TRIARCHIC PSYCHOPATHY AND RESPONSE TO AFFECTIVE PICTURES: AN EVENT-RELATED POTENTIAL AND STARTLE EYEBLINK STUDY

A Dissertation

by

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ABSTRACT

The triarchic model describes psychopathy as comprised of three traits: boldness (low negative affect, sensation seeking), meanness (antagonism, poor attachment), and disinhibition (low emotional and behavioral constraint). Within the field of psychopathy, there are increasing calls to examine (1) the potentially configural nature of the disorder, (2) use experimental tasks to elucidate the nature of triarchic traits, and (3) incorporate psychophysiological measures into study design. Thus far, the small body of work that does partially address these issues is limited because studies often fail to investigate psychopathy alongside internalizing symptomatology that may share common neurobiological correlates (e.g., blunted reactivity in depression and psychopathy). To help address these gaps in the literature, the current study measured both psychophysiological (electroencephalography, electromyography) and subjective measures (valence, arousal) of affective reactivity while undergraduate participants completed a passive picture viewing task that included unpleasant, neutral, and pleasant pictures. Participants were recruited along high and low levels of boldness and disinhibition (High Boldness/High Disinhibition; High Boldness/Low Disinhibition; High Disinhibition/Low Boldness) to examine potential differences in affective reactivity across configuration. Groups varied in affective reactivity only to an event-related potential (ERP) reflecting early affective reactivity (the P3), such that the High Boldness/High Disinhibition group displayed a larger P3 to pleasant pictures relative to the High Disinhibition/Low Boldness group. Groups did not differ in the late-positive potential, an ERP component reflecting elaborative processing of emotional stimuli, or startle eyeblink response. In addition to group results, regression analyses were conducted where measures of meanness and internalizing symptoms (depression, anxiety) were entered as simultaneous predictors of both psychophysiological (P3, LPP, startle) and subjective (valence, arousal) measures of affective reactivity. Individuals higher in meanness rated unpleasant pictures as more pleasant and less arousing, whereas depression and anxiety were unrelated. In contrast, greater depression was associated with a smaller P3 to unpleasant pictures, whereas greater anxiety was associated with a larger P3 to unpleasant pictures. Meanness was a trending significant predictor of the P3 to unpleasant pictures. Results suggest modest support for differences in affective reactivity across configuration of triarchic traits.

DEDICATION

This dissertation is dedicated to my family, friends, and mentors for their continuous support.

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1. INTRODUCTION

Despite decades of research, psychopathic personality disorder (PPD) remains the subject of substantive debate within personality and clinical psychology (Lilienfeld, Patrick, Benning, Berg, Sellbom, & Edens, 2012; Miller & Lynam, 2012). The scope of this discussion includes the centrality of criminal behavior (Skeem & Cooke, 2010) and whether psychopathy is a unitary or multidimensional construct (Skeem, Polaschek, Patrick, & Lilienfeld, 2011). Recent work has focused on the triarchic model of psychopathy (Patrick, Fowles, & Krueger, 2009), which argues psychopathy is comprised of boldness (low anxiety, social poise), meanness (callousness, interpersonal antagonism), and disinhibition (poor emotional and behavioral constraint). This model is highly influential (~ 690 citations) and has spurred debate focusing predominantly on the inclusion of ostensibly adaptive traits (i.e., boldness) into a model of personality pathology (Lilienfeld et al., 2012; Miller & Lynam, 2012). Despite the controversy, boldness has received some acceptance within the field. This is perhaps most evident in the alternative model of personality pathology in the *Diagnostic and Statistical Manual, 5th edition* by the inclusion of a boldness-like psychopathy specifier (low anxiousness, low submissiveness, high attention seeking) for the Antisocial Personality Disorder diagnosis (DSM-5; APA, 2013).

The triarchic model was developed to (1) reconcile contradictory findings and (2) provide a stronger link between psychopathic traits and neurobiological constructs (Patrick et al., 2009; Patrick & Drislane, 2014). Boldness and, to a lesser extent, meanness are the manifestation of trait fearlessness, which is characterized by reduced threat sensitivity and relates to reduced negative affectivity (Patrick et al., 2009). Disinhibition is the phenotypic expression of an externalizing vulnerability that is characterized by executive dysfunction and frequently related to poorer affective and behavioral constraint (Patrick et al., 2009). These neurobiological constructs are conceptualized as orthogonal to each other (Patrick et al., 2009), although research on self-report triarchic scales find modest to moderate intercorrelations among them (e.g., Donnellan & Burt, 2016; Ruchensky, Donnellan, & Edens, in press). Despite the emphasis on neurobiological referents, research on the triarchic model that incorporates neurobiological measures is relatively scarce. This study will help fill this gap by examining the relationship between triarchic traits and deficits in affective reactivity as measured by electrocortical and startle eyeblink response.

1.1. Models of Psychopathy

1.1.1. Historical Accounts of Psychopathy, Anxiety, and Fear

According to the triarchic model, these affective deficits and their phenotypic expression (i.e., boldness) reflect historical conceptualizations of psychopathy that emphasize low anxiety, fearlessness, and adaptive functioning (Patrick et al., 2009). Cleckley's (1946/1976) seminal description of psychopathic traits includes quasi-adaptive features, such as intelligence and the absence of psychotic and neurotic symptoms. Moreover, Cleckley (1956/1976) characterized the prototypical psychopath as the confluence of the appearance of psychological health that belies severe internal dysfunction. Specifically, the prototypical psychopath "appears almost as incapable of anxiety as of profound remorse" (Cleckley, 1976, p. 340). Nonetheless, it is important to note that debate exists regarding the appropriate interpretation of Cleckley's writings – much of which focuses on whether psychopaths experience similar or lower levels of anxiety relative to healthy controls and on the centrality of quasi-adaptive features to Cleckley's description (Lilienfeld, 2013; Marcus, Fulton, & Edens, 2013; Neumann, Johansson, & Hare, 2013; Skeem et al., 2011).

Initial findings on the role of anxiety and psychological distress found that Clecklyan psychopaths (based on Minnesota Multiphasic Personality Inventory results) reported reduced anxiety and displayed diminished galvanic skin response (GSR) in a fear conditioning paradigm relative to healthy controls (Lykken, 1957). These results supported Lykken's (1957) fearlessness hypothesis of psychopathy, which theorizes that psychopaths are demarcated from healthy individuals by reduced sensitivity to threats/reduced fear. Similar to Cleckley's seminal writings, Lykken's work spurred decades of research and debate on the role of anxiety and fear in psychopathic individuals (Lorber, 2004; Marsh & Blair, 2008; Newman & Brinkley, 1997; Sylvers, Brennan, & Lilienfeld, 2011). Much of this work (e.g., Mokros, Hare, Neumann, Santtila, Obermeyer, & Nitschke, 2015; Newman, MacCoon, Vaughn, & Sadeh, 2005; Skeem, Johansson, Andershed, Kerr, & Eno Louden, 2007; Skeem, Poythress, Edens, Lilienfeld, & Cale, 2003; Vaughn, Edens, Howard, & Smith, 2009) has focused on identifying subtypes of psychopathy that differ largely on the presence of internalizing symptoms (e.g., anxiety), as described by Lykken and Karpman (1941, 1955).

Historically, this literature describes differences between 'primary' and 'secondary' psychopaths primarily in terms of anxiety (Karpman, 1941). Both have high levels of psychopathic traits, but presumably differ in terms of etiology and other important psychopathological characteristics. That is, primary psychopaths are thought to develop from biological predispositions and are marked by high psychopathic traits and the absence of negative affect. In contrast, secondary psychopaths are thought to develop in response to external stressors (e.g., childhood trauma) and are marked by high psychopathic traits and the presence of internalizing symptoms. These etiological differences explain affective deficits in primary psychopaths, such that they experience diminished psychological distress (Karpman, 1941), and secondary psychopaths, who have greater affective instability and may present with an interaction of psychopathic and borderline personality disorder traits (Karpman, 1941; Skeem et al., 2007). Although research investigating purported etiological differences across these subtypes is scant, research generally supports at least the phenotypic distinction between these two types of psychopaths (e.g., Skeem et al., 2007; Vaughn et al., 2009) and dovetails with evidence that "psychopathy" is a heterogeneous disorder that can manifest with varying configurations of personality traits, psychopathology, and neurobiological functioning (Patrick et al., 2009).

1.1.2. Hare Model of Psychopathy

Perhaps the most dominant model of psychopathy is found in factor-analytic work of Hare's (2003) Psychopathy Checklist-Revised (PCL-R) (Skeem et al., 2011). The PCL-R is an interview and file-based measure based in part on Cleckley's description of psychopathy (Hare, 2003; Patrick et al., 2009). Initial exploratory factor-analytic work identified two separable dimensions within the 20 items comprising the PCL-R (Hare, Harpur, Hakstian, Forth, Hart, & Newman, 1990; Harpur, Hare, & Hakstian, 1989). Factor 1 reflects interpersonal and affective deficits (e.g., callousness, poor attachment), whereas Factor 2 reflects antisocial deviance (e.g., poor behavioral constraint, criminality; Hare et al., 1990; Harpur et al., 1989; Skeem et al., 2011). Subsequent research has parsed out three (Cooke & Michie, 2001) and four (Vitacco, Rogers, Neumann, Harrison, & Vincent, 2005) facet models within these 20 items to resolve issues of poor fit for the original two factor model. The two-factor model, however, has historically received the most attention from the research community.

Although widely used in clinical practice (DeMatteo & Edens, 2006), the PCL-R has been criticized for several conceptual and empirical limitations (Edens, Boccaccini, & Johnson, 2010; Patrick et al., 2009; Skeem & Cooke, 2010). For example, scholars have argued that the PCL-R conflates overt behavioral indicators of criminality with meaningful individual differences in personality constructs (Skeem & Cooke, 2010). This likely is the result of a scale development process that relied exclusively on forensic and correctional samples for the construction and validation of the PCL-R measure. This reliance reflects a general trend in forensic psychology that contributes to the unfortunate conflation of PPD with criminality (Skeem & Cooke, 2010). Also, the PCL-R inadequately covers ostensibly adaptive traits, such as low anxiety and fearlessness, that Cleckley and others included in their description of psychopathic individuals (Patrick et al., 2009). Although PCL-R scores tend to correlate negatively with indicators of negative affect and anxiety (e.g., Neumann et al., 2013; Pereira, Huband, & Duggan, 2008), items explicitly measuring adaptive traits were excluded from the final version of the PCL-R (Hare, 2003; Patrick et al., 2009).

Research investigating the relationship between internalizing pathology, neuroticism, and the PCL-R tends to find that the individual factors exhibit diverging patterns of associations. For example, interpersonal and affective deficits correlate negatively with measures of negative affect such as anxiety and depression (Harpur et al., 1989; Hicks & Patrick, 2006; Patrick et al., 2009), whereas impulsive dimensions correlate positively with distress and neuroticism (Hall, Benning, & Patrick, 2009). Similarly, PCL-R factors exhibit different patterns of associations with psychophysiological measures, including consistent findings that only Factor 1 is related to reduced response to unpleasant stimuli (Patrick et al., 2009), such as startle (Patrick, 1994) and electrocortical response to emotional pictures (Venables, Hall, Yancey, & Patrick, 2015). Additionally, Factor 1 relates positively to boldness and meanness, whereas Factor 2 relates positively to disinhibition and meanness (Venables, Hall, & Patrick, 2014).

1.1.3. Triarchic Psychopathy and Other Models of Normal and Psychopathic Personality

Although the triarchic model relates to the PCL-R in predictable ways, the triarchic traits likely share the most conceptual and empirical overlap with higher-order factors found using the Psychopathic Personality Inventory (PPI; Lilienfeld & Andrews, 1996) and its revision, the Psychopathic Personality Inventory – Revised (PPI-R;

Lilienfeld & Widows, 2005). The PPI is a self-report measure developed to comprehensively cover descriptions of psychopathic traits within the literature, including constructs relevant to boldness such as low anxiety, fearlessness, and social poise (Lilienfeld & Andrews, 1996). Factor analytic work typically identifies two higher-order dimensions, including Fearless-Dominance (FD; stress immunity, venturesomeness, low anxiety) and Self-centered Impulsivity (SCI; poor emotional and behavioral constraint, antisocial behavior) that are similar to boldness and disinhibition, respectively (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003; Patrick et al., 2009). Findings also indicate that the Coldheartedness subscale (similar to meanness) typically does not load on either dimension, although the factor structure of the PPI and PPI-R also vary as a result of sample type (i.e., offender versus community; Ruchensky, Edens, Corker, Witt, Donnellan, & Blonigen, 2018). Boldness and disinhibition are considered substantially similar to FD and SCI, respectively (Patrick et al., 2009), reflected in correlations across these measures (e.g., PPI-SCI with TriPM Disinhibition, $r = .60$; Sellbom & Phillips, 2013).

Beyond the PPI and PPI-R, boldness, meanness, and disinhibition are represented in other models and measures of PPD and normal personality. To elucidate the convergence of triarchic and other psychopathy models, this research tends to (1) examine associations with other psychopathy and normal personality measures (e.g., Drislane, Patrick, & Arsal, 2014) and (2) extract scales from existing measures to assess the triarchic traits (e.g., Hall et al., 2012; Ruchensky, Donnellan, & Edens, 2018). For example, the triarchic model correlates with measures of the Five-Factor Model

(FFM)/Big Five (e.g., Donnellan & Burt, 2016; Poy, Segarra, Esteller, López, & Moltó, 2014) as well the HEXACO model (Ruchensky & Donnellan, 2017) of normal personality. Boldness typically relates to lower neuroticism/negative affect and greater extraversion, whereas disinhibition relates to greater neuroticism/negative affect and lower conscientiousness (Donnellan & Burt, 2016; Ruchensky & Donnellan, 2017). In contrast, Meanness typically relates to lower agreeableness (Poy et al., 2014).

