the priming task, individuals with schizotypal features evidenced absent congruence effect and increased proportion of contrast errors at a short SOA.

In other words, these individuals were not as readily primed by emotionally congruent word pairs and made more errors in judging emotionally incongruent word pairs. In the long SOA condition, these differences disappeared. Differences between conditions could not be explained through trait neuroticism or state affect as they were controlled statistically in the analyses. The author notes that these findings possibly reflect intense emotion ambivalence among individuals with schizotypy, which impacts a number of affective processes, including emotion regulation and overt affective expression

Affective Expression in Schizotypy

Henry et al., (2009) examined the relationship between emotion regulatory behavior and affective expression within a schizotypal population during exposure to emotionally valenced film clips. In the first part of the study, the authors identified the upper and lower 15% of a large collegiate sample based on a self-report measure of schizotypy. They then presented these 27 high- and 27 low-schizotypy participants with an experimental task involving either expressive amplification or suppression of experienced emotions. The task comprised seven two-minute film clips alternating between neutral and amusing valence in counterbalanced order. Prior to presentation of the three amusing film clips, participants were instructed to either amplify, suppress, or naturally express emotions through their facial expression. Participants also provided self-report ratings of their affective valence following neutral and amusing clips, and video recordings of each participant allowed researchers to code facial affect. Between- and within-subject analyses based on observed facial affect revealed that only the low-schizotypy group was successful in amplifying both in response to the experimental manipulation and relative to baseline. That is, compared to the low-schizotypy group, individuals high in

schizotypy were less expressive when instructed to amplify their emotions and less expressive, in general, relative to their neutral affective state. These differences were also observed in self-report ratings of affective valance. In a follow-up study with an independent sample, the authors collected self-report data on inventories of schizotypy, emotion regulation, anxiety, depression, and social functioning. Within this sample, higher levels of suppression as an emotion regulation strategy were related to poorer social and emotional health. Further, the authors found that increased use of suppression was associated with higher levels of the three schizotypal factors (Raine et al., 1994), as well the specific domain of constricted affect. Collectively, these findings indicate a core deficit in affective regulation within schizotypy appears to involve the inability to modulate positive emotions, which may contribute to constricted affect.

A study conducted by Najolia, Cohen & Minor (2011) addressed the overlap of affective valance and affective expression among a sample of individuals with psychometrically defined schizotypy. This investigation compared schizotypic and control groups on measures of verbal affective expression during a laboratory-based, affect-inducing protocol. Participants were exposed to several blocks of slides including depicting pleasant, unpleasant or neutral images. One hundred eighteen participants made ratings of state affect before and after each block and responded verbally to prompts asking for open-ended responses describing the feelings and memories that the pictures elicited during the task. The authors performed lexical analysis (i.e., identification of relative proportions of positive versus negative words) on transcribed scripts of the participant's speech samples. Results of these analyses revealed that those with schizotypal features used a higher proportion of negative words and lower proportion of positive words compared to controls. The variability in use of emotionally charged words (either in the positive

or negative direction) was also lower within the schizotypy group as compared to controls. Moreover, results of between-group, repeated measures comparisons examining trait affect and patterns of responses to the induction procedure across conditions revealed that those with schizotypal features reported higher negative and lower positive trait and state ratings of affective valence. Pre- and post-stimulus ratings were also significantly different and interacted with this main effect, suggesting a more stable rate of change among the schizotypic group, particularly in response to unpleasant pictures. The authors note that these differences highlight affective dysfunction within schizotypy particularly as it relates to affective expression.

Taken together, these four studies support the notion that individuals high in schizotypal features experience increased negative and decreased positive affective valence and are generally less clear regarding their emotions than healthy controls. These studies demonstrate also that some elements of affective expression are constricted among individuals high in schizotypal features. Nonetheless, these results are largely dependent on self-report and observational data, creating an incomplete picture of affective valence and affective expression. Therefore, in order to achieve a more inclusive picture of affective process in schizotypy, the use of physiological measurement is warranted.

Facial Electromyography (EMG)

Electromyography is a measurement procedure that generates data regarding visually unobservable motor activity. In the context of affective expression, this motor activity is important to measure due to its association with implicit reactions and behavioral tendencies (Bradley & Lang, 2007). Early work in facial EMG highlighted the role of several major muscle groups in affective expression, including *corrugator supercilii*, which draws the brow down

toward the nose, and *zygomatic major*, which pulls the corners of the mouth back toward the ears.

Schwartz, Fair, Salt, Mendel and Klerman (1976) and Schwartz, Ahern and Brown (1979) provided some of the earliest evidence that activity in these muscle groups changed in response to positive and negative stimuli. Specifically, exposure to positive stimuli produced increased electrical activity in *zygomatic major*, whereas negative stimuli produced increased electrical activity in *corrugator supercilii*. Other research conducted independently of Schwartz and colleagues supported and extended these preliminary findings (Dimberg, 1988, 1990). Since these seminal investigations, numerous researchers have provided similar results and have linked activity in the *corrugator* and *zygomatic* muscles to broad negative and positive affect, respectively (Cacioppo, Berntson, Larsen, Poehlmann & Ito, 2000). Some data even suggest that the activity of these muscles occurs so quickly as to precede verbal recognition of affective valance (Andriassi, 2007; Dimberg & Petterson, 2000; Vacerin et al., 2010). These findings are consistent across multiple modes of evocative stimuli (e.g., imaginal, visual, olfactory, and auditory; Coan & Allen, 2007)

Psychometrically, EMG measurement is known to be highly reliable if they are collected in accordance with best practice guidelines (Fridlund, & Cacioppo, 1986; Lee, Shackman, Jackson & Davidson, 2009). Measurement of facial affect through EMG has been crucial in the validation of several emotion elicitation protocols, including the International Affective Picture System (IAPS; Lang, Bradley & Cuthbert, 2005), a collection of more than 1,000 positive, negative, and neutral pictures. Lang and Bradley (2007) note that among the normative sample for the IAPS, EMG activity over *corrugator supercilii* is generally strongest regarding pictures

that depict mutilation, threat, and danger and generally weakest regarding pictures that depict families, nature, and food. In contrast, EMG activity over *zygomatic major* is generally strongest regarding pictures that depict food, families, and babies and generally weakest regarding pictures that depict mutilation, loss, and erotica. These relationships are depicted graphically in Figure 1.

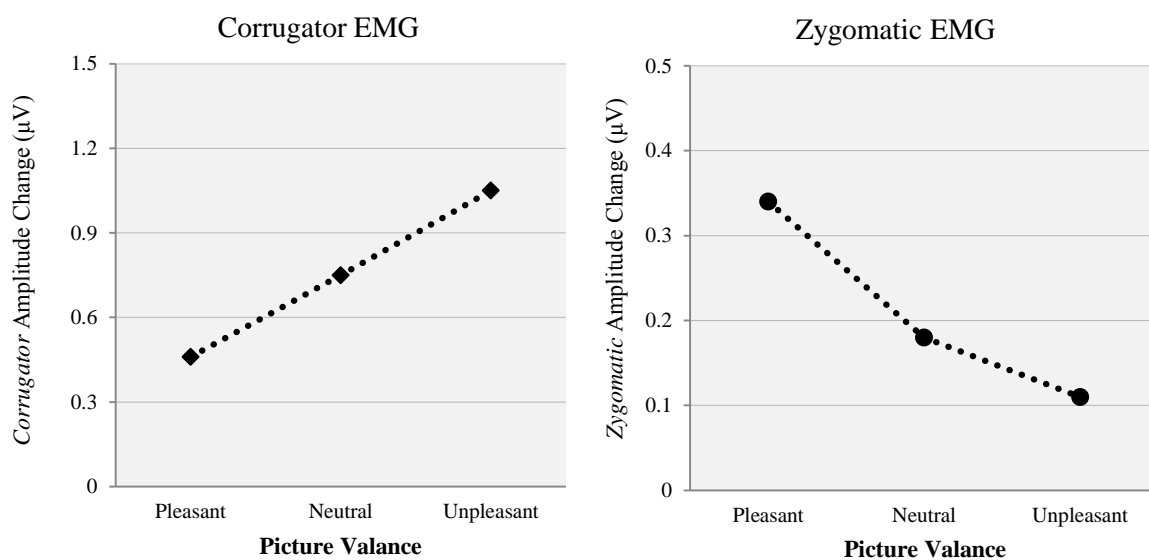


Figure 1. Normative EMG Change Scores at *Corrugator Supercilii* and *Zygomatic Major* in Response to Positive, Negative and Neutral Images (adapted from Bradley & Lang, 2007, p. 43)

Lang and Bradley (2007) also describe significant gender effects in these findings such that patterns EMG activity in men and women should be considered independently. The authors note that one limitation of these findings is the potential concordance of psychopathology during emotion elicitation, which inherently impacts emotional processing and by extension, EMG activity.