Triarchic traits can also be assessed using configurations of items from existing psychopathy and normal personality measures (e.g., Drislane, Brislin, Kendler, Andershed, Larsson, & Patrick, 2014). The ability to derive triarchic scales suggest that these traits transcend any particular model of psychopathy or normal personality and can be 'found' in other models that do not explicitly incorporate features similar to the triarchic traits (Ruchensky et al., in press). The operationalization of the triarchic model through self-report scales is a relatively recent innovation within psychopathy research. Much of the empirical work examining PPD has used either the interview and file-based PCL-R or the self-report PPI to offer insight into psychopathy's nomological network. Thus, more work is needed to elucidate the nomological network of *triarchic* traits. The triarchic model, particularly boldness, is an important conceptual shift away from the PCL-R and, consequently, it is essential to examine the replicability of prior PCL-R results, particularly in relation to psychophysiological correlates.

1.1.4. Boldness and the Prototypical Psychopath

Examination of the nomological network of triarchic traits is essential because of evidence that boldness is necessary to *describe* the prototypical psychopath. Over the past several years, researchers have used a prototypicality approach to elucidate the perceived relevance of traits to the construct of psychopathy (e.g., Berg, Lilienfeld, & Sellbom, 2017; Sörman et al., 2016). Prototypicality studies ask individuals, such as mental health professionals and laypeople, to rate vignettes, individual items, and/or traits on their relevance to describe the prototypical psychopath (Berg et al., 2017; Hoff, Kreis & Cooke, 2011). The perception of what is considered psychopathic is practically important because of the frequency with which psychopathy evidence is introduced into the courtroom (DeMatteo et al., 2014) and because the more jurors view the defendant as psychopathic, the harsher the punishments they are likely to dispense (e.g., greater endorsement of a death verdict; Cox, Clark, Edens, Smith, & Magyar, 2013; Edens, Colwell, Desforges, & Fernandez, 2005).

A recent study by Berg and colleagues (2017) provided vignettes reflecting different configurations of triarchic traits (e.g., boldness alone, boldness with disinhibition, boldness with meanness). Mental health professionals and graduate students then provided ratings on whether these vignettes depicted psychopathy as well as other personality disorders. Researchers found that participants viewed boldness as descriptive of psychopaths, particularly for interpersonal and affective deficits (PCL-R Factor 1) and less so for impulsive and antisocial traits (PCL-R Factor 2). These results fit well with research indicating that boldness helps differentiate APD (characterized by disinhibition and partially meanness) from psychopathy (characterized by boldness, meanness, and disinhibition) (Venables et al., 2014; Wall, Wygant, & Sellbom, 2015).

It is worth noting that much of the debate on boldness focuses on the relevance of the construct to psychopathy and *not* on whether it is a psychologically meaningful construct. Empirical work has linked boldness to models of normal personality (e.g., Ruchensky & Donnellan, 2017) and abnormal personality (Strickland, Drislane, Lucy, Krueger, & Patrick, 2013) in addition to psychophysiological indicators of defensive reactivity (e.g., startle; Esteller, Poy, & Moltó, 2016), error monitoring (Pasion, Cruz, & Barbosa, 2016), and electrocortical response to affective pictures (Ellis, Schroder, Patrick, & Moser, 2017). Indeed, the main argument against the inclusion of boldness focuses on generally null associations with antisocial correlates of psychopathy, such as aggression (Gatner, Douglas, & Hart, 2016).

This debate in part may reflect a divide between social-personality and clinical psychologists. Clinical psychologists are interested more so in personality traits that are inherently dysfunctional whereas social-personality psychologists are interested more so in comprehensive models of personality, regardless of whether traits are adaptive or maladaptive. There exists a similar divide in the literature surrounding narcissistic personality disorder, where social-personality psychologists, but not clinical psychologists, tend to incorporate adaptive components and outcomes into their conceptualization of the disorder (Miller & Campbell, 2008). In a recent overview of narcissism, researchers suggested that labels, such as 'adaptive' or 'maladaptive', should be "avoided to describe core features of narcissism… given that they do not carry much descriptive content" (Krizan & Herlache, 2017, p. 21). Along these lines, boldness may be critical for understanding the core features of psychopathy.

1.2. Psychopathy and Affective Reactivity

1.2.1. Measures of Affective Reactivity

Although self-reported traits/personality questionnaires can provide important descriptive information about psychopathy, experimental research – which employs dependent and independent variables, controls extraneous variables and is repeatable - is the most appropriate means of drawing causal conclusions about the mechanisms at work in psychopathy. In particular, experimental research that examines affective reactivity (e.g., how individuals high in psychopathic traits react to emotional versus neutral stimuli) has a key role to play in understanding psychopathy, in particular because of long-standing theorizing about the role of affective processing in psychopathy (e.g., Cleckley, 1946; Lykken, 1955). Despite the importance of such work and a strong body of experimental paradigms and methods available in the affective science literature, little work to-date has examined affective reactivity in psychopathy using experimental methods. Available evidence suggests that individuals high in psychopathic traits experience less affective reactivity to unpleasant stimuli (Levenson et al., 2000), though these results are contradicted by other studies that have found no differences in self-reported affective reactivity between high and low psychopathy participants (e.g., Herpertz et al., 2001). Using behavioral measures (i.e., reaction time on an affective priming task, where participants are primed with and then shown positively or negatively valanced words), other work has found that psychopathic individuals show reduced responsivity to emotional words relative to individuals lower in psychopathy (Blair, Richell, Mitchell, Leonard, Morton, & Blair, 2006). Therefore, while initial forays have been made into experimental research in psychopathy, the majority of studies have relied primarily on self-report or behavioral measures and have not generally taken advantage of psychophysiological measures in assessing affective reactivity.

One useful neuroscientific tool for studying psychopathy is event-related potentials (ERPs), evident in electroencephalographic (EEG) recordings. ERPs are deflections in the EEG waveform that are time-locked to events of interest, such as the presentation of emotional stimuli (e.g., pleasant or unpleasant pictures). With their high-level temporal resolution, ERPs permit examination of ms-by-ms changes in response to these events of interest. One increasingly popular ERP component in the psychopathy literature is the late positive potential (LPP), which is a positive-going component that begins approximately 300 milliseconds after stimulus onset and has a central-parietal scalp distribution (Hajcak et al., 2010). The LPP is larger for emotional compared to neutral stimuli, and demonstrates good internal consistency (Moran, Jendrusina, & Moser, 2013). A common means of eliciting an LPP is via a passive view task, in which participants are asked to simply view affective and neutral pictures, typically drawn from a standardized set of emotional stimuli, such as the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005). Unpleasant pictures can include scenes of mutilation, threat, and human suffering (e.g., natural disasters or war scenes) and pleasant pictures can include scenes of erotica, thrill-seeking and affiliation (e.g., happy couples or families). In contrast, neutral pictures can include images of everyday objects, neutral buildings and neutral faces. Differences in LPP magnitude across emotional and unemotional stimuli provides one means to assess emotional reactivity.

In addition to being larger for emotional versus neutral stimuli, the LPP is also sensitive to bottom-up and top-down manipulations of stimulus salience. For example, the LPP is larger when individuals are presented with pictures of loved ones (Vico, Guerra, Robles, Vila, & Anllo-Vento, 2010) or their own name (Tacikowski & Nowicka, 2010). The magnitude of the LPP also changes as a function of task demands. For example, the LPP is reduced under high compared to low working memory load (MacNamara & Proudfit, 2014; MacNamara, Schmidt, Zelinksky, & Hajcak, 2012). The LPP is also modulated by individual differences, such as anxiety (MacNamara, Jackson, Fitzgerald, Hajcak, & Phan, 2019), healthy personality traits (Speed, Nelson, Perlman, Klein, Kotov, & Hajcak, 2015), and psychopathic personality traits (Ellis, Schroder, Patrick, & Moser, 2017).

Another approach to assessing for individual differences in emotion-modulated psychophysiological reactivity is via startle eyeblink. One way of eliciting startle is in response to a loud, rapid-onset acoustic noise probe. Using electromyographic (EMG) recording time-locked to startle probe onset, the startle reflex is quantified as the magnitude of the blink response in the *orbicularis oculi* muscle (Lang, Bradley, & Cuthbert, 1998). Startle is larger when elicited during presentation of unpleasant stimuli, such as pictures of threat or mutilation, relative to neutral stimuli because the unpleasant stimuli tend to elicit a negative affective state that activates defensive systems (Bradley, Codispoti, Cuthbert, & Lang, 2001). In contrast, startle is *attenuated* when elicited during the presentation of pleasant stimuli, such as pictures of erotica or depictions of affiliative scenes, e.g., happy families or couples (Bradley et al., 2001), which tend to elicit positive affect. Within psychophysiological research, startle to emotional stimuli has become a widely used measure of affective reactivity (Vaidyanathan et al., 2011) and has been used in some of the first work investigating psychophysiological processes underpinning psychopathic traits (Patrick, 1994).

In addition to neurobiological reactivity to emotional stimuli, subjective reactivity to emotional stimuli is important in understanding affective response across multiple levels of analysis. One way of measuring subjective reactivity to emotional stimuli is via the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). The SAM is a non-verbal, pictorial measure that enables participants to make subjective (numerical) ratings about the valence (i.e., unpleasant or pleasant) and arousal level (i.e., intensity) of their emotional response to stimuli (Bradley & Lang, 1994). The SAM is easy to administer, and like the LPP and startle eyeblink, can be used as a measure of emotional reactivity by comparing differences in SAM response to emotional versus neutral stimuli.

1.2.2. Abnormal Psychophysiological Reactivity to Emotional Stimuli in Psychopathy

Most of the psychophysiological research in psychopathy has focused on offender samples using the PCL-R (e.g., Rothemund, Ziegler, Hermann, Gruesser, Foell, Patrick, & Flor, 2012) or an abbreviated version (e.g., Sadeh & Verona, 2012), with some work using the PPI in nonincarcerated samples (e.g., Medina et al., 2016). Studies have typically used an extreme groups comparison approach, where offenders high on total PCL-R scores (i.e., 'psychopaths')[1] are compared to offenders with comparatively lower PCL-R scores (e.g., Pastor, Moltó, Vila, & Lang, 2003). Most studies in nonincarcerated samples use a similar approach and classify participants as high or low on psychopathy using the PPI/PPI-R (e.g., Medina et al., 2016). These findings indicate that psychopathic individuals have a blunted LPP to unpleasant pictures relative to those lower in psychopathy (Anderson & Stafford, 2012; Medina et al., 2016). Additionally, PCL-R identified psychopaths demonstrate consistently reduced startle while viewing unpleasant pictures (Levenston, Patrick, Bradley, & Lang, 2000; Pastor et al., 2003; Patrick, 1994; Vaidyanathan et al., 2011). These findings align with theorizing that psychopathy is characterized by deficient defensive reactivity (Patrick et al., 2009) and that startle may be sensitive to the interpersonal and affective deficits that characterize psychopathy. Along these lines, reduced startle to unpleasant stimuli differentiates PCL-R identified psychopaths from those diagnosed with Antisocial Personality Disorder (APD), which is a disorder that includes the poor impulse control but not the interpersonal and affective deficits of psychopathy (Vaidyanathan, Hall, Patrick, & Bernat, 2011).

[1] Taxometric analyses on psychopathy measures are typically unable to identify a 'psychopath' taxon (Edens, Marcus, Lilienfeld, & Poythress, 2006; Guay, Ruscio, Knight, & Hare, 2007; Marcus, John, & Edens, 2004; Walter, Gray, Jackson, Sewell, Rogers, Taylor, & Snowden, 2007). Failure to identify a taxon indicates that psychopathy is best conceptualized and measured dimensionally, rather than categorically (Edens et al., 2006).

Recent studies have also examined psychopathy dimensionally and have considered the contribution of specific facets to the disorder, rather than examining the disorder as a discrete category (i.e., psychopath or not) using total scores. This dimensional approach represents a substantive improvement over the use of categorical comparisons (i.e., psychopath or not) because of mounting evidence that psychopathy is a multidimensional construct that can manifest with differing trait configurations across individuals (Lilienfeld, 2018). Consistent with the more common categorical approach (i.e., high psychopathy versus low psychopathy), greater PCL-R Factor 1, but not Factor 2, (Venables et al., 2015) relates to a smaller LPP to unpleasant stimuli. Moreover, reduced LPP to unpleasant, but not pleasant, stimuli has replicated across community (Anderson & Stafford, 2012), undergraduate (Medina et al., 2016), and offender (Venables et al., 2015) samples. However, the use of ERP components such as the LPP to elucidate affective and other psychological processes in psychopathic traits remains understudied.

The first study investigating associations between specific psychopathic traits and startle involved a large, community sample of young men ($N = 355$; $M_{age} = 20$; Benning, Patrick, & Iacono, 2005). Participants completed measures of PPI Fearless Dominance (similar to Boldness) and PPI Self-centered Impulsivity (similar to Disinhibition) and a brief passive picture viewing task. The task consisted of unpleasant, neutral, and pleasant pictures and startle probes were delivered while pictures were onscreen. Participants identified as high in FD but not those identified as high in SCI, demonstrated reduced startle to unpleasant pictures. Regression analyses yielded a marginally significant prediction of reduced startle for unpleasant pictures by only PPI FD (p = .053), consistent with findings from the extreme-groups comparison approach (Benning et al., 2005). These findings suggest that reduced psychophysiological reactivity is related specifically to ostensibly adaptive psychopathic traits and that examination of specific traits provides a more nuanced picture of psychophysiological reactivity in psychopathy.

Similar findings have emerged regardless of sample type used (e.g., community, offender). For example, in community samples, PCL-R Factor 1 (Vanman, Mejia, Dawson, Schell, & Raine, 2003) and PPI FD (Dvorak-Bertscha, Curtin, Rubinstein, & Newman, 2009; López et al., 2013) relate to reduced startle to unpleasant stimuli.[2] Similar findings are also evidenced in offender samples using the PCL-R (Patrick, 1994; Patrick et al., 1993; Poy et al., 2009; Vaidyanathan et al., 2011). The generalizability of results across sample type is important because of evidence that the structure of psychopathic personality disorder varies across offender and community samples, especially with regard to traits related to defensive reactivity (i.e., stress immunity, fearlessness; Ruchensky et al., 2018). The consistency of findings across models and sample types suggests that reduced startle reactivity to unpleasant pictures is a stable indicator of psychopathy in both incarcerated and nonincarcerated samples.

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[2] This effect appears to be limited to affective pictures and does not replicate when using startle probes paired with affective faces (Anderson, Wan, Young, & Stanford, 2010).

1.2.3. The Triarchic Model and Existing Psychophysiological Research

Thus far, the psychophysiological research on the triarchic model has been fairly limited despite the explicit emphasis on neurobiological referents in the model (trait fearlessness, externalizing vulnerability; Patrick et al., 2009). Boldness and, to a lesser extent, meanness are thought to be the manifestation of reduced threat sensitivity, whereas disinhibition is the manifestation of an externalizing vulnerability that predisposes individuals to difficulties with self-regulation. Based on the triarchic model, boldness should relate to blunted reactivity (LPP, startle, SAM scores) to unpleasant, but not pleasant, stimuli. Meanness may demonstrate similar, albeit smaller, associations because both boldness and meanness are phenotypic manifestations of trait fearlessness. Null associations between meanness and emotional reactivity are consistent with findings that meanness is unrelated to self-reported neuroticism (Ruchensky & Donnellan, 2017) and negative affect (Latzman et al., 2018). Disinhibition may also relate to greater emotional reactivity because individuals high in disinhibition are characterized by poor emotional and behavioral constraint (Ruchensky & Donnellan, 2017) and prior work has consistently linked disinhibition to greater neuroticism (Poy et al., 2014) and negative affect (Latzman et al., 2018).

Only one study to-date has examined the relation between triarchic traits and startle (Esteller et al., 2013). In an unselected sample of undergraduates, boldness, but not meanness and disinhibition, related to reduced startle to unpleasant, but not pleasant or neutral, pictures. These findings suggest that deficient defensive responding is specific to boldness and unrelated to meanness, despite theorizing that both are manifestations of an underlying abnormality in defensive reactivity (Esteller et al., 2013; Patrick et al., 2009). Further, these results dovetail with work indicating that boldness and reduced startle to unpleasant stimuli differentiates psychopathy from APD, which is characterized by disinhibition but not the interpersonal and affective deficits found in psychopathy (Venables, Hall, & Patrick, 2014; Wall, Wygant, & Sellbom, 2015).

Additionally, only one study has examined the relation between triarchic traits and the LPP to affective pictures (Ellis et al., 2017). In this study, greater boldness correlated ($r = -.29$, $p < .05$) with smaller LPPs to unpleasant pictures (Ellis et al., 2017), whereas meanness and disinhibition were unrelated to the LPP. Interestingly, boldness was unrelated to self-reported emotional reactivity, suggesting a potential disconnect between psychophysiological and self-report measures of emotional reactivity. This disconnect provides evidence for Cleckley's (1946) description of psychopaths as presenting with artificial psychological health that disguises internal affective deficits (Ellis et al., 2017).

1.2.4. Limitations in Triarchic Psychopathy Research

Results from both studies (i.e., Ellis et al., 2017; Esteller et al., 2016) are consistent with prior findings suggesting that interpersonal and affective aspects of psychopathy are characterized by reduced defensive (Vaidyanathan et al., 2011) and emotional (Venables et al., 2015) reactivity. However, this research is limited in several ways. First, prior studies recruited at high and low ends of only the boldness continuum (Ellis et al., 2017) or used an entirely unselected sample (Esteller et al., 2016). Although one would expect boldness to relate to blunted reactivity to unpleasant stimuli (Patrick et al., 2009), this sampling strategy makes it challenging to examine whether this blunting is specific to boldness because correlations between other triarchic constructs may be attenuated due to restriction of range. This is problematic because disinhibition is characterized by poor emotional constraint (Patrick et al., 2009) and consistently relates to greater self-reported internalizing pathology (Latzman et al., 2018). This suggests that individuals high in disinhibition might be more prone to experiencing unpleasant affect and may be expected to display greater psychophysiological arousal to unpleasant stimuli. Indeed, Ellis and colleagues (2017) note that their results are consistent with expectations (i.e., only boldness relates to blunted emotional reactivity), but that this unique relationship could be the result of restricted range in disinhibition and meanness.

Second, neither study examined varying configurations of triarchic traits because the sampling strategies did not allow for representation across the continuum of triarchic traits. This leaves open questions such as whether reduced startle denotes individuals who are high in *only* boldness (and not disinhibition and meanness) or those who are high in boldness regardless of their level of other triarchic traits. Reduced startle has demonstrated some utility as a biomarker of psychopathy in previous work using the PCL-R (Vaidyanathan et al., 2011), but the specificity of this finding has not been examined within a triarchic framework. Replication across models of psychopathy is essential because the triarchic model only demonstrates moderate convergence with the PCL-R (Venables et al., 2013; Wall et al., 2014), partially because the PCL-R does not explicitly include or adequately cover the adaptive components that are a central feature in the triarchic model (Patrick et al., 2009). Thus, future work would benefit from examining whether differences in psychophysiological reactivity to emotional stimuli vary as a function of triarchic trait *configuration*.

This suggestion fits with indications that the statistical interaction of boldness and disinhibition provide additional explanatory power for negative outcomes, such as endorsement of sexually predatory tactics (Marcus et al., 2013). Boldness and disinhibition may exhibit different patterns of associations with psychophysiological indicators, but the interaction of the two could yield a different psychophysiological profile. For example, perhaps a reduced LPP to affective pictures is specific to those high in boldness and disinhibition but not those just high in boldness or disinhibition alone. The need for a sampling strategy that recruits at high and low ends of more than one triarchic trait is in line with recent calls within the psychopathy literature to examine how configurations of triarchic traits might help clarify the nomological network of psychopathy, with some arguing that examination of these interactions should become standard in all research on psychopathy (Lilienfeld, 2018; Marcus et al., 2013). Consideration of trait configuration also mirrors the clinical reality of personality pathology because patients often present with varying configurations of symptoms, despite meeting criteria for the same disorder (Balsis, Ruchensky, & Busch, 2017; Cooper, Balsis, & Zimmerman, 2010).

Additionally, there are no studies that have examined the relationship between the triarchic traits and psychophysiological reactivity to pleasant pictures as indexed by the LPP. Moreover, only one study has examined the relationship between triarchic traits and startle to pleasant pictures (Esteller et al., 2016). The few studies using other psychopathy measures that *do* include pleasant pictures typically find that psychopathic traits do not relate to emotional reactivity as measured by the LPP (e.g., Benning et al., 2005), but startle results are less conclusive (Levenston et al., 2000). Some findings indicate enhanced startle (Levenston et al., 2000; Loomans, Tulen, & van Marle, 2015), reduced startle (Herpertz et al., 2001), or no relationship between startle to pleasant pictures and psychopathic traits (Benning et al., 2005; Esteller et al., 2016; Patrick et al., 1993; Vaidyanathan et al., 2011). Psychophysiological reaction to pleasant pictures is thought to reflect activation of an appetitive system distinct from the defensive system activated by unpleasant pictures (Bradley et al., 2001). Thus, it is essential to examine whether altered reactivity in psychopathic traits occurs for pleasant versus unpleasant pictures.

In sum, research incorporating psychophysiological assessment and the triarchic model is sorely needed. The triarchic model emphasizes the neurobiological of psychopathic traits (Patrick et al., 2009), yet most of the literature has foregone the inclusion of psychophysiological measures and has instead relied on self-report, interview and informant measures of affective reactivity (i.e., approaches more commonly used in personality research).

1.3. Current Study

The current study will address prior methodological limitations (e.g., limited sampling strategies) and provide novel information regarding affective reactivity as it relates to the triarchic constructs. My central objective is to determine how the configuration of triarchic traits relates to individual differences in affective reactivity as measured by electrocortical activity, startle eyeblink, and subjective ratings. To this end, I recruited participants with varying configurations of high and low levels of boldness and disinhibition (e.g., High Boldness with High Disinhibition, High Disinhibition with Low Boldness).

I hypothesize that startle and the LPP will differ across configurations of boldness and disinhibition. Specifically, those high in boldness (i.e., High Boldness and High Disinhibition; High Boldness and Low Disinhibition) will have a blunted startle and LPPs to unpleasant pictures relative to those low in boldness (i.e., Low Boldness and High Disinhibition; Low Boldness and Low Disinhibition). In contrast, I hypothesize that those high in disinhibition and low in boldness will have an enhanced startle and LPPs to unpleasant pictures relative to those high in boldness (i.e., High Disinhibition and High Boldness, Low Disinhibition and High Boldness). I expect this pattern to be reflected in subjective evaluations (i.e., valence, arousal) of unpleasant stimuli, although it may be the case that there are no differences across levels of boldness given recent evidence of a disconnect between self-report and psychophysiological indicators of affective reactivity (Ellis et al., 2017).

I also hypothesize that those high in boldness as well as those high in disinhibition (i.e., High Boldness and High Disinhibition; High Boldness and Low Disinhibition; Low Boldness and High Disinhibition) will have an enhanced LPP and less attenuated startle to pleasant pictures relative to those low in disinhibition and low in boldness. This hypothesis is rooted in conceptual links between boldness and disinhibition with thrill-seeking and boredom proneness (Benning et al., 2003), although this is relatively exploratory considering the scarcity of experimental research on the triarchic traits. I expect similar patterns to emerge for subjective evaluations (i.e., valence, arousal), although this is also exploratory due to limited available research.

Finally, a secondary goal of this study is to examine affective reactivity as it relates to the presence of internalizing psychopathology (e.g., social anxiety) within a psychopathic sample. There is no study that has examined whether triarchic traits are associated with similar psychophysiological profiles as internalizing pathology, such as anxiety and depression. The exclusion of internalizing pathology in psychopathy research is a weakness that has not yet been addressed using psychophysiological measures (Vaidyanathan, Patrick, & Cuthbert, 2009).

There are a number of internalizing symptom dimensions previously linked to individual differences in psychophysiological reactivity and self-reported triarchic traits. Broadly, internalizing pathology characterized by anxiety should relate to greater reactivity to unpleasant pictures (e.g., LPP; Hajcak et al., 2010). Of particular interest is (low) anxiety which is included in theoretical descriptions of boldness (Patrick et al., 2009; Patrick & Drislane, 2014) and are related to greater self-reported disinhibition (Latzman et al., 2018). In contrast to anxiety, depressive symptoms may blunt emotional reactivity as measured by the LPP and startle (Bylsma, Morris, & Rottenberg, 2008; Weinberg, Perlman, Kotov, & Hajcak, 2016), which parallels blunted reactivity to unpleasant stimuli in psychopathy. Depression may be especially pertinent because individuals high in these symptoms are characterized by poor self-concept (Sowislo & Orth, 2013), whereas psychopathic individuals are characterized by “the absence of negative self-directed affect" (Lynam & Widiger, 2007, p. 174). These internalizing dimensions are empirically linked to triarchic traits at the self-report level but it remains unclear whether they share similar or diverging patterns of associations with psychophysiological indicators.

Psychophysiological measurement of affective reactivity provides a level of analysis distinct from the self-report methodology traditionally used in personality research. Furthermore, examination of internalizing pathology with triarchic traits enables consideration of shared neurobiological features across disorders. For example, depression and psychopathy may share a deficient defensive system as indicated by blunted LPP and startle to unpleasant stimuli. However, psychopathy may not interfere with functioning of appetitive systems that are aberrant in depression.

I expect that constructs of relevance to anxiety, such as negative affectivity, will relate to exaggerated LPP and startle to affective pictures, specifically those that are unpleasant. I also expect depressive symptoms to relate to blunted LPP and startle to affective pictures, both pleasant and unpleasant. It may also be the case that controlling for internalizing pathology augments or reduces the magnitude of relations between psychopathy and affective reactivity.

2. METHOD

2.1. Participants

Participants were 66 undergraduates (age: M = 18.85; SD = .94) and predominately white (75.40%) and female (56.9%). Approximately 20 participants were recruited for each of four groups (High Boldness and High Disinhibition, High Boldness and Low Disinhibition, High Disinhibition and Low Boldness, Low Disinhibition and Low Boldness) to allow for comparisons across configurations of psychopathic traits and to insure range in the sample. This sample was recruited through the Texas A&M University (TAMU) Psychology Subject Pool. Participants at high and low ends of boldness and disinhibition (i.e., upper and lower terciles) were identified through prescreening. A careless responding scale within the Triarchic Psychopathy Measure (TriPM; Patrick, 2010) was used to eliminate participants who may have responded carelessly to prescreening questionnaires (Mowle et al., 2016). Additionally, those who had missing data for any TriPM items were removed from the prescreening data. Potential participants were contacted and, if interested, scheduled for a lab visit. With respect to the recruited sample (N = 66), one participant was removed due to insufficient trials completed as a result of participant error accidentally closing the program. Although four groups were initially planned for analyses, only participants in three of the groups were sufficiently responsive to recruitment emails, thus restricting group-level analyses to three groups (High Disinhibition/Low Boldness = 18; High Boldness/Low Disinhibition = 22; High Boldness/High Disinhibition = 18). Of note, sample size for the last group (Low Boldness/Low Disinhibition) was too small for analysis (N = 7). Group analyses therefore involved a subset of the larger sample (N = 58), relative to the full sample used for continuous analyses (N = 65). Gender composition was relatively similar across groups (High Disinhibition/Low Boldness; male = 7, female = 12; High Boldness/Low Disinhibition; male = 10, female = 12; High Boldness/High Disinhibition; male = 9, female = 9).