Several theorists and researchers have noted that deficits in affective processing (Kerns, 2005) and regulation (Henry et al., 2009; Kring & Werner, 2004) may be responsible for the patterns of constricted affect observed among individuals with schizotypal traits. Therefore, some have proposed that the constricted affect that is typically associated with schizotypy stems from a deficiency in adaptive affect regulation strategies or maladaptive use of intact affect regulation strategies (Henry et al., 2009). In an extension of these hypotheses, Kerns (2006) suggests that problems with cognitive control (e.g., ineffective prefrontal inhibition) may lead to these deficiencies as well as chronic “emotional confusion” (p. 419) and blunted affect. Similarly, Cohen, Morrison, Brown and Minor (2011) recently postulated that diminished cognitive resources may also contribute to constricted affect in schizotypy.

Observational and physiological data regarding constricted affect in schizophrenia clearly support decreased facial expression among these patients (Barenbaum & Oltmanns, 1992; Earnst, et al., 1996). Additionally, some researchers have noted that individuals with schizotypy and schizophrenia are less accurate also in decoding the facial expressions of others (Mandal, Pandley, & Prasad, 1998), perhaps suggesting a deficit in global processing of affective expression. Despite these efforts, no study has utilized facial EMG to examine facial affect in schizotypy. Some studies, however, have applied EMG measurement to patients with schizophrenia, and suggest potential parallel relationships with schizotypy.

Wolf, Mass, Keifer, Wiedemann, and Nabler (2006) recently reported on a new EMG method to detect facial expression in schizophrenia, involving measurement of positive affect at two other groups of muscles surrounding the mouth (*orbicularis* and *levator*) in addition to *zygomatic major*. Relative to controls, the sample of schizophrenia patients included in their

investigation did not display significant activity in *zygomatic major* in response to a positive affect induction task, whereas activity at other muscles was significantly elevated following the induction task, supporting the presence of constricted positive facial affect at *zygomatic major*. To address *corrugator* activity, Park and Kim (2011) presented emotion-eliciting film clips to control and schizophrenia groups while measuring autonomic nervous system (ANS) arousal. In addition to invariable skin conductance and elevated heart rate responses, the authors observed significantly decreased *corrugator* activity associated with negative emotions only, supporting the presence of constricted negative facial affect at *corrugator supercilii*. Given these findings, a similar trend would be expected among individuals with schizotypal features.

Statement of Purpose and Hypotheses

Taken together, investigations measuring EMG in schizophrenia documents constricted affective expression. Although these findings would be expected to extend to schizotypy, no such empirical data exists presently. Therefore, in an extension of these findings, the present investigation will rely on EMG analysis in addition to subjective description of affective valence to identify how individuals with schizotypy respond to emotionally unpleasant visual stimuli.

Empirical studies such as Barenbaum et al., (2006) and Kerns (2005) support the notion that self-reported negative affective valence is increased in schizotypy. Furthermore, empirical studies such as Henry et al. (2009), and Najolia, Cohen & Minor (2011) demonstrate that within this population, observed constricted affective expression occurs across a range of affective states (i.e., both positive and negative). In order to extend these findings, however, one methodological issue must be addressed.

Emerging technologies allow for objective and increasingly precise measurement of facial affective expression through EMG. To date, no previous studies have examined facial affect within schizotypy through objective measurement of EMG responses in *corrugator supercilii* and *zygomatic major*. Thus, measurement of affect through EMG within individuals with psychometrically defined schizotypy will extend current findings beyond previous studies that were unable to detect expressive behavior at the physiological level. The hypotheses we address in this investigation are as follows:

1. Participants' mean subjective ratings of affect in response to IAPS images will be consistent with ratings observed in the standardization sample (Lang et al., 2008). Similarly, across both groups, EMG responses to these images will be consistent with those reported by Lang and Bradley (2007).
2. Relative to healthy controls, individuals high in schizotypal features will report higher levels of negative affect in response to the threatening and distress images, but will not differ in response to neutral images.
3. Relative to healthy controls, individual high in schizotypal features will display lower levels of *corrugator* EMG activity in response to threatening and distress images, but will not differ in response to neutral images.

CHAPTER TWO: METHODOLOGY

Participants

Fifty-six individuals participated for course credit, but this sample was reduced through data inspection procedures (described below). The final sample comprised 48 undergraduate students (24 female) who ranged in age from 18 to 48 ($M = 20.46$, $SD = 4.81$). All students received course credit in exchange for their participation. The sample identified as Caucasian (66.7%), Hispanic (12.5%), African American (4.2%), Asian (4.2%), and mixed race (12.5%). The control group consisted of 20 individuals.

Self-Report Measures

Schizotypal Personality Questionnaire (SPQ; Raine, 1991).

The SPQ is a 74-item self-report questionnaire that assesses traits observed in SPD based on the Raine et al. (1994) theoretical model. Participants respond to each item by indicating whether or not a given statement applies to them. The SPQ yields a total score in addition to nine individual subscale scores, which each load onto three latent factors. The Cognitive-Perceptual factor (i.e., positive symptoms) comprises items measuring ideas of reference, odd beliefs or magical thinking, unusual perceptual experiences and suspiciousness. The Interpersonal factor (i.e., negative symptoms) comprises items measuring social anxiety, lack of close friends, constricted affect, and suspiciousness. The Disorganized factor (i.e., disorganized symptoms) comprises items measuring odd or eccentric behavior and odd speech. The SPQ has

demonstrated sound psychometrically properties with Cronbach's alphas ranging from 0.67 to 0.91.

Marlowe-Crowne Social Desirability Scale - Abbreviated (SDS-A; Reynolds, 1982).

The SDS-A is a 13-item self-report inventory that measures response biases in self-report research. Items are rated on a "yes/no" basis. Higher scores reflect greater tendency to respond in a manner that misrepresents overall behaviors. The SDS-A was included in the present study to serve as a validity manipulation and control for participants "faking good." The SDS-A has good internal consistency ($\alpha = .76$) and is highly correlated with the original Marlowe-Crowe Standard form ($r = .93$). This measure was used to filter out participants who provided biased responses during screening.

Infrequency Scale (IFS; adapted from Jackson, 1984).

The instruments described here assume that respondents understand and are compliant with the procedures involved in data screening and collection. Nonetheless, given the prospective for inattention and/or carelessness in participants' responding, the researchers included a number of items designed to serve as a validity manipulation. The Infrequency Scale of Personality Research contains three items that are answered on a "true/false" basis and describe experiences that are abundantly common for most individuals. For example, one question states "There have been a number of occasions when people I know have said hello to me." A response of "false" on this item may indicate a random pattern of responding or insufficient effort on the part of the participant. This measure was used to filter out participants who provided invalid responses during screening.

Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988).

The BAI is a 21-item self-report measure that assesses symptoms of state anxiety. Each item describes common cognitive and somatic symptoms of anxiety and is rated on a scale from 0 (*not at all*) to 3 (*severe*). BAI total score is calculated by summing ratings on all items with higher scores reflecting higher levels of anxiety. This instrument has demonstrated high internal consistency and test retest reliability (with alphas ranging from 0.85 to 0.92), and can reliably discriminate anxious (e.g., panic disorder and generalized anxiety disorder) and non-anxious (e.g., major depression) diagnostic groups. In the context of the present investigation, the BAI is intended to account for differences in anxiety between individuals in the experimental groups.

Self-Assessment Mannequin (SAM; Lang et al., 2008).

The SAM is a self-report rating system that utilizes graphic figures and numbers to assess a number of constructs. We chose to focus on the dimensional scales of affective valence (ranging from *pleasant* [9] to *unpleasant* [1]), and arousal, (ranging from *excited* [9] to *calm* [1]). High scores on the valence and arousal dimensions represent increased negative affect and decreased arousal, respectively. Figure 2 includes SAM rating scales for both of these dimensions.