2.2. Materials

2.2.1. Stimuli

Twenty-four unpleasant, twenty-four neutral, and twenty-four pleasant pictures[3] were selected from the International Affective Picture System (IAPS; Lang et al., 1999). Acoustic startle probes were delivered through headphones to both ears. Probes were brief (40 milliseconds), loud (95 dB) bursts of white noise with near instantaneous rise time that are commonly used in startle paradigms.

2.2.2. Subjective Ratings

Valence and arousal ratings were made using the SAM analog scales (Bradley & Lang, 1994). Ratings for valence ranged from 1 to 9, where 1 indicated unpleasant valence and 9 indicated pleasant valence. Ratings for arousal ranged from 1 to 9, where 1 indicated low arousal and 9 indicated high arousal.

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[3] Unpleasant pictures: 1300, 3001, 3016, 3030, 3120, 3150, 3180, 3400, 3530, 3550, 6312, 6313, 6560, 8230, 9041, 9042, 9412, 9413, 9423, 9426, 9610, 9910, 9912, 9920; Neutral pictures: 1670, 2026, 2745.1, 5520, 6150, 7002, 7004, 7006, 7009, 7012, 7018, 7020, 7025, 7036, 7037, 7039, 7040, 7080, 7081, 7150, 7491, 7500, 7547, 7705; Pleasant pictures: 1710, 2030, 2034, 2071, 2345, 4003, 4006, 4071, 4090, 4130, 4150, 4220, 4225, 4250, 4255, 4533, 4542, 4574, 4599, 4609, 4623, 4641, 4698, 8001.

2.2.3. Self-Report Measures

Triarchic Psychopathy Measure. The TriPM (Patrick, 2010) is a 58-item measure of boldness (social potency, low anxiety, stress immunity), meanness (callousness, interpersonal antagonism, poor attachment), and disinhibition (poor self-regulation). Participants rated each item using a four-point scale (0 = false, 1 = mostly false, 2 = mostly true, 3 = true), where higher numbers reflect higher levels of triarchic psychopathy.

Intolerance of Uncertainty Scale. The IUS (Carleton, Norton, & Asmundson, 2007; Freeston et al., 1994) is a 12-item measure of IU, where participants rated items on a scale of 1 (not at all characteristic of me) to 5 (entirely characteristic of me). Higher scores indicate greater IU. Factor analytic work has yielded two factors referred to as Prospective and Inhibitory IU (Carleton et al., 2007). Prospective IU refers to individual differences in beliefs and perceptions that uncertainty is threatening, whereas Inhibitory IU refers to freezing and avoidant responses to uncertainty (Caleton et al., 2007).

Positive and Negative Affect Schedule (Expanded Version). The PANAS-X (Watson & Clark, 1991) is a 60-item measure of positive and negative affect. Participants used a scale of 1 (very slightly or not at all) to 5 (extremely), with higher numbers indicating higher affective levels. The PANAS-X yields two higher-order factors representing Positive and Negative Affect, as well as several lower-order factors for negative emotions (fear, hostility, guilt, sadness), positive emotions (joviality, self-assurance, attentiveness), and other emotions (shyness, fatigue, serenity, surprise).

Inventory of Depression and Anxiety - II. The IDAS-II (Watson et al., 2012) is a 99-item measure of internalizing pathology, with each item assessing a specific symptom. Participants rated each symptom based on the past two weeks on a scale of 1 (not at all) to 5 (extremely), with higher scores indicating more symptoms. This instrument was designed to provide comprehensive coverage of internalizing symptom dimensions, including post-traumatic stress disorder, depression, social anxiety and mania. The IDAS-II scales are non-overlapping and have good convergent and discriminant validity (Watson et al., 2012).

Social Phobia Inventory. The SPIN (Connor, Churchill, Sherwood, Foa, & Wesler, 2000) is a brief, 17-item measure of social phobia. Participants rated each item on a scale of 0 (not at all) to 4 (extremely), with higher scores indicating greater social phobia symptom severity. Prior work has yielded three factors identified as fear, avoidance, and psychophysiological arousal (Corner et al., 2000).

Beck Depression Inventory - II. The BDI-II (Beck, Steer, & Brown, 1996) is one of the most widely used self-report measures of depression. Participants rated each of the 21 items on a scale of 1 to 3 to describe depressive symptoms over the course of the past two weeks, with higher scores indicating more severe depressive symptomatology. The label attached to each point on the rating scale varies across questions (Beck et al., 1996).

Spielberger Trait Anxiety Inventory. The STAI (Spielberger, 1983) is a widely used self-report measure of anxiety. Participants rated each of the 20 trait anxiety items on a scale of 1 (almost never) to 3 (almost always) to describe anxiety symptoms in general, with higher scores indicating greater trait anxiety.

2.3. Procedure

Upon arrival, trained research assistants obtained informed consent. Next, participants completed self-report questionnaires online via TAMU Qualtrics and then completed the passive picture viewing task while EEG and startle eyeblink were recorded.

2.4. Task

Participants were instructed to view a series of pleasant, unpleasant and neutral pictures presented onscreen (see Figure 2.1). Twenty-four pictures of the same valence were presented in each of three blocks, with block order randomized for each participant. Previous passive picture paradigms have used blocks with pictures of the same valence to study the LPP (Pastor, Bradley, Löw, Versace, Moltó, & Lang, 2008; Schupp, Schmälzle, Flaish, Weike, Hamm, 2012) and startle (Smith, Bradley, & Lang, 2005). Within the current study, each picture was presented for 5000 ms, followed by a white fixation cross (+) presented on a black background for 500 ms; following this, participants rated the previously presented picture on valence and arousal using the SAM scales with a brief fixation cross (500ms) separating valence and arousal ratings. Participants had unlimited time to make these ratings. Next, a fixation cross was displayed for 4000 to 4500 milliseconds during the intertrial interval. Startle probes were delivered randomly during the 2500-4000ms following picture onset, with eight startle probes delivered during each block, and a maximum of one startle probe per picture.

Prior to starting the task, participants completed three practice trials (one for each picture type) that were equivalent in structure and duration as trials within the real experiment (but without startle). After completion of the practice trials, three startle probes were delivered to habituate participants to the noise.

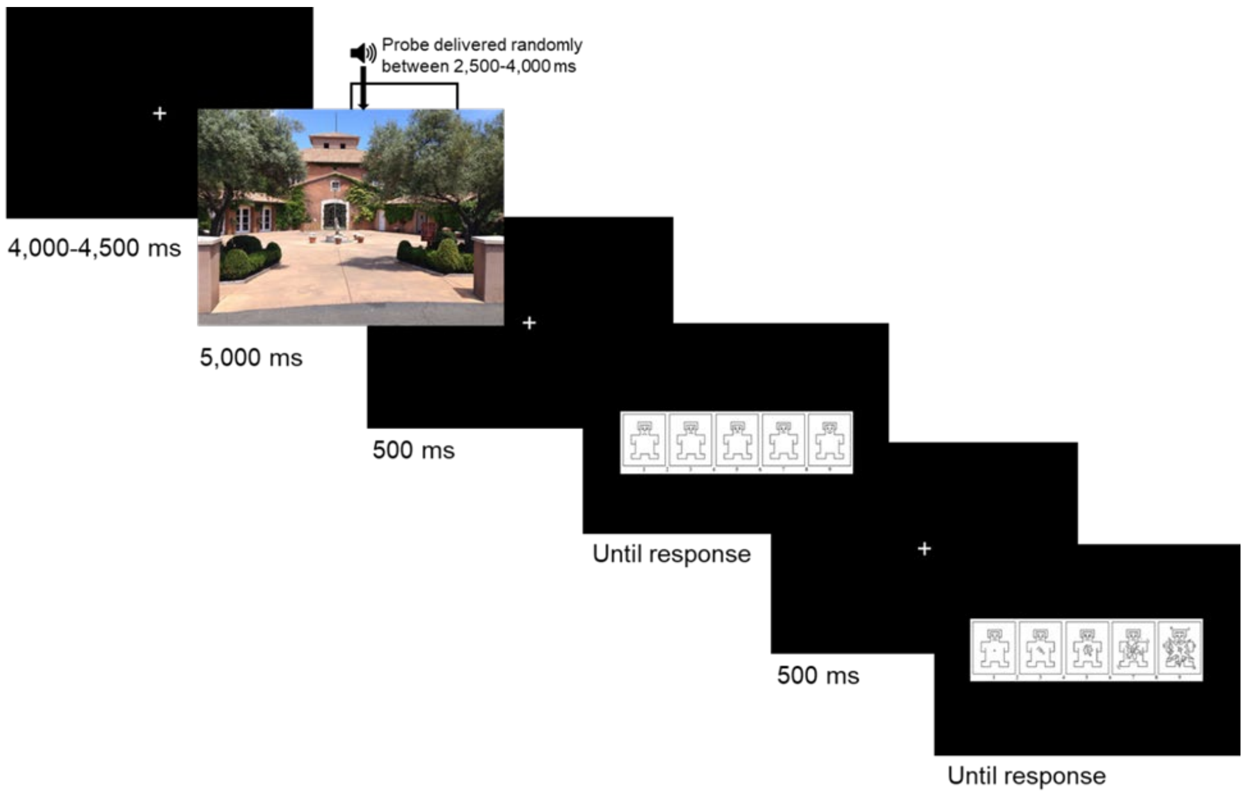

Figure 2.1 Each picture was presented for 5000 ms, followed by a white fixation cross (+) presented on a black background for 500 ms; following this, participants rated the previously presented picture on valence and arousal using the SAM scales with a brief fixation cross (500ms) separating valence and arousal ratings. Participants had unlimited time to make these ratings. Next, a fixation cross was displayed for 4000 to 4500 milliseconds during the intertrial interval. Startle probes were delivered randomly during the 2500-4000ms following picture onset.

2.5. Psychophysiological Recording and Data Processing

2.5.1. Electroencephalography

Continuous EEG was recorded using an ActiCap and the ActiChamp amplifier system (Brain Products GmbH, Gilching Germany). The ActiCap contained 32 electrode sites based on the 10/20 system. Electrooculogram data was collected using four electrodes. Two electrodes were placed 1cm above and the right eye to measure vertical eye movement. Two electrodes were placed 1cm beside the outer rim of each eye to measure horizontal movement. EEG data was digitized at 24-bit resolution with a sampling rate of 1000 Hz.

EEG data was processed offline using Brain Vision Analyzer 2 software (Brain Products GmBH, Gilching, Germany). Signal from each electrode was re-referenced using the average electrocortical activity of left and right mastoids (TP9/10) and band-pass filtered using both high (0.01 Hz) and low (30 Hz) pass filters. Each trial was segmented starting 200ms prior to picture onset until picture offset (5200 ms). Baseline correction was completed using the 200ms interval prior to picture onset. Corrections for eye blinks and eye movements were made using the approach published by Miller, Gratton and Yee (1990). Artifact analysis was also used to identify a voltage step of more than 50.0 μV between sample points, a voltage difference of 300.0 μV within a trial, and a maximum voltage difference of less than 0.50 μV within 100 ms intervals. EEG data was inspected visually for any residual artifacts and data from individual channels with artifacts were rejected on a trial-to-trial basis. Participants were excluded if EEG data was not usable in more than 50% of trials, which resulted in removal of one participant. Based on visual inspection and prior research (Hajcak et al., 2010), the LPP was scored where maximal by averaging amplitudes at pooling, FC1, FC2, Cz, CP1, and CP2, in early (450-2500ms) and late (2500-5000ms) time windows. A P3 component was also evident and scored at Pz using the average amplitude between 300-400ms, consistent with prior literature (Hajcak et al., 2010).

2.5.2. Electromyography

Eyeblink response to probes was measured using two 4-mm diameter electrodes placed below the left eye over the orbicularis oculi muscle. Specifically, one electrode was attached 1 cm below the pupil and another placed 1 cm adjacent to the initial electrode (i.e., closer to the ear). Data was recorded using the ActiChamp amplifier system and digitized at 24-bit resolution using a sampling rate of 1000 Hz. Offline, data was processed using a bandpass filter of 28-499 Hz and segmented using a 250-ms window that began 50 ms prior to startle probe onset. The data was rectified and then smoothed with a 50Hz low-pass filter. Startle amplitude was quantified as the peak amplitude occurring between 20 ms and 150 ms after startle probe onset relative to the average baseline (i.e., average activity in the 50 ms window preceding probe onset). Trial-level data was inspected visually for inclusion or exclusion within data analysis. Blinks were scored as nonresponses if EMG amplitude did not yield a peak that was visually differentiated from baseline activity. Nonresponses were scored as 0. Blinks were also classified as missing if there is significant noise, movement artifact, or if a spontaneous blink occurs in the baseline period. Participants included in startle analyses had at least two acceptable blinks per condition to be included, which resulted in the exclusion of 22 participants (remaining $N = 44$).

2.6. Data Analysis

To examine group-level differences across configurations of psychopathic traits, irrespective of individual differences in depression and anxiety, a 3 (group: High Boldness and High Disinhibition, High Boldness and Low Disinhibition, High Disinhibition and Low Boldness) X 3 (picture type : unpleasant, neutral, pleasant) mixed measures analysis of covariance (ANCOVA) was conducted with depression and anxiety as covariates[1]. ANCOVAs were performed separately for each dependent variable – i.e., the LPP, P3, startle, valence and arousal ratings. To examine the nature of any significant group by picture type interaction, one-way ANOVAs comparing picture type were performed separately for each group, and significant effects were followed up using independent samples *t*-tests. In addition to group analyses, regression was used to examine the unique contribution of continuous variation in meanness and internalizing symptoms to variation in psychophysiological and subjective data after controlling for shared variance across these constructs. Specifically, independent variables (meanness, depression, anxiety) were entered simultaneously as predictors of dependent variables of interest (e.g., LPP). Dependent variables in these analyses were residualized scores representing variance unique to a) unpleasant compared to neutral pictures and b) pleasant compared to neutral pictures. Residualized scores were derived by regressing variables of interest (e.g., LPP to unpleasant pictures) onto the control variable (e.g., LPP to neutral pictures) and saving the unstandardized residuals (Meyer, Lerner, de los

Reyes, Laird, &Hajcak, 2017). All analyses were performed using SPSS statistical software version 25.0 (IBM, Armonk, NY).