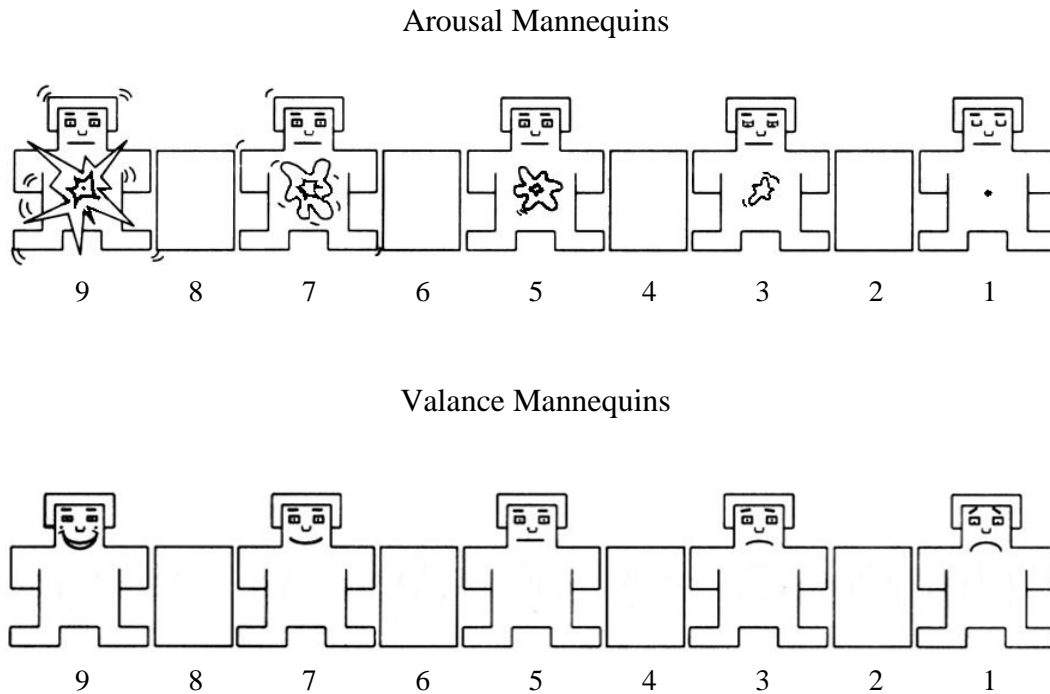


Figure 2. Self-Assessment Mannequins (SAM)

Physiological Measures

Facial Electromyography (EMG).

Facial muscle activity was measured during baseline and the picture observation task using electromyography equipment provided by MindWare Technologies Inc. (Gahanna, OH). Five cup-style Ag–AgCl facial electrodes (two measuring *corrugator supercilii*, two measuring *zygomatic major*, and one ground electrode) were filled with saline conductive gel and attached to the participant using 4-mm adhesive disks. EMG signals were collected via shielded cables through a BioNex 8-Slot Chassis (Model 3711-08) and amplified at a gain of 2000. Signals were then digitized at a sample rate of 500 and recorded through BioLab Acquisition software

(Version 3.0; MindWare Technologies, 2010) on desktop computers. Incoming signals were inspected visually and compared to a video feed of the participant's head and chest from a small, grey tabletop camera. Offline, data were subjected to a 30 Hz – 200 Hz Band Pass filter to exclude movement and eye-blink artifact and were fully rectified using MindWare EMG 3.0 biosignal processing software. To ensure assessment of a true baseline (and not the process of habituation to the experimental setting), we chose to use the first eight of the last thirty seconds of a 300-second baseline phase (i.e., seconds 270-278). Additional information regarding the baseline phase is provided below. EMG activity can be quantified using a variety of indices representing separate electrical variables. For the purposes of this investigation, mean EMG amplitude change (mean period amplitude – mean baseline amplitude) was used to assess muscle activity at these two muscle groups.

Electrodermal Activity (EDA).

Electrodermal activity is a measure of electrical fluctuations on the surface of skin. Skin conductance (SC), was assessed during baseline and the image observation task using two foam transducers placed on the thenar eminence and hypothenar eminence of participant's left hand. EDA signals were collected with shielded cables through a BioNex 8-Slot Chassis and amplified at a gain of $10 \mu\Omega$. The signal was then digitized at a sample rate of 500 and recorded through BioLab Acquisition software on desktop computers. Incoming signals are inspected visually and compared to a video feed of the participant's body. Offline, data were subjected to a 1 Hz Low Pass filter to exclude movement artifact using MindWare EDA 3.0 biosignal processing software. We were interested in two measures of skin conductance during stimulus presentation: skin conductance change (measured in microsiemens, μS) and skin conductance response count.

We derived mean SC change (ΔSC) by calculating the difference between SC value during the 8-second image presentation period relative and a comparable 8-second epoch selected during the 300-second baseline. These scores were and averaged across all images for each image category (i.e., neutral, threat, distress). SC response (SCR) count was derived from a raw count of all SC responses that occurred during the 8-second image presentation period. A SC response was defined as 0.05 μS (or greater) increase in skin conductance.

Electrocardiography (ECG).

Electrocardiography is a measure of the electrical depolarization in the cardiac muscle that is responsible for contraction. We measured HR during baseline and during the image observation task using three Ag–AgCL snap electrodes placed in standard Lead-II configuration. ECG signals were collected with shielded cables through a BioNex 8-Slot Chassis, amplified at a gain of 500 and sampled 500 times per second. Signals were then digitized and recorded through BioLab Acquisition software on desktop computers. Incoming signals were inspected visually and compared to a video feed of the participant's body. Offline, data were subjected to a 0.5 Hz – 45 Hz Band Pass filter to exclude movement artifact using MindWare HRV 3.0 biosignal processing software. The recording of this process yields several indices, including heart rate (HR, measured in beats/second), which is of particular importance in the present investigation as a decrease in HR is associated with the orienting response.

Experimental Manipulation

Affective Picture Observation Task (APOT).

The stimulus presentation paradigm comprises a series of still images chosen from the IAPS and associated SAM rating scales (Lang, Bradley & Cuthbert, 2005). Images are categorized broadly as either neutral or aversive. Aversive images include two sub-categories: threatening and others in distress. Neutral images were selected based on neutral valence and low arousal; aversive images were selected based on unpleasant valence and high arousal. All valence and arousal ratings were measured and normed using the SAM affective rating system (see Figure 2). Image categories (neutral, threatening, distress) contained five images each. Mean valence ratings for the neutral, threatening and others in distress categories were 4.96, 3.14, and 1.85, respectively. Mean arousal ratings for the neutral, threatening and others in distress categories were 2.16, 6.23, and 6.45, respectively. Appendix A provides normative means and standard deviations for the IAPS images used in the present study.

The stimuli presentation task was developed based on procedures described in previous investigations, and executed using E-Prime 2.0 software (Psychology Software Tools, 2002). Participants were seated in a comfortable chair at a desk with 19-inch color television monitor and keyboard. When the task initiated, participants were first provided audio-recorded instructions for completing SAM ratings and were allowed to engage in two practice trials. A 300-second baseline period followed this instructional procedure. The baseline period was intended to account for individual differences in physiology and to allow biological signals to stabilize. Image presentation and SAM rating procedures were identical for each trial. The image was presented for eight seconds followed by each of the SAM rating scales, presented

sequentially. On-screen text prompted participants to utilize the keypad to record their ratings on the three scales. There was no minimum or maximum time allotted for these subjective ratings. An inter-stimulus interval (randomly jittered between 30 and 40 seconds) began immediately after the final rating was made. During this interval, a blank white screen was presented on the monitor. Including the five-minute baseline, the task lasted approximately 15 minutes.

Procedure

Initial recruitment and screening procedures were conducted through a university-based study participation and management website (Sona Systems). Participants first completed a consent document describing the aim and scope of the investigation. Participants then responded to a survey containing a basic demographic questionnaire (e.g., age, sex, ethnicity), the SPQ, and the two validity scales (SDS-A and IFS). Data from the screening portion were examined and scored in order to determine participant's eligibility for part two of the investigation.

Several methods are used to define eligibility during online screening. Primarily, participants were excluded from analysis if their IFS score was greater than one, which would suggest insufficient effort and/or attention to the items included in the survey. Additionally, participants are excluded if their SDS-A score fell more than two standard deviations above the mean for all participants, which would suggest unwillingness to disclose true psychopathology on the basis of social desirability. Finally, the research team examined the duration taken to respond to the online survey. Any individual whose total completion duration fell within the bottom 10th percentile (approximately 20 minutes) are excluded to help eliminate individuals who may have not put sufficient thought or consideration into the items.

Participants who were identified as eligible for continued participation were then organized into two groups based on total SPQ scores. The Schizotypic group comprised participants who scored in the top 20% of the first 200 respondents on the SPQ. The Control group comprised those participants who score in the lowest 20% of the first 200 respondents on the SPQ. After participants in these groups were identified, the research team contacted each participant individually via email to invite them to participate in part two of study and to schedule an appointment.

Part two of the study was conducted in the Health, Emotion, and Psychophysiology Laboratory and the Schizophrenia Research Laboratory located at University of Central Florida. Upon arrival, each participant met with a graduate student investigator and undergraduate research assistant, who provided a detailed informed consent document and a brief verbal description of the data collection procedure. The investigator ensured the participant understands and consents to all procedures included in the study prior to further data collection. The participant then completed a paper-pencil self-report battery (as a component of a different study). All participants completed the SPQ a second time during this battery to ensure the reliability of each individual's online self-report.

After completing self-report inventories, participants were prepared for physiological measurement and subsequently engaged in the APOT. Preparation for physiological measurement involved cleansing, exfoliation, and placement of surface electrodes on the participant's face (EMG), torso (ECG) and palm (EDA), as well as a standard respiration belt around the participant's chest. Surface impedance between each of the facial electrodes and the ground lead was measured using a Checktrode model 1089 mk-III electrode tester (Moro Bay,

CA) before the APOT began. The participants were then presented with a set of instructions via audio recording and completed two APOT practice trials. The participants were then asked to remain seated and avoid moving for a 300-second habituation/baseline period. After termination of the task, each participant received debriefing document explaining the purpose of the study and expected results in greater detail. At that time, the participants were given the opportunity to discuss any questions with the investigator. Participants were asked also if they would be interested in participating in future studies, and if so, they provided permission for the investigator to contact them in the future.

CHAPTER THREE: RESULTS

Prior to data analyses, we inspected, catalogued, and removed all cases with invalid response sets. These cases either no longer met screening cut-off criteria on the SPQ based on the initial selection process, or were identified as multivariate outliers. Six individuals (three in the Control group and three in the Schizotypic group) were eliminated due to discrepancies greater than five-points between the original on-line screening SPQ score and the subsequent the in-person SPQ score. Additionally, four different individuals (one in the Control group, and three in the Schizotypic group) were eliminated due to multiple EMG responses that were greater than three standard deviations above the mean for their group. These responses were either due to movement artifact or participant's manipulation of the facial electrodes during recording. These multivariate statistical outliers were confirmed through Mahalanobis distance value calculation ($p < .01$).

We then compared the eliminated and retained cases on several study variables (i.e., age, SPQ full-scale scores, and SPQ factor scores), to examine whether any significant differences existed between these two groups. A one-way multivariate analysis of variance (MANOVA) revealed no significant differences between the removed and remaining cases on variables of age ($p = .99$), SPQ full-scale score ($p = .90$), or SPQ factor scores (all p 's $> .53$).

Preliminary Examination of the Study Groups

The initial step in data analysis with the final sample was to ensure independence between the Control and Schizotypic groups on several demographic and independent variables. Results of an independent samples t -test comparing mean age between two groups suggest the

Control ($M = 21.70$) and Schizotypic groups ($M = 19.43$) did not differ significantly, $t(46) = 1.65$, *n.s.* Chi-square tests of independence also indicated equivalence in the relative proportion of ethnicities within each group, $\chi^2(4, N = 48) = 4.11$, *n.s.*

The DSM-IV does not suggest whether symptom presentation differs by sex, though it does stipulate to potential sex difference in prevalence. Therefore, in examining dependent variables in this investigation, it was important to understand whether scores on the SPQ differ as a function of participant sex. To this end, we conducted a 2 (Group) X 2 (Sex) MANOVA using SPQ total scale and factor scores as outcome measures.

Multivariate tests revealed a significant main effect for group, $\Lambda = .10$, $F(6, 39) = 57.12$, $p < .001$, indicating significantly different scale scores between the experimental groups. Further analysis confirmed significant differences in SPQ total scale scores, $F(1, 44) = 208.76$, $p < .001$, $\eta^2 = .91$, as well as in Cognitive/Perceptual ($F[1, 44] = 64.98$, $p < .001$), Disorganized ($F[1, 44] = 108.86$, $p < .001$), and Interpersonal subscale scores ($F[1, 44] = 80.08$, $p < .001$), with individuals in the Schizotypic group scoring higher on each measure. Table 1 contains means, standard deviations, and F ratio comparisons for both experimental groups. There was no significant main effect for sex, nor was there a significant group by sex interaction. The main effects for group were expected given that extreme scores on these measures formed the groups. Nonetheless, the absence of a significant group by sex interaction on these scales will be important to interpretations of findings that are reported below.

Table 1. SPQ and BAI Mean Scores (SD) by Experimental Group.

Scale	Control (<i>N</i> = 20)	Schizotypic (<i>N</i> = 28)	<i>F</i> ratio (1, 46)	<i>p</i> value
SPQ-Total	6.30 (2.99)	38.71 (4.48)	217.21	< .001
SPQ-C/P	2.50 (2.60)	15.96 (7.00)	66.94	< .001
SPQ-I	2.90 (2.26)	12.75 (4.46)	81.99	< .001
SPQ-D	0.95 (1.01)	9.96 (3.79)	106.91	< .001
BAI	3.85 (3.87)	13.25 (7.33)	27.29	< .001

Note: SPQ = Schizotypal Personality Questionnaire; C/P = Cognitive/Perceptual Subscale; I = Interpersonal Subscale; D = Disorganized Subscale; BAI = Beck Anxiety Inventory.

In a subsequent ANOVA, we examined whether these groups differed on anxiety level as measured by the BAI. This analysis also indicated a main effect for group, $F(2, 43) 23.24, p < .001, \eta^2 = 0.52$, with individuals in the Schizotypic group scoring higher than those in the Control group. We did not detect a main effect for sex, nor did we detect a significant interaction among these groups. Comparisons of BAI scores in each experimental group are presented also in Table 2. Appendix B includes between group comparisons on SPQ subscales.

Verification of the Experimental Manipulation

In order to accurately assess differences between groups in self-report and facial expression, it is crucial to demonstrate that IAPS images elicited emotional responses comparable to those reported by previous researchers (see Bradley & Lang, 2007). Therefore, we examined self-report, EDA, and ECG during presentation of the images and compared these patterns to those observed in previous research. Previous research has demonstrated that

threatening and distressing images are associated with psychological changes that include increases in skin conductance and decreases in heart rate. These changes are found in the 3 to 10 seconds immediately following stimulus presentation (Bradley, Codispoti, Cuthbert & Lang 2001). Therefore, establishing that participants' physiological responses while viewing the pictures were consistent with what were found during previous research supports the validity of the APOT protocol used here.

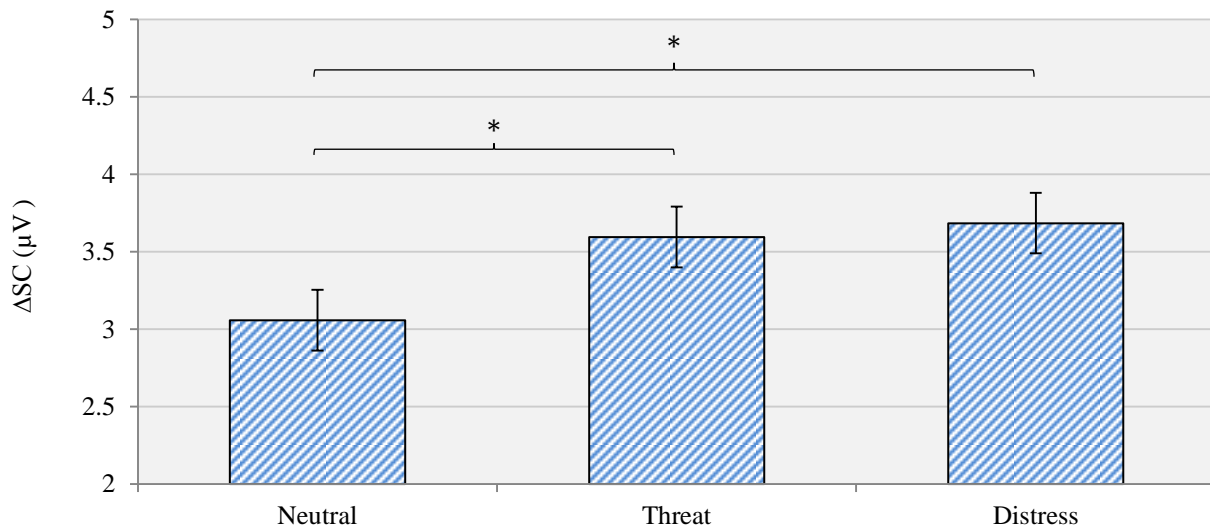
First, we conducted a series of two-sample *z*-tests to address whether mean valence and arousal SAM ratings in our full sample differed from those reported in the IAPS standardization sample (Lang et al. 2008). No significant differences in valence or arousal ratings were obtained, indicating that our participants responded to the experimental manipulation with comparable levels of valence and arousal. Appendix A contains observed means and standard deviations for the SAM ratings in the present study.

Next, we conducted a series of 2 (Group) X 2 (Sex) X 3 (Image Category) repeated measures MANOVAs using mean Δ SC, SCR count, and HR as outcome variables. Main effect and interaction terms were tested using the multivariate criterion of Wilks' Lambda (Λ). Planned pair-wise comparisons were conducted to examine between-group and within-subjects differences across the image categories.