3. RESULTS

3.1. Descriptive Statistics

Table 3.1 presents descriptive statistics for self-report measures between groups and collapsed across groups. Table 3.2 presents descriptive statistics for psychophysiological measures (P3, LPP, startle) and subjective ratings (valence, arousal) between groups and collapsed across groups. [4]

Table 3.1 Descriptive statistics

Self-Report Measures	High Dis/ Low Bold	High Bold/ Low Dis	High Bold/ High Dis	Overall
TriPM				
Boldness	2.16 (.24)	3.13 (.31)	3.17 (.22)	2.78 (.53)
Meanness	1.55 (.37)	1.47 (.33)	1.81 (.52)	1.58 (.41)
Disinhibition	2.03 (.27)	1.32 (.09)	1.92 (.18)	1.69 (.37)
IUS				
Total	33.78 (9.26)	23.77 (8.47)	24.56 (8.62)	27.12 (9.73)
Prospective	20.11 (5.68)	16.82 (5.32)	16.17 (5.97)	17.64 (5.79)
Inhibitory	13.67 (4.00)	6.95 (3.67)	8.39 (3.94)	9.48 (4.77)
PANAS-X				
Positive Affect	29.67 (3.97)	29.68 (3.83)	32.22 (4.12)	30.47 (4.075)
Negative Affect	24.56 (4.53)	22.95 (6.44)	26.11 (5.13)	24.42 (5.57)
Fear	14.50 (5.23)	9.91 (3.75)	10.78 (5.00)	11.60 (4.98)
Sadness	13.17 (4.55)	8.91 (4.55)	10.44 (4.53)	10.71 (4.81)
Guilt	12.33 (5.74)	8.77 (4.78)	8.83 (3.35)	9.90 (4.93)
Hostility	10.44 (3.81)	8.68 (4.29)	10.83 (4.23)	9.90 (4.17)

[4] Repeated-measures ANOVAs were conducted to examine whether there was an interaction of group type and trial count for picture types across electrodes used for ERP components. There were no significant interactions (*p*'s > .05).

Table 3.1 Continued

Self-Report Measures	High Dis/ Low Bold	High Bold/ Low Dis	High Bold/ High Dis	Overall
Shyness	10.17 (2.96)	6.91 (3.62)	7.33 (2.89)	8.05 (3.47)
Fatigue	14.72 (2.56)	11.95 (4.11)	11.72 (3.54)	12.74 (3.71)
Joviality	25.17 (7.73)	28.50 (6.10)	29.44 (5.09)	27.76 (6.51)
Self-Assurance	15.50 (3.62)	19.23 (4.67)	22.89 (3.43)	19.21 (4.91)
Attentiveness	13.33 (2.38)	15.27 (3.09)	14.82 (2.20)	14.53 (2.71)
Serenity	8.67 (2.87)	10.00 (2.78)	10.83 (2.33)	9.84 (2.77)
Surprise	6.28 (2.63)	6.50 (2.82)	7.56 (2.89)	6.76 (2.79)
SPIN				
Total	43.94 (13.78)	26.36 (8.67)	26.06 (7.17)	31.72 (12.97)
FPS	8.50 (3.09)	6.27 (2.98)	5.89 (2.03)	6.84 (2.94)
FNE	19.17 (7.30)	10.82 (3.78)	11.22 (4.28)	13.53 (6.40)
FUSS	16.22 (5.62)	9.77 (3.93)	9.11 (4.28)	11.57 (5.53)
BDI-II	37.17 (8.58)	29.22 (8.10)	27.22 (5.60)	31.07 (8.63)
STAI	48.11 (9.19)	35.77 (9.59)	37.11 (8.61)	40.02 (10.56)
IDAS-II				
General Depression	49.11 (12.53)	37.68 (13.60)	36.39 (8.29)	40.83 (12.93)
Dysphoria	24.83 (7.00)	17.77 (8.62)	17.00 (6.10)	19.72 (8.07)
Lassitude	17.44 (5.65)	13.27 (5.26)	13.06 (3.87)	14.50 (5.31)
Insomnia	14.17 (4.64)	11.41 (3.92)	12.00 (3.61)	12.45 (4.17)
Suicidality	7.33 (3.11)	6.91 (2.04)	6.56 (.86)	6.93 (2.18)
Appetite Loss	7.83 (3.07)	5.72 (2.64)	5.39 (1.42)	6.28 (2.67)
Appetite Gain	6.28 (2.11)	6.10 (3.21)	6.61 (2.38)	6.31 (2.62)
Well-Being	21.61 (7.15)	26.73 (6.78)	27.06 (4.68)	25.24 (6.69)
Ill Temper	6.22 (2.58)	6.68 (3.55)	6.67 (2.68)	6.53 (2.97)
Mania	10.28 (3.56)	9.95 (4.80)	10.72 (4.87)	10.29 (4.41)
Euphoria	8.22 (3.72)	10.05 (4.42)	10.61 (2.81)	9.66 (3.83)
Panic	9.94 (4.77)	9.18 (4.77)	8.72 (2.93)	9.28 (3.73)
Social Anxiety	13.78 (4.77)	9.18 (4.18)	8.44 (3.28)	10.38 (4.67)

Table 3.1 Continued

Self-Report Measures	High Dis/ Low Bold	High Bold/ Low Dis	High Bold/ High Dis	Overall
Claustrophobia	6.61 (1.97)	5.68 (2.46)	6.56 (3.65)	6.24 (2.75)
Traumatic Intrusions	6.78 (2.18)	5.23 (3.05)	6.00 (2.91)	5.95 (2.79)
Traumatic Avoidance	9.00 (3.79)	6.73 (3.74)	6.44 (3.85)	7.34 (3.89)
Checking	7.67 (2.95)	6.86 (3.80)	6.89 (3.36)	7.12 (3.38)
Ordering	10.00 (3.09)	10.45 (3.84)	8.61 (3.76)	9.74 (3.62)
Cleaning	9.72 (3.27)	10.27 (5.46)	8.33 (3.56)	9.50 (4.32)

Note: Dis = Disinhibition; Bold = Boldness; TriPM = Triarchic Psychopathy Measure; IUS = Intolerance of Uncertainty Scale; PANAS-X = Positive and Negative Affect Schedule – Expanded; SPIN = Social Phobia Inventory; FPS = Fear of Physical Symptoms; FNE = Fear of Negative Evaluation; FUSS = Fear of Uncertainty in Social Situations; BDI-II = Beck Depression Inventory – II; STAI = Spielberger Trait Anxiety Inventory; IDAS-II = Inventory of Depression and Anxiety Symptoms – Expanded Version II.

Table 3.2 Means (SD) for psychophysiological and subjective ratings

Psychophysiological Measures	Picture Type	High Dis/ Low Bold	High Bold/ Low Dis	High Bold/ High Dis	Overall
P3 (µv; 300 – 400ms)	Unpleasant	6.00 (6.36)	10.38 (8.94)	8.76 (6.28)	8.35 (7.89)
	Neutral	3.20 (5.14)	6.69 (7.43)	5.95 (5.78)	5.15 (6.52)
	Pleasant	9.30 (6.27)	12.55 (6.92)	14.09 (5.10)	12.18 (6.83)
LPP (µv; 400 – 2500ms)	Unpleasant	7.36 (5.32)	8.72 (7.09)	9.23 (9.25)	8.10 (7.32)
	Neutral	3.46 (5.09)	1.82 (4.68)	.97 (5.50)	1.92 (5.10)
	Pleasant	11.70 (6.14)	11.66 (5.23)	11.41 (8.42)	11.45 (6.32)
LPP (µv; 2500 – 5000ms)	Unpleasant	9.51 (7.72)	9.57 (8.56)	9.77 (12.03)	9.60 (9.08)
	Neutral	7.65 (9.33)	5.58 (5.44)	1.89 (8.92)	5.06 (4.96)
	Pleasant	12.53 (7.87)	13.67 (6.16)	11.72 (8.79)	12.85 (7.38)
Startle (µv)	Unpleasant	37.36 (28.96)	63.71 (51.11)	48.31 (51.81)	51.52 (46.09)
	Neutral	34.25 (25.43)	57.07 (46.79)	45.34 (47.76)	46.42 (41.05)
	Pleasant	35.39 (24.71)	49.37 (43.20)	43.47 (46.67)	44.12 (39.65)

Table 3.2 Continued

Subjective Ratings	Picture Type	High Dis/ Low Bold	High Bold/ Low Dis	High Bold/ High Dis	Overall
Valence	Unpleasant	2.40 (1.02)	2.50 (.98)	2.72 (.93)	2.52 (.96)
	Neutral	4.89 (.44)	5.03 (.25)	4.98 (.44)	4.98 (.36)
	Pleasant	6.08 (.86)	6.32 (.96)	6.59 (.58)	6.32 (.80)
Arousal	Unpleasant	5.56 (2.23)	4.70 (2.17)	4.87 (1.65)	4.98 (2.01)
	Neutral	1.74 (1.02)	1.37 (.44)	1.75 (.72)	1.60 (.75)
	Pleasant	2.77 (1.13)	2.87 (1.59)	3.37 (1.54)	3.06 (1.46)

Note: Dis = Disinhibition; Bold = Boldness; Δ = unstandardized residual; LPP = Late Positive Potential; P3 = P300. N = 65 for LPP, P3, and Subjective Ratings. N = 44 for Startle.

3.2. Mixed-measures ANCOVAs

3.2.1. P3

Figure 3.1 depicts picture-locked grand average waveforms at electrode Pz and scalp distributions for each condition shown separately across group. There was an effect of picture type, $F(2,106) = 3.32$, $p = .04$, $\eta^2 = .06$. Group X picture type interacted, $F(4,106) = 2.94$, $p = .02$, $\eta^2 = .10$. Follow-up one-way ANOVAs assessing the effect of picture type separately for each group revealed no significant effect of group for the P3 to unpleasant, $F(2,55) = 1.71$, $p = .19$, or neutral, $F(2,55) = 1.77$, $p = .18$, pictures. There was a trending group effect for the P3 to pleasant pictures, $F(2,55) = 2.80$, $p = .07$. Compared to the High Disinhibition/Low Boldness group, the High Boldness/High Disinhibition group had a larger pleasant P3s, $t(34) = -2.51$, $p = .02$. There was no difference between the High Boldness/High Disinhibition group and the High Boldness/Low Disinhibition group for pleasant pictures, $t(38) = -.78$, $p = .44$. There was also no difference between the High Disinhibition/Low Boldness group and the High Boldness/Low Disinhibition group for pleasant pictures, $t(38) = -1.54$, $p = .13$.

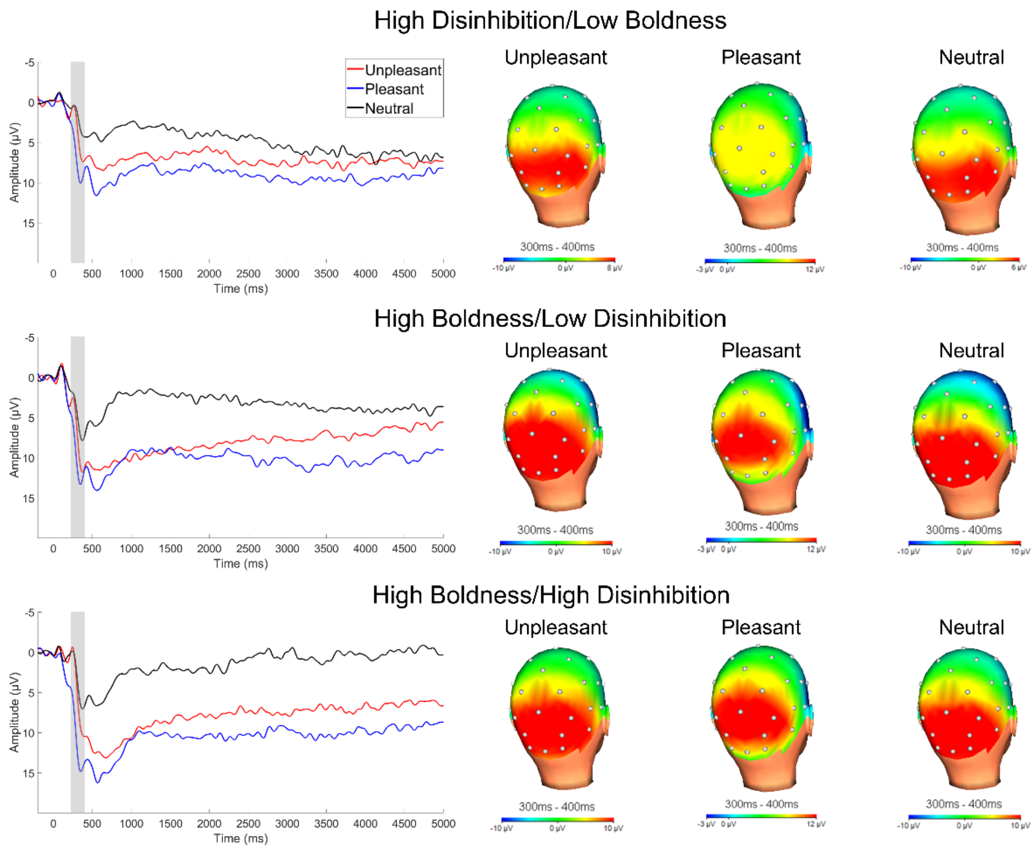

Figure 3.1 Grand-averaged waveforms at electrode Pz and scalp distributions for each condition (unpleasant, pleasant, neutral) shown separately for each group. The P3 was scored from 300 – 400ms after picture onset.