Multivariate results testing differences in mean Δ SC and SCR count did not reveal a main effect for experimental group. However, these results did indicate main effects for both sex, $\Lambda = 0.75$, $F(2, 49) = 8.29$, $p = .001$, and image category, $\Lambda = 0.62$, $F(4, 47) = 7.24$, $p < .001$. This finding indicates that not only did these measures differ significantly between males and females,

but also that these measures varied as a function of image category. These results permitted further examination of the findings to determine the nature of these differences.

Univariate tests performed on mean Δ SC did not reveal significant main effects for experimental group or sex, but did reveal a main effect for image category, $F(2, 100) = 6.85, p = .003$. That is, relative to the neutral images, the threat and distress categories were associated with increased SCL (all p 's $< .05$). Differences within the sample are depicted graphically in Figure 3.

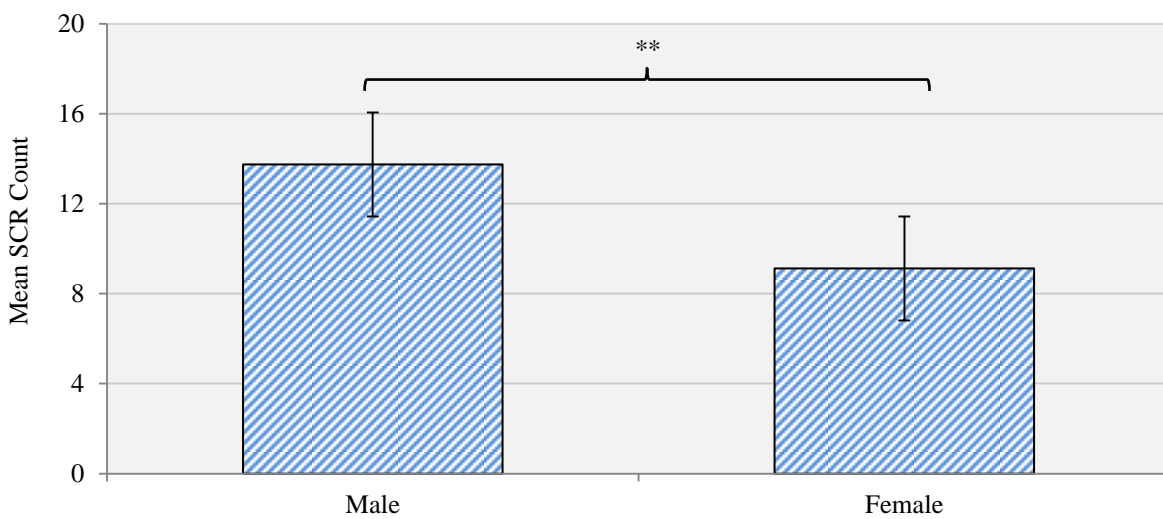


Note: Error bars denote standard error of the mean; * $p < .05$ (Tukey's correction).

Figure 3. Change in Mean SCL for All Participants While Viewing Neutral, Threat, and Distress Image Categories ($F(2, 100) = 6.85, p = .003$).

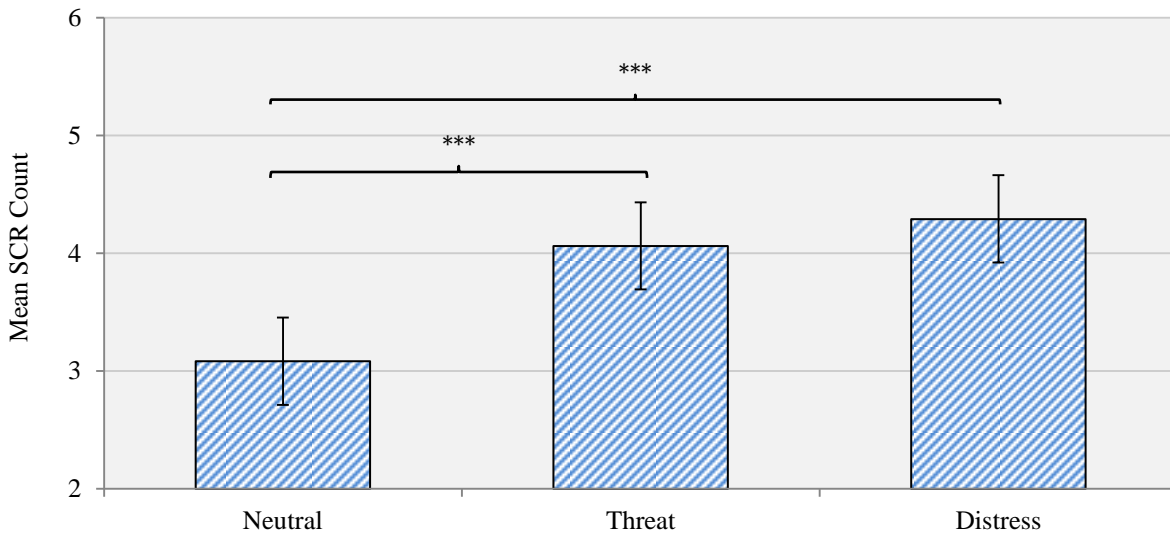
Results from univariate tests performed on SCR count also failed to detect a main effect for experimental group, but revealed a significant a significant main effect for sex, $F(1, 50)$

16.63, $p < .001$ and a main effect for image category, $F(2, 100) = 14.24, p < .001$. Figures 4 and 5 depict these differences graphically. Pairwise comparisons indicated males and females differed significantly on their mean number of SCRs, with higher response counts among males in all image categories (p 's $< .01$). Pairwise comparisons also indicated that relative to neutral images, the threat and distress categories were associated with a greater number of SCRs across the entire sample (all p 's $< .001$). This difference was not significant between the Schizotypic and Control groups.



Note: Error bars denote standard error of the mean; ** $p < .01$ (Tukey's correction).

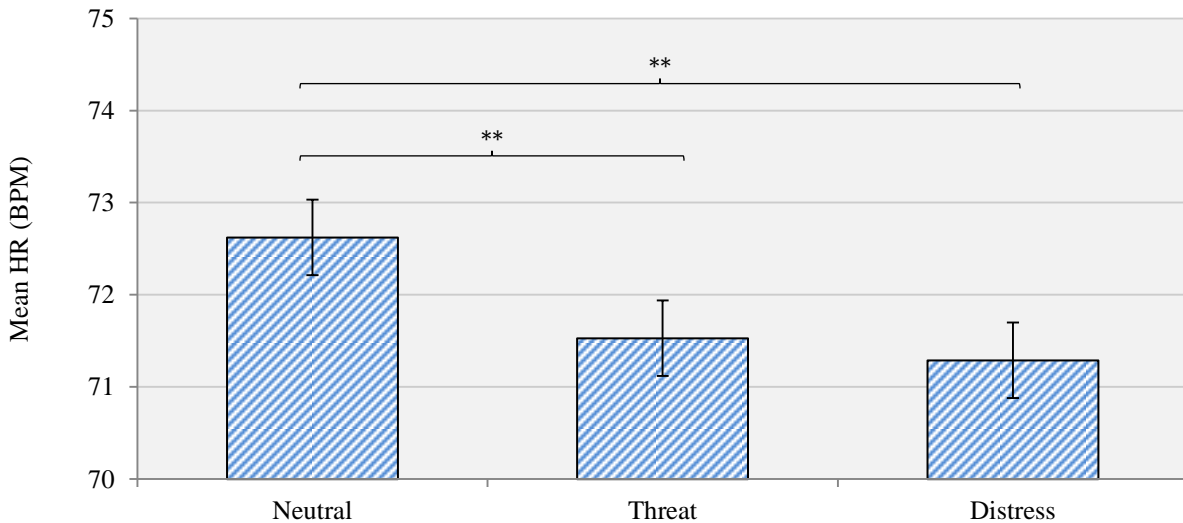
Figure 4. Mean SCR Counts in Males and Females Across All Image Categories. ($F(1, 50)$ 16.63, $p < .001$).



Note: Error bars denote standard error of the mean; *** $p < .001$ (Tukey's correction).

Figure 5. Mean SCR Counts for All Participants While Viewing Neutral, Threat, and Distress Image Categories ($F(2, 100) = 14.24, p < .001$).

Analyses pertaining to HR differences within the sample did not reveal main effects for experimental group. However, results did reveal a main effect for image category $F(2, 88) = 7.89, p < .001$, suggesting that participant's HR differed significantly as a function of image presentation. Planned comparisons revealed that across all participants HR was significantly lower during presentation of threat and distress images relative to the neutral image (p 's $< .01$). The threat and distress images were not, however, significantly different from one another. These findings are depicted graphically in Figure 6.



Note: Error bars denote standard error of the mean; ** $p < .01$ (Tukey's correction).