3.2.2. LPP

Figure 3.2 depicts picture-locked grand average waveforms at pooling FC1, FC2, Cz, CP1, CP2, for each condition shown separately for each group. Figure 3.3 depicts scalp distributions of amplitudes at for early (400 – 2500ms) and late (2500 – 5000ms) time windows for each condition, shown separately for each group.

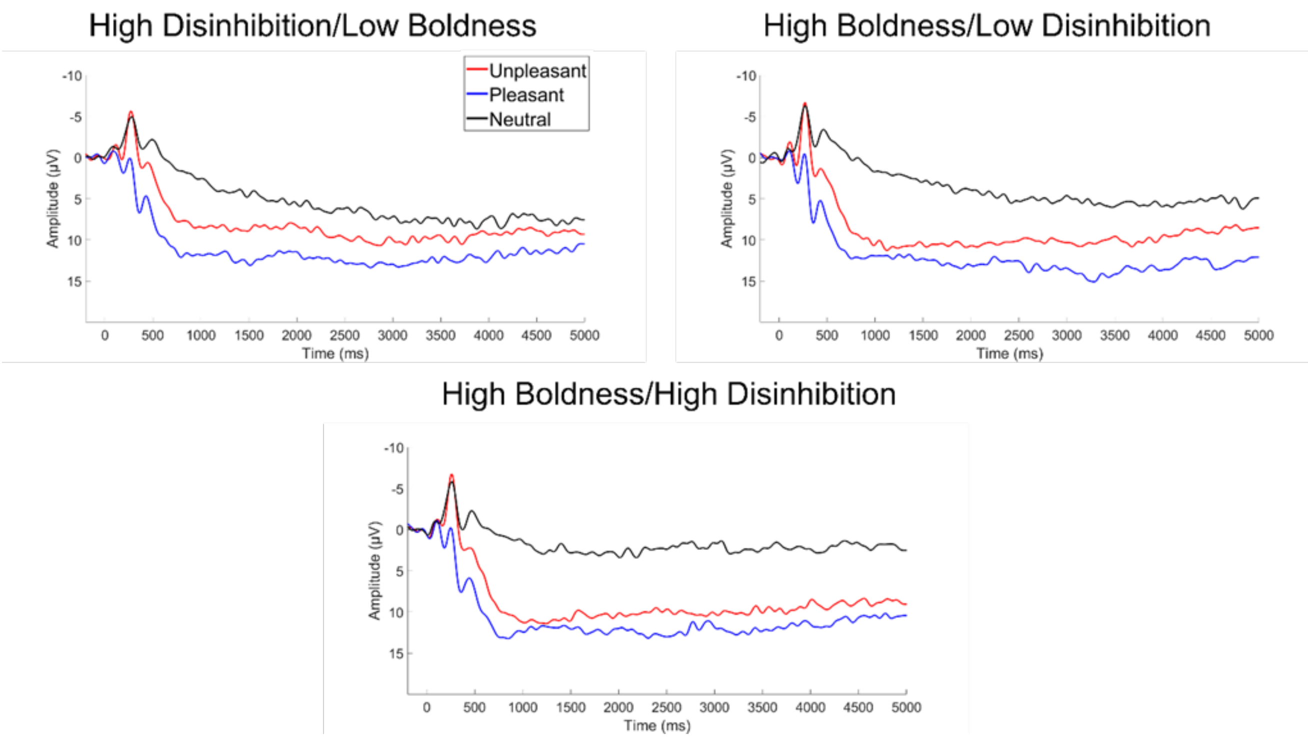

Figure 3.2 Grand-averaged waveforms at pooling (FC1, FC2, Cz, CP1, CP2) for each condition (unpleasant, pleasant, neutral) shown separately for each group. Both the early (400 – 2500ms) and late (2500 – 5000ms) LPP are displayed.

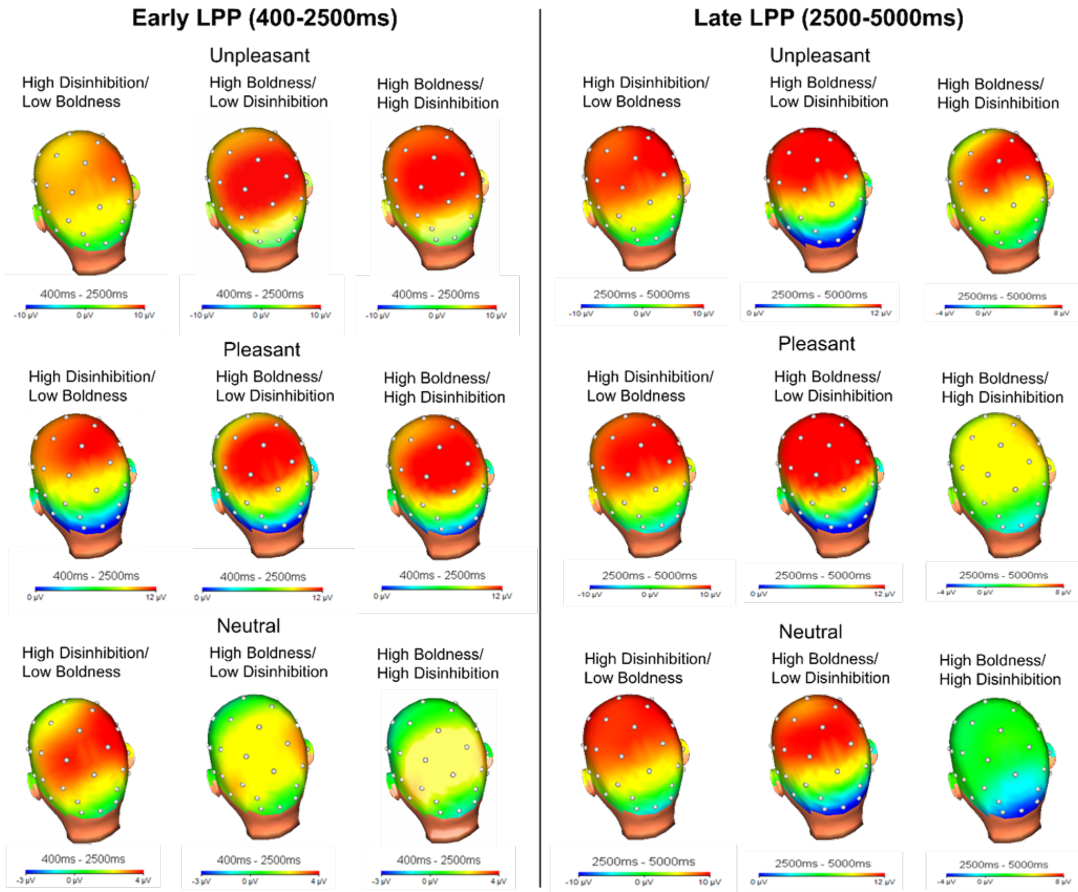

Figure 3.3 Grand-averaged headmaps for each condition (unpleasant, pleasant, neutral) shown separately for each group. Both the early (400 – 2500ms) and late (2500 – 5000ms) LPP are displayed.

3.2.3. 400-2500ms

There was an effect of picture type, $F(2,106) = 3.64$, $p = .03$, $\eta^2 = .06$. The effect of group did not reach significance, $F(4,106) = .53$, $p = .71$, $\eta^2 = .02$.

3.2.4. 2500-5000ms

There was an effect of picture type, $F(2,106) = 4.04$, $p = .02$, $\eta^2 = .07$. The effect of group did not reach significance, $F(4,106) = 1.91$, $p = .11$, $\eta^2 = .07$.

3.2.5. Startle

There was a trending significant effect of picture type, $F(2,68) = 3.02$, $p = .06$, $\eta^2 = .08$. The effect of group did not reach significance, $F(4,68) = .40$, $p = .81$, $\eta^2 = .02$.

3.2.6. Ratings

There was an effect of picture type for valence, $F(2,106) = 14.58$, $p < .001$, $\eta^2 = .22$, and arousal, $F(2,106) = 3.56$, $p = .03$, $\eta^2 = .06$. The effect of group did not reach significance for valence, $F(4,106) = .33$, $p = .86$, $\eta^2 = .01$ or arousal ratings, $F(4,106) = .58$, $p = .68$, $\eta^2 = .02$.

3.3. Regression Analyses

Results for regression analyses are presented in Table 3.3. The overall regression model for the ΔP3 to unpleasant pictures was significant, F(3,64) = 3.74, p = .02. Anxiety significantly predicted enhanced amplitude of the ΔP3 to unpleasant pictures, whereas depression predicted decreased amplitude of ΔP3. There was a trend for greater meanness to be associated with a decreased ΔP3 to unpleasant pictures. The model was not significant for the ΔP3 to pleasant pictures, F(3,64) = .28, p = .84, and there were no significant predictors (ps > .43). Figure 3.4 depicts the bivariate correlation between meanness and ΔP3 to unpleasant pictures.

Table 3.3 Regressions with meanness, BDI-II, and STAI as simultaneous predictors of psychophysiological measures and subjective report

Psychophysiological Measures	Picture Type	Meanness	BDI-II	STAI
		β	**β**	**β**
ΔP3 (μv; 300 – 400ms)	Unpleasant	-.22†	**-.61****	**.59***
	Pleasant	-.10	-.03	-.03
ΔLPP (μv; 400 – 2500ms)	Unpleasant	-.03	-.32	.10
	Pleasant	-.18	-.09	.03
ΔLPP (μv; 2500 – 5000ms)	Unpleasant	.11	-.25	-.02
	Pleasant	-.07	-.03	.07
ΔStartle (μv)	Unpleasant	-.02	.10	-.18
	Pleasant	.21	.24	.02
Subjective Ratings	**Picture Type**	**β**	**β**	**β**
ΔValence	Unpleasant	**.42****	-.03	-.02
	Pleasant	.06	.16	-.36
ΔArousal	Unpleasant	**-.28****	.00	.05
	Pleasant	.17	.07	-.17

Note: BDI – II = Beck Depression Inventory - II; STAI = Spielberger Trait Anxiety Inventory; Δ = unstandardized residual; LPP = Late Positive Potential; P3 = P300. † $p < .10$. * $p < .05$. ** $p < .01$. Significant effects ($p < .05$) are also in bold. $N = 65$ for LPP, P3, and Subjective Ratings. $N = 44$ for Startle. The meanness scale is taken from the Triarchic Psychopathy Measure (TriPM).

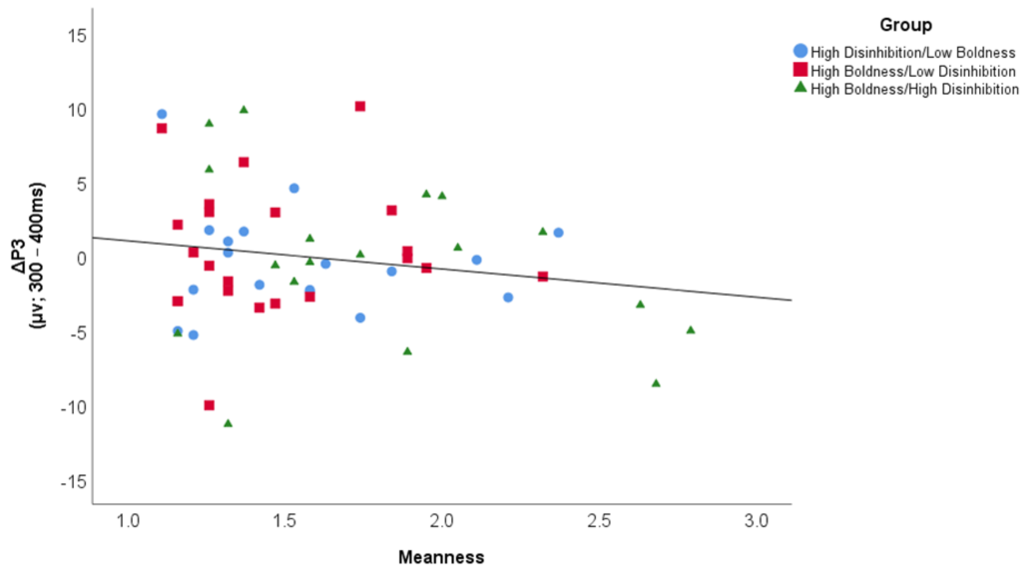

Figure 3.4 Scatterplot depicting the correlation between meanness and ΔP3 to unpleasant pictures (i.e., the unstandardized residual) during the 300 – 400ms time scored at electrode Pz.

In contrast to the P3 results, models for the LPP (*p*s > .14) and startle (*p*s > .21) did not reach significance, nor did any individual predictors emerge as significant for the LPP (*p*s > .15) or startle (*p*s > .16). Results for subjective ratings suggested that individuals higher on meanness, but not depression and anxiety, rated unpleasant pictures as more pleasant, $F(3,64) = 4.25$, $p = .01$. In contrast, the model predicting valence ratings for positive pictures was not significant, $F(3,64) = 1.33$, $p = .27$ and individual predictors also failed to reach significance (*p*s > .12). Similarly, models were not significant for subjective ratings of arousal to unpleasant, $F(3,64) = 1.89$, $p = .14$, or pleasant pictures, $F(3,64) = .90$, $p = .45$ and individual predictors did not reach significance for pleasant pictures (*p*s > .18). Meanness did significantly predict arousal ratings for unpleasant pictures, such that individuals higher on meanness rated unpleasant pictures as less arousing.

4. DISCUSSION

4.1. Summary of Results

This study set out to determine whether affective reactivity, as indicated by psychophysiological indicators (ERPs, startle) and subjective ratings (valence, arousal), differed across configurations of triarchic constructs. Specifically, study design included unpleasant *and* pleasant (as well as neutral) pictures to examine potential group differences in reactivity to differently valenced stimuli. It was hypothesized that groups high in boldness would demonstrate reduced psychophysiological reactivity to unpleasant, but not pleasant, pictures relative to groups low in boldness. It was also hypothesized that groups high in boldness and/or disinhibition would display enhanced psychophysiological reactivity to pleasant pictures. Hypotheses for self-report were exploratory considering the dearth of empirical research on emotional reactivity and psychopathy using laboratory tasks as well as contradictory findings for subjective reactivity to emotional stimuli in psychopathic individuals (Ellis et al., 2017; Herpertz et al., 2017). For example, some studies suggest those high in psychopathy report reduced subjective emotional reactivity to unpleasant stimuli (Levenston et al., 2000), whereas others find no relationship between psychopathy and subjective reactivity to unpleasant stimuli (Ellis et al., 2017; Herpertz et al., 2001). No study thus far has examined subjective reactivity to pleasant stimuli.

A secondary aim for the current project was to examine the contribution of psychopathic traits to variation in affective reactivity holding internalizing symptoms/constructs constant. Prior empirical work has not examined whether the effects of psychopathic traits on emotional reactivity persist or are altered after controlling for the presence of internalizing symptoms, such as depression and anxiety. This is problematic considering prior work has strongly linked psychopathy, particularly the triarchic traits, to negative affect (Latzman et al., 2018) and known associations between negative affect and affective reactivity. For example, prior work found depression is linked to a blunted LPP to unpleasant pictures (Hajcak Proudfit, Bress, Foti, Kujawa, & Klein, 2015), which is similar to effects observed in psychopathy (Ellis et al., 2017). However, given the dearth of prior empirical research incorporating measures of psychopathy and internalizing symptoms into the same study, there were no specific hypotheses. It was expected that relations between psychopathy and affective reactivity might be altered after controlling for internalizing symptoms, such as depression.

A strength of the current study was the inclusion of different indicators of affective reactivity, thereby enabling a more fine-grained analysis than in prior research. Prior work on the P3 indicates that this early ERP component reflects rapid mobilization of resources to salient stimuli (such as emotional pictures), whereas the LPP reflects *sustained* attention to motivational content that persists even after stimulus offset (Hajcak et al., 2010). al., 2010). During picture presentation, startle eyeblink was measured while probes were delivered. Recording of the startle reflex provides a discrete psychophysiological indicator of affective reactivity, rather than the continuous, ms-by-ms information provided by the LPP and P3. In contrast to the modulation pattern of the

P3 and LPP, empirical work on the affective modulated startle finds a linear trend, such that startle is potentiated for unpleasant, but attenuated for pleasant stimuli, with neutral stimuli typically elicited a response somewhere in between these two categories (Grillon & Baas, 2003). To complement these psychophysiological recordings, participants also provided ratings of the valence and arousal of their emotional response, yielding insight into subjective emotional experience. Subjective experience of affective stimuli has been hypothesized to diverge from psychophysiological indicators in psychopathy.

4.2. Reactivity to Unpleasant Pictures

Overall, hypotheses were not borne out with respect to affective reactivity to unpleasant stimuli. Specifically, groups high in boldness did not significantly differ on the P3, LPP, or startle to unpleasant pictures relative to groups low in boldness. These findings contrast with the hypothesis that a blunting effect would be observed in groups with *high* boldness. Prior work using similar paradigms has found that individuals higher in boldness demonstrate blunted response to unpleasant pictures relative to those low in boldness (Ellis et al., 2017). Furthermore, the triarchic model characterizes boldness and, to a lesser extent, meanness as the manifestation of reduced sensitivity to threat (i.e., trait fearlessness; Patrick et al., 2009), which might also be expected to associated with reduced reactivity to unpleasant pictures. In sum, the nonsignificant findings for responsivity to unpleasant (and not pleasant) pictures in this study contrast with this characterization of psychopathic traits, such that one would predict reduced reactivity for those high in boldness based on the triarchic model. Nevertheless, some work suggests that fear deficits in psychopaths may be moderated by attention, such that when psychopathic individuals focus on threatening stimuli they display normal fear response but, when threatening stimuli are not goal-relevant (and therefore not the focus of attention), psychopaths display deficient fear response (Newman, Curtin, Bertsch, & Baskin-Sommers, 2010). Therefore, it is possible that deficient fear response in psychopaths is situation-specific, and may not have been observed in the current study in part because participants were instructed to attend to the picture at all times.

Thus far, there is some evidence supporting the role of attention as a key player in deficient fear response in psychopaths. For example, an imaging study using a sample of male inmates found that individuals high in psychopathy displayed *enhanced* amygdala activation and skin conductance in a fear conditioning task where participants were instructed to attend to an electrical shock (Schultz, Balderston, Baskin-Sommers, Larson, & Helmstetter, 2016). In another study, researchers manipulated attention to focus on information either relevant to fear (i.e., paired with an electric shock) or irrelevant to fear (i.e., not paired with an electric shock; Newman et al., 2010). Psychopathic inmates displayed the classic fear deficit, as measured by fear-potentiated startle, in the alternative focus condition, but exhibited normal fear-potentiated startle when focused on fear-relevant information (Newman et al., 2010). However, other studies have used passive picture paradigms similar to the current study and found a blunting effect in boldness (or boldness-like constructs) to threatening (Esteller et al., 2016) and, more generally, unpleasant pictures (Ellis et al., 2017; Medina et al., 2016) that are consistent with characterizations of psychopathic individuals as displaying deficient response to threatening stimuli regardless of attention manipulations.

Interestingly, the groups also did not differ in terms of subjective ratings for valence or arousal. The lack of differences in subjective ratings of valence and arousal are in line with the nonsignificant differences in psychophysiological indicators of emotional reactivity. Results suggest that for individuals high and/or low on boldness and disinhibition, their perception of their emotional reactivity is consistent with psychophysiological indicators of emotional reactivity, at least at the group level. Furthermore, the nonsignificant effect of group on subjective ratings is in line with some prior evidence suggesting greater psychopathy does not relate to reduced subjective emotional response to unpleasant stimuli (e.g., Ellis et al., 2017; Herpetz et al., 2001).

4.3. Reactivity to Pleasant Stimuli

In contrast to the nonsignificant group differences for unpleasant stimuli, a group difference emerged for reactivity to pleasant pictures. The High Boldness/High Disinhibition group displayed *enhanced* P3 to pleasant pictures relative to the High Disinhibition/Low Boldness group. It is worth noting that the High Boldness/Low Disinhibition group did not significantly differ from the High Boldness/High Disinhibition or High Disinhibition/Low Boldness groups. This enhanced reactivity in the high psychopathy group (High Boldness/High Disinhibition) is in line with predictions that the combination of boldness and disinhibition relate to increased sensitivity to pleasant stimuli. The P3 reflects an early, rapid response to salient stimuli, such as emotional pictures (Hajcak et al., 2010). The significant findings for P3 and not the LPP or the startle (delivered well-into picture onset) suggest this increased sensitivity to rewarding or appetitive pictures is specific to *early* affective processing for individuals high in both boldness and disinhibition. The lack of differences in LPP modulation across groups suggest that more conscious, elaborative processing does not differ across varying levels of boldness and disinhibition. However, these results should be interpreted with caution because the follow-up simple effects analyses were only trending significant despite a significant interaction in the omnibus levels.

With respect to the broader psychopathy – ERP literature, the significant group difference for the P3 to pleasant pictures is more difficult to interpret. The psychopathy – ERP literature is relatively small and most psychopathy studies employing a passive picture paradigm restrict their analyses to the LPP (e.g., Medina et al., 2016) and focus on unpleasant pictures (e.g., Ellis et al., 2017). This focus on affective reactivity to unpleasant stimuli in psychopathy research reflects a broader neglect in the field of examining aberrant reactivity to pleasant or rewarding stimuli in psychopathic individuals (Hirschtritt, Carroll, & Ross, 2018). Among studies using other paradigms, such as an affective oddball task, results for the P3 tend to be mixed in part due to methodological differences, such as group versus dimensional analyses (Pasion, Fernandes, Pereira, & Barbosa, 2018). Thus, the current finding represents a relatively novel contribution to the psychopathy literature.

Despite these initial hesitations, this enhanced, early sensitivity (as measured by the P3) to appetitive images *is* consistent with descriptions of psychopathic individuals as high in sensation-seeking (boldness) and as hyper-reactive (disinhibition; Patrick et al., 2009). Research consistently links disinhibition to a greater likelihood of substance use (Patrick, Poythress, Edens, Lilienfeld, & Benning, 2008) and risky sexual behavior

(Fulton, Marcus, & Zeigler-Hill, 2014), both phenomena can be thought of as associated with aberrant responses to appetitive/rewarding stimuli. Emerging evidence also finds boldness relates to risk-taking in behavioral tasks (Satchell, Bacon, Firth, & Coor, 2018) and self-reported positive urgency (Ruchensky & Donnellan, 2017). Taken together, the literature characterizes psychopathic individuals as more likely to engage in reward-related behavior and sensitive to stimuli that elicit positive affect.

In line with self-report and behavioral evidence, there is also neurological evidence from other studies suggesting that psychopathic individuals display aberrant reward sensitivity/processing. For example, imaging studies have found that greater scores on the PCL-R correspond to increased activation in brain areas implicated in reward processing (nucleus accumbens; Hosking et al., 2017). There is also evidence of enhanced communication between brain areas involved in reward and those involved in behavioral control, implying a connection with the behavioral outcomes commonly associated with the disorder, such as substance use (Geurts, von Borries, Volman, Bulten, Cools, & Verkes, 2016). In contrast to findings that point toward increased responsiveness to rewarding or positive stimuli, another study found that greater callous-unemotional traits corresponded to *reduced* reactivity to reward outcome (Cohn et al., 2015) in the amygdala, an area that is integral to the processing of rewarding stimulus and positive affect (Murray, 2007). Taken together, the current study and prior work indicate a greater need to explore potential abnormalities in processing of positive affect and reward, as this area has largely been neglected in psychopathy research (Hirschtritt et al., 2018).

In contrast to the P3 results, no significant differences emerged for self-reported reactivity to positive pictures across groups. This points to the potential for a disconnect between self-reported and early psychophysiological reactivity to pictures selected to elicit positive affect. Potentially, individuals high in boldness and disinhibition may have limited insight into early affective reactivity to positive stimuli or they may misrepresent (intentionally or not) their subjective experience. Because the only group difference that emerged was for an early ERP component (the P3), it may be that the early attentional abnormalities in high psychopathy individuals disappear over time when stimuli are presented for an extended period of time to allow for more deliberate processing. Underscoring this claim is the lack of differences in LPP and self-report ratings to pleasant pictures across groups, which suggest elaborative processing of positive affect is intact. Therefore, this group difference may represent an implicit bias toward rewarding cues.

4.4. Dimensional Analyses with Meanness and Internalizing Symptoms (Depression, Anxiety)

Meanness is conceptualized as a phenotype of trait fearlessness and manifests as difficulties forming meaningful attachment to others, an exploitative interpersonal style and reduced empathic responding (Patrick et al., 2009). These deficits align theoretically (Patrick et al., 2009) and empirically (Venables et al., 2014) with the interpersonal and affective deficits of the psychopath that are considered the hallmark features of the disorder (Sörman et al., 2016). Thus, meanness may also relate to a reduced reactivity to unpleasant stimuli, particularly those involving others in pain (Patrick et al., 2009).

Results emerged with respect to the P3 to unpleasant, but not pleasant, pictures. Specifically, greater depression and meanness were significant and trending predictors, respectively, of reduced P3 to unpleasant pictures. In contrast, greater anxiety emerged as a significant predictor of enhanced P3 to unpleasant pictures. As such, this is the first study to demonstrate converging and opposing relations to a psychophysiological indicator of emotional reactivity within the same sample for both psychopathic traits and internalizing symptoms. This suggests psychopathy may be linked to neurobiological mechanisms that are associated with internalizing psychopathology. Meanness was unrelated to startle or the LPP to unpleasant pictures, suggesting that reduced reactivity to unpleasant pictures is specific to early affective reactivity.

The P3 results may indicate that unpleasant stimuli, including scenes of threat and mutilation, are not as salient initially for 'meanner' individuals. These results are directly in line with behavioral evidence that youth higher in callous-unemotional traits (akin to meanness) display reduced recognition of fearful faces in a continuous flash task which enables examination of implicit emotion processing (Jusyte, Mayer, Künzel, Hautzinger, & Schönenberg, 2015). In another study, youth higher in callous-unemotional traits displayed reduced amygdala activity, an area implicated in early affective processing, to masked fearful faces (Viding et al., 2012). This reduced reactivity to unpleasant pictures within the current is also in line with other work finding aberrant early attentional processing, as indexed by early ERP components, of threat-paired cues (Baskin-Sommers, Curtin, Li, & Newman, 2012). However, the current results are only trending significant and thus should be interpreted with caution.