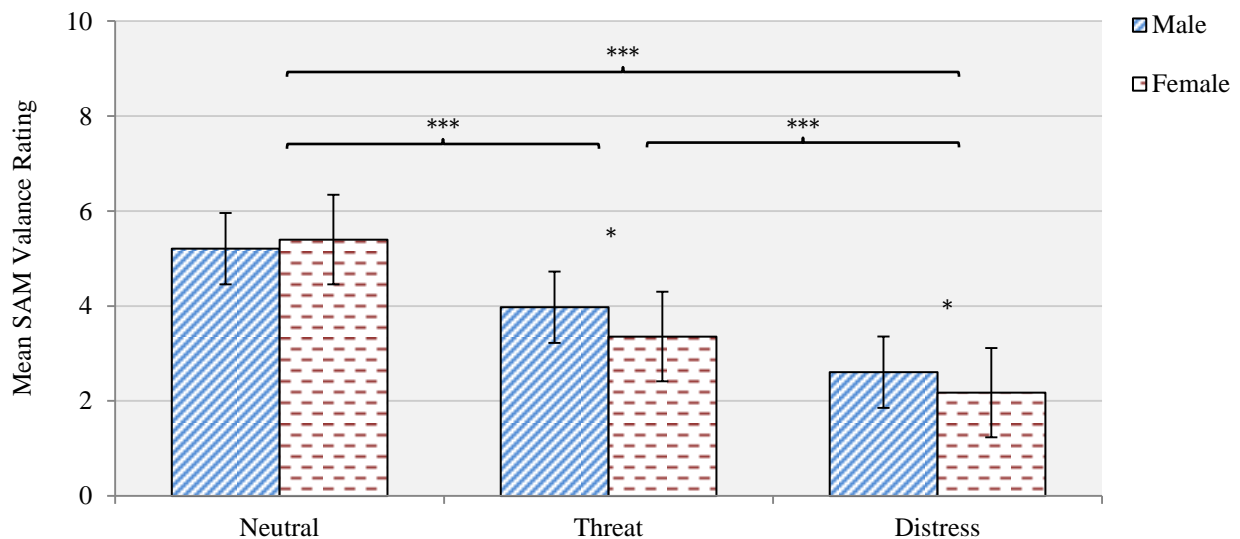
Figure 6. Comparison of Mean HR for All Participants While Viewing Neutral, Threat, and Distress Image Categories ($F(2, 88) = 7.89, p < .001$)

In conjunction with the EDA findings described above, these results provide sufficient evidence to suggest that the APOT experimental manipulation elicited the physiological responses similar to the original Bradley and Lang (2007) standardization protocol, permitting further analysis self-report and EMG data by group.

Self-Report Ratings While Viewing Neutral, Threat, and Distress Images

A 2 (Group) X 2 (Sex) X 3 (Image Category) repeated measures MANOVA was then conducted to determine whether the Control and Schizotypic groups differed in their SAM valence and arousal ratings. Main effect and interaction terms were tested using the multivariate criterion of Wilks' Lambda (Λ). Planned pair-wise comparisons were conducted to examine

between-group and within-subjects differences across the image categories. Omnibus tests of the full model did not reveal main effects for either group or sex. These tests did reveal a main effect for image category, $\Lambda = .12$ $F(2, 43) = 82.55, p < .001, \eta^2 = 0.88$, as well as a sex by image category interaction, $\Lambda = 0.80, F(4, 41) = 3.35, p = .052, \eta^2 = 0.20$, suggesting that valance and arousal ratings changed across the three image categories and the rate of change were different as a function of sex. All findings reported here are presented graphically in Figure 7.



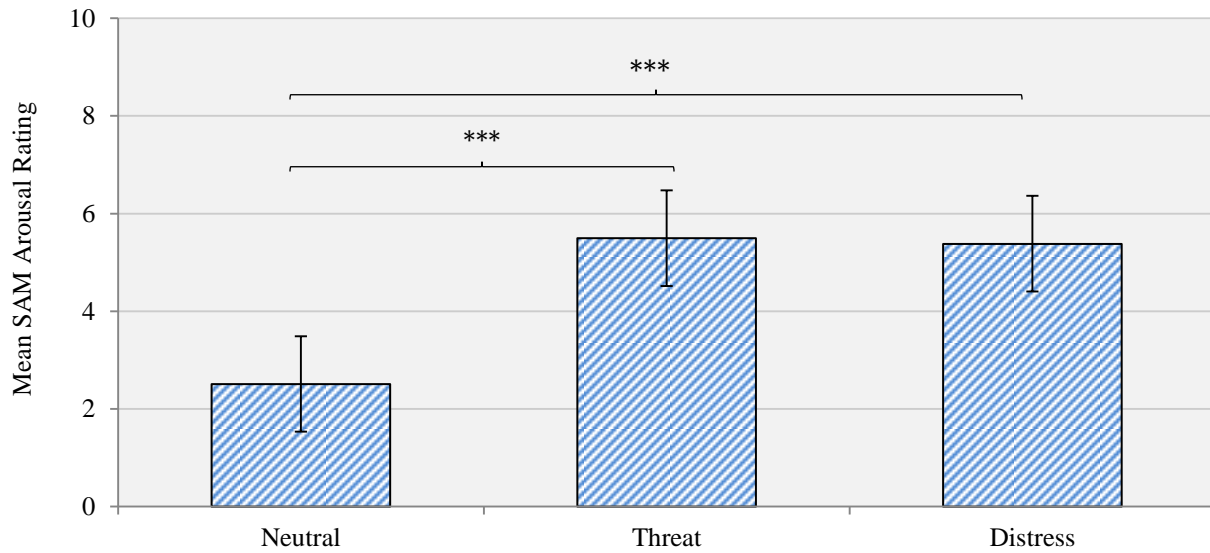
Note: Error bars denote standard error of the mean; * $p < .05$, *** $p < .001$ (Tukey's correction)

Figure 7. Mean SAM Valance Ratings by Sex and Image Category ($F(2, 88) = 4.43, p = .016$).

Results of tests comparing valance ratings did not reveal main effects for group or sex, but confirmed a main effect for image category, $F(2, 88) = 184.30, p < .001$, partial $\eta^2 = 0.81$,

suggesting that both the Control and Schizotypic groups self-reported increased negative valance across image categories, but that these groups did not differ significantly from one another on these responses. The group by image category interaction failed to reach significance. This pattern indicates that valance ratings in a given image category was not dependent on group membership. Planned within-subjects contrasts confirmed that while both groups rated the threat images more negatively than the neutral images ($p < .001$), and the distress images more negatively than the threat images ($p < .001$), these ratings did not vary by group membership. Although we did not detect differences in valance ratings as a function of participant sex, a significant sex by image category interaction was obtained, $F(2, 88) = 4.43, p = .016, \eta^2 = 0.09$, indicating compared to males, females tended to respond with increased negative affect in the threat and distress image categories relative to the neutral category (both p 's $< .05$).

A different trend was observed on ratings of arousal in response to the three image categories. There was no main effect for experimental group or sex, but a main effect for image category was obtained $F(2, 88) = 128.57, p < .001, \eta^2 = 0.75$, suggesting that arousal ratings differed significantly within groups but that this pattern was equivalent across groups and sex (see Figure 8). No interactions reached significance. Planned within-subjects contrasts revealed significantly lower arousal ratings in the neutral images relative to the threat and distress categories, (all p 's $< .001$). Taken together, these findings reveal relatively uniform patterns in self-reported valance and arousal across experimental groups at each level of image category, with some evidence for increased self-reported negative affect among females when viewing threatening images and images of others in distress.



Note: Error bars denote standard error of the mean; *** $p < .001$ (Tukey's correction).

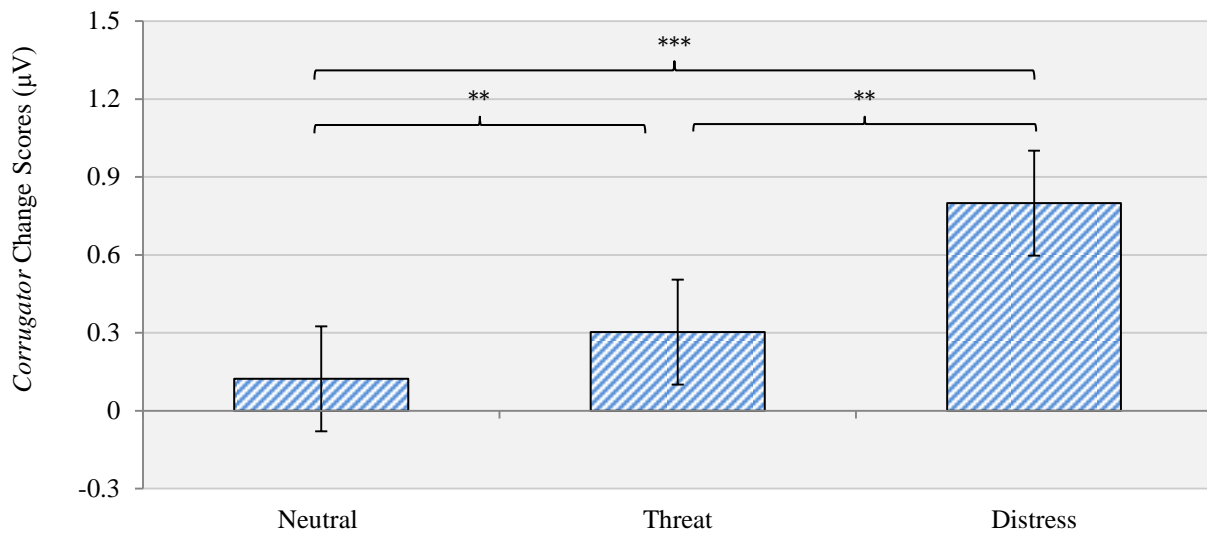
Figure 8. Mean SAM Arousal Ratings Across All Participants ($F(2, 88) = 128.57, p < .001$).

Facial EMG While Viewing Neutral, Threat and Distress Images

Prior to further data analysis, we determined that EMG responses to each of the five images within each category were not significantly different from one another (all p 's $> .27$), permitting image categories to be averaged into a single variable. In addition, known EDA and ECG differences between males and females prompted us to include sex as a nested factor in order to control for potentially discrepant physiological patterns (see Carillo et al., 2001 for a review). Therefore, analyses testing our fourth hypothesis were based on a 2 (Group) X 2 (Sex) X 3 (Image Category) repeated measures MANOVA run separately for *corrugator* and *zygomatic* EMG as dependent measures. Main effect and interaction terms were tested using the

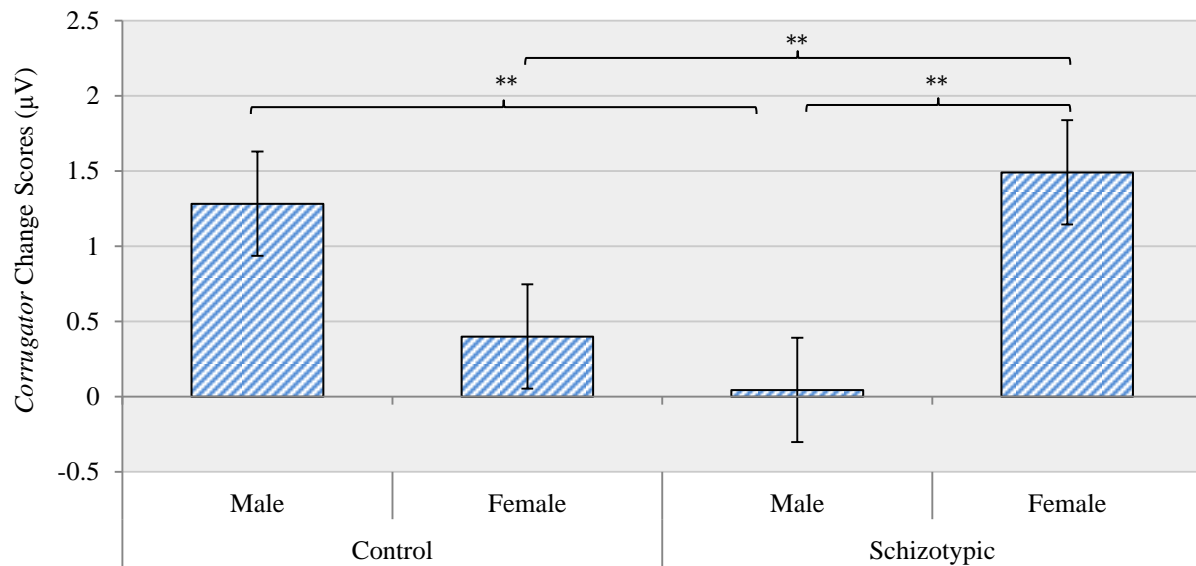
multivariate criterion of Wilks' Lambda (Λ). Planned pair-wise comparisons were conducted to examine between-group and within-subjects differences across the image categories.

Analyses pertaining to differences in *corrugator* muscle activity did not indicate main effects for group or sex, but revealed a significant main effect for image category, $F(2, 88) = 15.89, p < .001$, partial $\eta^2 = 0.27$ (see Figure 9). Planned comparisons revealed that across the full sample, the threat ($p < .01$) and distress ($p < .001$) image categories were associated with increased *corrugator* activation compared to neutral images. *Corrugator* activation in the distress image category was also significantly greater than the threat category ($p < .01$). Males in the Schizotypic group evidenced particularly limited *corrugator* activity, with some decreases in *corrugator* activity relative to both baseline and males in the control group.



Note: Error bars denote standard error of the mean; ** $p < .01$ (Tukey's correction).

Figure 9. Mean *Corrugator* Change Scores For All Participants While Viewing Neutral, Threat, and Distress Images ($F(2, 88) = 15.89, p < .001$).



Note: Error bars denote standard error of the mean; ** $p < .01$ (Tukey's correction).

Figure 10. Mean Corrugator Change Scores by Group and Sex While Viewing Distress Images ($F(2, 88) = 5.08, p = .007$).

In addition, we detected a significant three-way interaction between group, sex, and image category $F(2, 88) = 5.08, p = .01, \eta^2 = 0.10$, indicating differing patterns in *corrugator* activation. In response to the distress images *corrugator* activity was significantly different between males and females in both experimental groups (all p 's $< .01$). Whereas females in the Schizotypic group responded with significantly higher *corrugator* EMG relative to both females in the Control group ($p = .028$) and males in the Schizotypic group ($p = .004$), males in the Schizotypic group responded with significantly lower *corrugator* activity to the distress images relative to males in the Control group ($p = .013$) and females in the Schizotypic group. These

differences are depicted graphically in Figure 10. Analyses examining *zygomatic major* revealed no significant main effects or interactions for experimental group, sex, or image category.

CHAPTER FOUR: CONCLUSIONS

The purpose of this investigation was to examine patterns of self-reported affect and affective expression within a schizotypic population. To achieve this purpose, we presented two groups of individuals (a control group and a group with psychometrically defined schizotypy) with neutral, threatening and distressing visual images and measured self-reported affective valance and arousal as well as facial EMG during image presentation.

Preliminary examination of the data indicated that the Schizotypic and Control groups did not differ demographically. Males and females within each group also did not differ on schizotypal factors or anxiety level. Verification of the experimental manipulation suggested that overall our sample performed as expected given the self-report IAPS ratings provided by Lang et al., (2008). Moreover, elevated EDA and decreased ECG measurements across the full sample supported the effectiveness of our experimental manipulation at an autonomic level.

Compared to one another, the Control and Schizotypic groups' SAM ratings of valance and arousal were not significantly different. In the full sample, however, self-reported affective valance did vary as a function of sex. Interestingly, we found that these male-females differences also varied by image category. Relative to neutral images, the threat and distress images were associated with a larger discrepancy in affective valance, with higher negative affective valance among females. The lack of significant differences between experimental groups on SAM valance and arousal ratings is unexpected given previous research within this population. Recently published findings may help clarify this discrepancy. Yan, et al. (2012) reported results of a meta-analysis suggesting that individuals on the schizophrenia spectrum may not differ in valance and arousal experiences compared to those not on this spectrum. The authors concluded

that within this population, current (state) ratings of valance and arousal are not subject to complex cognitive processing that tends to interfere with noncurrent (trait) affective ratings. Though speculative, this conclusion would account for differences in trait measures (i.e., SPQ) and not state measures (i.e., SAM ratings) observed in our sample.

EMG results indicated that negative affective expression increased parametrically as images became progressively unpleasant, with particular elevation occurring in response to distress images. Evidence from studies in gender differences in physiological activity (Carillo et al., 2001) prompted us to include participant sex as a nested factor. Males in the Schizotypic group evidenced markedly decreased negative affective expression relative to both Control males and Schizotypic females. In the case of neutral and threat images, this particular group responded with decreased *corrugator* activity, a pattern that has even been linked to constricted/flattened affect (Larsen et al., 2003). These findings are consistent with both descriptions of blunted/inappropriate affect outlined in the DSM-IV-TR, and current theories describing emotion-processing deficits among this population. Females in the Schizotypic group, however, evidenced a different pattern of responses during distress image presentation, which encompassed significantly increased negative affect relative to Control females and Schizotypic males. While this pattern represents some degree of consistency with the elevated female response pattern detected on self-report SAM ratings, it conflicts with descriptions of blunted/inappropriate affect. We were surprised and excited by the sex differences observed in the present sample, and we argue that these findings demonstrate an as yet unidentified sex effect in affective expression deficits within this population.