In addition to P3 results, individuals higher on meanness also rated unpleasant images as more pleasant and less arousing. This indicates that ‘meanner’ individuals may have a blunted subjective reaction to unpleasant pictures. Considering many of the unpleasant images used here involved depictions of others in pain (e.g., scenes of violence), the self-report findings are consonant with other studies finding reduced self-reported empathic concern, including poorer ability to take others’ perspective among those higher in meanness (Almeida et al., 2015). The significant association between meanness and self-reported reactivity contrasts with the nonsignificant LPP and startle results, which indicate that meanness does not relate to more elaborative affective reactivity. This disconnect may suggest that ‘meanner’ individuals misinterpret their emotional reactivity as dampened or reduced, even though they are as physiologically responsive as those lower in meanness. This may relate to broader deficits in emotion recognition that have long been theorized to play a role in the affective deficits of psychopaths (Bird & Viding, 2014; Cleckley, 1976). In particular, poor recognition of their own internal affective experience may help explain why psychopathic individuals have difficulty taking the perspective of others (Bird & Viding, 2014). This is in line with empirical work that psychopaths have difficulties recognizing emotional, particularly fearful, faces (Marsh & Blair, 2008).

In contrast to trending and significant results for affective reactivity to unpleasant pictures and meanness, no significant results emerged for psychophysiological or subjective reactivity to pleasant pictures. This is perhaps surprising considering the pictures selected depict scenes of attachment (affiliation, intimacy). In particular, one might expect 'meanner' individuals to report a reduced reactivity to pleasant images because they are characterized by poor attachment to others (Patrick et al., 2009). These results parallel findings from other work noting no association between Factor 1 (similar to meanness) and the LPP to pleasant stimuli (Venables et al., 2015). Together, results suggest processing of pleasant emotional stimuli remains intact among individuals at higher levels of interpersonal and affective deficits.

4.5. The Role of Internalizing Symptoms

A secondary and exploratory aim of the current study was to examine the impact of internalizing symptomatology on the association between psychopathic traits and affective reactivity. Group-level analyses controlled for anxiety (MacNamara & Hajcak, 2009), and depression (MacNamara, Kotov, & Hajcak, 2016). Inclusion of these variables of interest are also in line with increasing calls to incorporate disorders that are often studied separately into empirical work, particularly personality and psychopathology work (Kotov et al., 2017). These results are also in line with recent calls to investigate the neurobiological underpinnings of symptomatology, such as depression and anxiety, in the context of traits, such as personality, within the same sample (Patrick & Hajcak, 2016). Research using psychophysiological measures typically investigate internalizing and externalizing disorders separately, which creates distinct bodies of literature that typically do not communicate. For example, work identifying abnormalities in internalizing disorders has largely focused on clinical populations that do not present with co-occurring externalizing issues. This is problematic because externalizing disorders often exhibit associations with psychophysiological indicators that are in direct contrast to associations found with internalizing disorders. For example, the error-related negativity (ERN) is an ERP component that indexes error monitoring (Olvet & Hajcak, 2008). Prior work has noted that disinhibition corresponds to a reduction in the ERN (Hall, Bernat, & Partick, 2007), whereas anxiety corresponds to an increased ERN (Moser, Moran, Schroder, Donnellan, & Yeung, 2013). Despite work linking greater disinhibition to greater anxiety (Latzman et al., 2018), no work yet has examined whether these constructs exhibit any additive, interactive, or unique effects on variation in the ERN.

Moreover, recent factor analytic work has successfully incorporated self-report with psychophysiological indicators of traits directly relevant to triarchic psychopathy, including threat sensitivity (Yancey et al., 2016) and disinhibition (Venables et al., 2018). This 'psychoneurometric' approach suggests the possibility of a more refined, biologically-based understanding and assessment of personality and personality pathology than prior approaches that have often relied entirely on self-report or interview-based methodology. Considering triarchic psychopathy is heavily rooted in neurobiological constructs, research investigating the nature of this conceptualization of psychopathy may particularly benefit from this measurement approach. Inclusion of additional assessment sources, such as psychophysiological measures, to index traits that cut across disorders may also help bridge the gap between other, related, areas of work that are often not investigated in psychopathy research. For example, using a psychophysiological indicator of threat sensitivity in study designs may help identify connections between psychopathic boldness and fear-based pathology, which are constructs that are clearly theoretically linked. This reasoning is in line with recent calls to investigate personality and psychopathology together dimensionally, rather than as entirely separate entities (Kotov et al., 2017).

4.6. Limitations and Future Directions

Although there are several strengths to the current study, including a novel sampling approach and the inclusion of multiple sources of assessment, there are a number of limitations to the current research. Perhaps most obvious is the reliance on an undergraduate sample. Although the sampling strategy insured inclusion of extreme ends of triarchic traits, a college population is naturally restricted in range because they represent a typically healthy sample with limited representation of diagnosable personality disorders. Comparatively, there is a greater representation of individuals high in meanness and disinhibition in a correctional population relative to undergraduates or another healthy population. In contrast, boldness may be more commonly found in a healthy sample because it relates heavily to psychological functioning (Patrick et al., 2009). For comparison, the overall sample within the current study scored lower on meanness and disinhibition and approximately the same on boldness to a correctional sample (boldness: $M = 2.67$, $SD = .45$; meanness: $M = 2.18$, $SD = .58$; disinhibition: $M = 2.69$, $SD = .57$; Stanley, Wygant, & Sellbom, 2012). However, these differences may partially be due to the inclusion of behavioral items in the TriPM that reflect criminal activity (e.g., "I have robbed someone"), rather than psychopathic personality, that are more likely to be endorsed in a correctional than undergraduate sample (Patrick, unpublished).

Regardless of this limitation, the sampling strategy is directly in line with recent calls to examine whether interactions of psychopathic traits contribute to variation in correlates of interests, such as aggression and psychopathology (Lilienfeld, 2018). The current study's design is better equipped than traditional approaches (e.g., high versus low total psychopathy scores) to address this concern because this sample specifically considers the configuration of personality traits. Still, this study is limited by the lack of an unselected sample to examine continuous associations between triarchic traits and measures of affective reactivity. Prior work has found significant associations between boldness and the LPP (Ellis et al., 2017) and startle (Esteller et al., 2016) to unpleasant pictures using samples that better reflect a normal distribution of psychopathic traits. This limitation is underscored by the results with meanness, which was examined dimensionally because participants were not selected on this triarchic trait. It may be the case that boldness and/or disinhibition relate to affective reactivity dimensionally, rather than in the current, group-level approach.

Another limitation is the lack of a low psychopathy group for comparison to the other groups. Specifically, the sample size of the low psychopathy group ($N = 7$) was too small to conduct group-level analyses across low and high psychopathy groups, which is inconsistent with prior work in psychopathy (Medina et al., 2016). This makes it more challenging to fit the current results within the existing literature examining psychopathy and psychophysiological indicators of affective reactivity. Along these lines, it is harder to make claims about the specificity of group-level differences because of the lack of a sufficiently powered low psychopathy group. It may be the case that group-level differences disappear or change via the inclusion of a low psychopathy group.

Similarly, this study focused exclusively on psychopathic personality and internalizing constructs and did not consider normal personality traits. One of the strengths of the triarchic model is the clear ties with models of normal personality, including the five-factor model (Patrick & Drislane, 2015) and the HEXACO model (Ruchensky & Donnellan, 2017). Some psychopathy researchers have made strong cases empirically and theoretically that psychopathy is best conceptualized as an extreme variant of normal personality traits (Miller & Lynam, 2015). This argument aligns well with alternative, dimensional models of personality pathology that bear a striking resemblance in both structure and content with models of normal personality (Thomas, Yalch, Krueger, Wright, Markon, & Hopwood, 2012). With respect to the triarchic model, empirical work has been successful at developing triarchic proxy scales, suggesting that the triarchic traits can essentially be 'located' within a normal personality framework by reconfiguring items from broadband personality measures (Ruchensky, Donnellan, & Edens, 2018). In fact, current arguments against the inclusion of boldness in a model of psychopathic personality disorder argue that boldness is (1) simply "stable extraversion" (p. 320, Miller & Lynam, 2012) and (2) too strongly associated with psychological health (i.e., low neuroticism; Miller & Lynam, 2012). However, this argument almost exclusively relies on self-report and interview-based methodology and often ignores the existing body of psychopathy research that uses psychophysiological measures and/or experimental paradigms.

Arguments rooting psychopathic personality in models of normal personality are particularly important for consideration in psychophysiological work because of recent findings linking normal personality with variation in psychophysiological measures. For example, extraversion is linked to a larger LPP to both unpleasant and pleasant pictures (Speed, Nelson, Perlman, Klein, Kotov, & Hajcak, 2015), whereas neuroticism is linked to a larger LPP to unpleasant, but not pleasant, pictures (Warren Brown, Goodman, & Inzlicht, 2013). Additionally, extraversion and neuroticism interact to explain event-related potentials that reflect reward processing (Speed et al., 2018). In light of evidence suggesting normal personality is linked to variation in neural indices (Speed et al., 2015) and the triarchic model (Ruchensky & Donnellan, 2017), it may be that traditional psychopathy findings (e.g., blunted reactivity to unpleasant pictures; Patrick, 1994) are attenuated after controlling for normal personality. Consequently, inclusion of measures of normal and psychopathic personality into psychophysiological work may help clarify whether they relate similarly to neurobiological systems, such as reward processing and conflict monitoring. Future work incorporating models of both normal and psychopathic personality with psychophysiological measures into the same study should be poised to differentiate psychopathic from normal personality.

Furthermore, work is needed examining the neurobiological correlates of psychopathic personality disorders in correctional samples. Although correctional samples are particularly difficult to involve in research studies given their status as a vulnerable population, clearer understanding of the potential contributions of aberrant neural activity to psychopathology, particularly psychopathy, may better inform treatment and, ultimately, reductions in recidivism. Psychophysiological work in correctional settings has historically been limited by a number of factors, including small sample sizes, minimal representation of historically marginalized populations, consideration of psychopathy as a unitary construct, and a dearth of research examining internalizing issues that often complicate in-depth understanding of externalizing symptoms.

One of the most innovative lines of research to emerge that addresses some of these concerns involves treating two antisocial subtypes using neurobiologically-based empirical work and theory (Baskin-Sommers, Curtin, & Newman, 2015). These authors argue that the psychopathy subtype demonstrates affective deficits because of a failure either attend to emotional stimuli that are normally ignored if not goal-relevant. In contrast, the externalizing (but not psychopathic) subtype displays difficulties inhibiting emotional and behavioral responses. To this end, authors designed separate treatments that were specifically developed to target attentional deficits (psychopathy subtype) or constraint deficits (externalizing subtype). This treatment is heavily informed by neuroscience work that argues (1) affective deficits in psychopaths are the manifestation of a failure to attend to emotional information and (2) behavioral problems are the result of a hyperreactivity characteristic of antisocial (but not psychopathic) individuals. After receiving subtype-specific treatment, both groups demonstrated improvement on cognitive tasks that involve integration of affective and cognitive information relative to baseline, but only when the provided treatment targeted deficits of the respective subtypes (Baskin-Sommers et al., 2015). From a triarchic perspective, psychopathy is differentiated from antisocial personality disorder (APD) via boldness (Venables et al., 2014), with high disinhibition being particularly characteristic of APD (Patrick et al., 2009). Even though this intervention was not designed from a triarchic model perspective, the two antisocial subtypes represent varying configurations of triarchic psychopathy, which is conceptually in line with the sampling strategy of the current work. Although it is unclear if these treatment gains translate into meaningful changes, such as reduced recidivism, this research represents an important step in the consideration of configuration of personality traits in designing neurobiologically-informed treatments.

5. CONCLUSIONS

5.1. Overall Conclusion

Overall, results suggest modest support for the importance of considering configurations of triarchic traits in research on psychopathy, with the only significant difference emerging for an ERP component indexing early affective reactivity to pleasant stimuli. The lack of significant differences for groups high and low on boldness are inconsistent with predictions from the triarchic model that greater boldness relates to reduced reactivity to unpleasant pictures. In contrast to largely null group-level results, dimensional analyses yielded support for meanness relating to reduced subjective reactivity (valence, arousal) to unpleasant pictures. Similarly, meanness and depression related to reduced early affective processing (P3) of unpleasant pictures, whereas anxiety was associated with greater early affective processing. These results suggest future research may benefit from incorporating measures of both psychopathic traits and internalizing constructs into work examining aberrant affective reactivity.

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APPENDIX A

TABLE 1: BIVARIATE CORRELATIONS BETWEEN MEANNESS AND INTERNALIZING SYMPTOMS WITH PSYCHOPHYSIOLOGICAL MEASURES AND SUBJECTIVE PICTURE RATINGS

Psychophysiological Measures	**Picture Type**	**Meanness**	**BDI-II**	**STAI**	**SPIN**	**IDAS - Dysphoria**
ΔP3 (μv; 300 – 400ms)	Unpleasant	-.21†	-.10	.08	.14	.05
	Pleasant	-.10	-.06	-.06	.07	.01
ΔLPP (μv; 400 – 2500ms)	Unpleasant	-.02	-.23†	-.17	-.12	-.22
	Pleasant	-.18	-.06	-.04	.11	.00
ΔLPP (μv; 2500 – 5000ms)	Unpleasant	.12	**-.27***	-.23†	-.21	**-.29***
	Pleasant	-.08	.03	.05	.09	.08
ΔStartle (μv)	Unpleasant	-.01	-.04	-.09	.03	.10
	Pleasant	.20	.24	.21	.29†	**.33***
Subjective Ratings	**Picture Type**	**Meanness**	**BDI-II**	**STAI**	**SPIN**	**IDAS - Dysphoria**
ΔValence	Unpleasant	**.42****	-.07	-.06	-.16	-.20
	Pleasant	.06	-.15	-.23†	-.18	-.10
ΔArousal	Unpleasant	**-.26***	.07	.08	**.31***	.19
	Pleasant	.17	-.08	-.12	.00	-.11

Note: SPIN = Social Phobia Inventory; IDAS = Inventory of Depression and Anxiety Symptoms; Δ = unstandardized residual; P3 = P300; LPP = Late Positive Potential. † p <

.10. * $p < .05$. ** $p < .01$. Significant ($p < .05$) correlations are also in bold. N = 65 for LPP, P3, and Subjective Ratings. N = 44 for Startle.

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