In an effort to account for gender differences in some facets of the SPQ (Fossati, Raine, Carretta, Leonardi, & Maffei, 2003), as well as slightly higher SPD prevalence rates among males (Lenzenweger, 2009), several theorists and researchers have advanced the notion that all personality disorders develop from underlying biological factors and vary solely as a function of environment or sociocultural influence, including gender roles (Cloninger, 1986; Depue & Lenzenweger, 2005). While speculative, females with schizotypal traits may not evidence flattened or inappropriate affect, despite the presence of other prototypical schizotypic symptoms. Recently, Guerra (2005) reported that females with elevated schizotypal traits scored higher on the 'Big Five' measure of *Openness to Experience* compared to males with equivalent traits. Previous research indicates that higher levels *Openness* are associated with a greater tendency toward emotional expressivity (Gross & John, 1995), clarifying why the female schizotypic subgroup responded the way they did.

In light of the physiological findings, it seems that the group by sex effects observed here may carry significant clinical implications. Most notably, the tendency for schizotypic females to respond with heightened (as opposed to flattened) negative affect in some situations could obscure the diagnostic procedure. Clinicians who rely on behavioral observations to assess blunted affect may not be able to detect such behaviors among females in this population, potentially contributing to underdiagnosis, and therefore, discrepant prevalence rates. Consideration of how presentation of this syndrome varies between males and females would allow for increasingly detailed observations, thereby strengthening assessment protocols.

This study contains several procedural and methodological limitations. First, the relatively small size of the final sample limits the power of the statistical analyses. Equivalent

cell sizes and a minimum n of 15 for each cell are traditional analytic guidelines for both ANOVA and MANOVA. By these standards, the analyses presented here may carry certain interpretive limitations. Another limitation includes the possible confound of emotion-related third variables. For example, depressed mood is typically associated with limited affective expression in response to both positive and negative stimuli. Because mood ratings were not collected, it is impossible to control for this variable. In light of these shortcomings, there exists great potential for future research in this area.

One particularly important extension of this investigation involves examination of affective responses to positively valenced stimuli in addition to the neutral and negative stimuli presented here. In the context of this paradigm, being exposed to increasingly pleasant images for example, may contribute to ambivalence in emotional expression in a schizotypal population. Moreover, as outlined by Land et al., (2008), the IAPS images can also be organized into basic descriptive categories (e.g., mutilation, loss, food, erotica), which may themselves alter patterns of affective responses. Indeed, within the threat category presented here, some threat images depicted interpersonal threat (i.e., an angry male face), where as other images contained natural threat (i.e. a snake preparing to strike). Given the observed interpersonal sensitivity within the schizotypic population, such a distinction may be empirically relevant. Finally, in light of the finding that images of others in distress were related to differential EMG activation, it is important to consider whether contextual factors can affect schizotypic symptom presentation. The present findings may have repercussions, for instance, on the notion that those with schizotypal features are ineffective in processing emotions of others (Henry, Bailey, & Rendell, 2008; Mandal, Pandley, & Prasad, 1998).

**APPENDIX A:
STADARDIZATION AND OBSERVED SAM RATINGS**

Table 2a. Comparison of Normative and Obtained Valance Ratings^a for IAPS Images and Categories

IAPS Image Number; Description	Lang et al., (2008) M (SD)	Mitchell (2012) M (SD)
Neutral		
7000; rolling pin	5.00 (0.84)	5.41 (1.12)
7010; wicker basket	4.94 (1.07)	5.09 (0.73)
7175; lamp	4.87 (1.00)	5.30 (0.86)
7090; book	5.19 (1.46)	5.67 (1.32)
7080; fork	5.27 (1.09)	5.31 (0.84)
Threat		
1114; open mouthed snake	4.03 (2.16)	4.13 (1.42)
1525; attack dog	3.09 (1.72)	3.52 (1.13)
2120; close-up of angry male face	3.34 (1.91)	4.35 (1.41)
6260; gun pointed at observer	2.44 (1.54)	2.98 (1.42)
6830; masked man with guns	2.82 (1.81)	3.37 (1.42)
Distress		
9413; men being hanged	1.76 (1.08)	2.59 (1.13)
2703; crying children	1.91 (1.26)	2.11 (1.14)
9075; starving child	1.29 (0.64)	2.35 (1.27)
6550; woman held at knife point	2.73 (2.38)	2.24 (1.33)
3168; mutilated face	1.56 (1.06)	2.72 (1.28)

Note: ^a ranges from 1 (*unpleasant*) to 9 (*pleasant*)

Table 2b. Comparison of Normative and Obtained Arousal Ratings^b for IAPS Images and Categories

IAPS Image Number; Description	Lang et al., (2008) M (SD)	Mitchell (2012) M(SD)
Neutral		
7000; rolling pin	2.42 (1.79)	2.65 (1.68)
7010; wicker basket	1.76 (1.48)	2.30 (1.60)
7175; lamp	1.72 (1.26)	2.59 (1.83)
7090; book	2.61 (2.03)	2.57 (1.73)
7080; fork	2.32 (1.84)	2.19 (1.53)
Threat		
1114; open mouthed snake	6.33 (2.17)	5.31 (1.98)
1525; attack dog	6.51 (2.25)	5.78 (1.82)
2120; close-up of angry male face	5.18 (2.52)	5.00 (1.86)
6260; gun pointed at observer	6.93 (1.93)	6.44 (1.99)
6830; masked man with guns	6.21 (2.23)	5.20 (1.92)
Distress		
9413; men being hanged	6.81 (2.09)	4.57 (1.83)
2703; crying children	5.78 (2.25)	5.74 (2.06)
9075; starving child	6.57 (2.39)	6.43 (1.90)
6550; woman held at knife point	7.09 (1.98)	5.96 (1.92)
3168; mutilated face	6.00 (2.46)	5.19 (1.99)

Note: ^b ranges from 1 (*calm*) to 9 (*excited*)

**APPENDIX B:
SPQ SUBSCALE SCORES BY GROUP**

Table 3. SPQ Mean Subscale Scores (*SD*) By Group

Subscale	Control (N = 20)	Schizotypic (N = 28)	<i>F</i> ratio (1, 46)	<i>p</i> value
Ideas of Reference	1.20 (1.50)	5.32 (2.51)	41.29	< .001
Magical Thinking	0.10 (0.31)	2.68 (2.58)	19.65	< .001
Unusual Perceptions	0.60 (0.99)	3.75 (2.22)	34.64	< .001
Paranoid ideation	0.60 (0.99)	4.21 (2.04)	53.16	< .001
Social Anxiety	1.65 (1.46)	5.25 (2.54)	35.85	< .001
Constricted Affect	0.75 (1.12)	4.29 (2.21)	42.02	< .001
No Close Friends	0.50 (0.69)	3.21 (1.37)	68.33	< .001
Odd Behavior	0.25 (0.55)	4.07 (2.34)	51.57	< .001
Odd Speech	0.70 (0.73)	5.89 (2.10)	111.31	< .001

**APPENDIX C:
IRB APPROVAL LETTER**



University of Central Florida Institutional Review Board
 Office of Research & Commercialization
 12201 Research Parkway, Suite 501
 Orlando, Florida 32826-3246
 Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1
 FWA00000351, IRB00001138**

To: **Kathleen Ragsdale and Co-PIs: Daniella Schlander, Jonathan Mitchell, Lisa S. Kadison,
 Thomas A. Altro**

Date: **October 13, 2011**

Dear Researcher:

On 10/13/2011, the IRB approved the following minor modification to human participant research until 06/22/2012 inclusive:

- Type of Review: IRB Addendum and Modification Request Form
- Modification Type: A new measure that includes the TEPS and ACIPS has been added to the study.
- Project Title: Personality traits related to skin conductance response to affective pictures
- Investigator: Kathleen Ragsdale
- IRB Number: SBE-11-07728
- Funding Agency:
- Grant Title:
- Research ID: N/A

The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <https://iris.research.ucf.edu> .

If continuing review approval is not granted before the expiration date of 06/22/2012, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewska, Ph.D., L.C.S.W., CF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 10/13/2011 04:20:53 PM EDT

**APPENDIX D:
COPYRIGHT PERMISSION LETTER**

Tuesday, February 5, 2013 5:10:17 PM ET

Subject: FW: Academic Permissions Request Form
Date: Friday, December 7, 2012 5:15:24 AM ET
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Dear Mr Mitchell,

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Z_TheirTitle	Measurement of Negative Affectivity in Psychometrically Defined Schizotypy Using Facial Electromyography
Z_Author	Jonathan Mitchell
Z_Publisher	University of Central Florida
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Page 1 of 2

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Z_Title1	Handbook of Emotion Elicitation and Assessment
Z_editedby1	J.A. Coan & J. J. B. Allen
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