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Emotional reactivity and regulation in individuals with psychopathic traits: Evidence for a disconnect between neurophysiology and self-report

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Abstract

Individuals with psychopathic traits often demonstrate blunted reactivity to negative emotional stimuli. However, it is not yet clear whether these individuals also have difficulty regulating their emotional responses to negative stimuli. To address this question, participants with varying levels of psychopathic traits (indexed by the Triarchic Measure of Psychopathy; Patrick, 2010) completed a task in which they passively viewed, increased, or decreased their emotions to negative picture stimuli while electrocortical activity was recorded. During passive viewing of negative images, higher boldness, but not higher disinhibition or meanness, was associated with reduced amplitude of the late positive potential (LPP), an ERP that indexes reactivity to emotionally relevant stimuli. However, all participants demonstrated expected enhancement of the LPP when asked to increase their emotional response. Participants did not show expected suppression of the LPP when asked to decrease their emotional response. Contrary to the electrophysiological data, individuals with higher boldness did not self-report experiencing blunted emotional response during passive viewing trials, and they reported experiencing greater emotional reactivity relative to other participants when regulating (e.g., both increasing and decreasing) their emotions. Results suggest inconsistency between physiological and self-report indices of emotion among high-bold individuals during both affective processing and regulation.

KEYWORDS

emotion regulation, emotional reactivity, late positive potential, psychopathy

1 | INTRODUCTION

Individuals with psychopathic traits often become involved with the criminal justice system (Coid et al., 2009; Harpur & Hare, 1994). In addition, psychopathy is difficult to treat and is associated with high rates of recidivism (Hare, Clark, Grann, & Thorton, 2000; Harris, Skilling, & Rice, 2001). Blunted physiological responding to unpleasant stimuli among individuals with psychopathic traits (Anderson, Stanford, Wan, & Young, 2011; Anderson & Stanford, 2012; Baskin-Sommers, Curtin, & Newman, 2013; Levenston, Patrick, Bradley, & Lang, 2000) may contribute to the behaviors seen in psychopathy. To date, however, only a small handful of studies have examined emotion regulation processes among individuals with psychopathic traits.

1.1 | Psychopathy and reduced emotional response

Deficits in emotional reactivity among individuals with psychopathic traits are well documented. Individuals with psychopathy typically show blunted emotional responses including startle blink modulation when presented with emotion-provoking stimuli, such as photographs of others in pain (Anderson et al., 2011; Anderson & Stanford, 2012; Baskin-Sommers et al., 2013; Levenston et al., 2000; Patrick, Bradley, & Lang, 1993; Patrick, Cuthbert, & Lang, 1994). These deficits in emotional response are most related to the core interpersonal-affective features of psychopathy (Patrick & Bernat, 2009). These interpersonal-affective features have typically been assessed in studies of criminal offenders using items comprising Factor 1 of the Psychopathy Checklist–Revised (PCL-R; Hare, 2003) and in studies of nonoffenders, by scores on the fearless dominance factor of the Psychopathic Personality Inventory (PPI; Lilienfeld, & Andrews, 1996). Whether indexed by PCL-R Factor 1 or PPI fearless dominance, scores on the interpersonal-affective component of psychopathy predict diminished affective-physiological reactivity to emotional (in particular, aversive) stimuli (e.g., Benning, Patrick, & Iacono, 2005; Gordon, Baird, & End, 2004; Patrick, 1994; Verona, Patrick, Curtin, Bradley, & Lang, 2004).

In investigations of the cortical late positive potential (LPP), an internally consistent and reliable brain response measure used to study emotional reactivity (Moran, Jendrusina, & Moser, 2013; Schupp et al., 2000), individuals with psychopathic traits have shown reduced differentiation in LPP amplitude between emotional and neutral pictures (Anderson & Stanford, 2012; Baskin-Sommers et al., 2013; Decety, Lewis, & Cowell, 2015; Medina, Kirilko, & Grose-Fifer, 2016)—with some work demonstrating impaired reactivity to negative emotional stimuli specifically, in relation to interpersonal-affective features (Venables, Hall, Yancey, & Patrick, 2015). Blunted processing of the early anterior positivity (EAP), as well as the LPP, has also been observed among individuals with high levels of psychopathic traits during an emotional Stroop task (Carolan, Jaspers-Fayer, Asmaro, Douglas, & Liotti, 2014). Differences in emotion processing among individuals with psychopathic traits are also apparent even at a young age: Cheng, Hung, and Decety (2012) reported that juvenile offenders with interpersonal-affective features of psychopathy (cf. Frick & Viding, 2009) showed blunted emotional responding, indexed by reduced LPP, when viewing pictures of individuals inflicting pain on others.

In contrast to reliable findings of reduced physiological reactivity among high-psychopathic individuals, results for self-report ratings of affect have been less consistent. Whereas some studies (e.g., Levenston et al., 2000) have found that participants high in psychopathic traits reported experiencing somewhat lowered emotional reactivity to negative stimuli, other studies (e.g., Herpertz et al., 2001; Patrick, Bradley, & Lang, 1993; Patrick, Cuthbert, & Lang, 1994) have found reports of emotional response among high-psychopathic individuals to be similar to those of other participants. Collectively, the literature suggests a potentially important disconnect between physiological and self-report indicators of emotional response among individuals with psychopathic traits.

1.2 | Psychopathy and emotion regulation

Emotions can be modulated through affect-regulation strategies, such as attentional control (e.g., ignoring emotional features of stimuli, distraction) and cognitive change (e.g., reappraisal; Oschner & Gross, 2005). The ability to reappraise negative emotion by reinterpreting an unpleasant stimulus as less negative (e.g., imagining a scene as improving or as artificial) has been shown to be associated with enhanced reports of well-being, positive affect, and stronger relational skills (Gross & John, 2003). Physiological indicators of emotional processing such as the LPP are also sensitive to affect-regulation procedures (Hajcak & Nieuwenhuis, 2006; Lee, Shackman, Jackson, & Davidson, 2009; Moser, Krompinger, Dietz, & Simons, 2009). Additionally, the ability to use reappraisal to increase negative emotions has been associated with enhanced cognitive control (Moser, Most, & Simons, 2010). Consequently, emotion regulation strategies are included in interventions for several different psychopathologies (Blackledge & Hayes, 2001; Linehan, 1993; Papa, Boland, & Sewell, 2012).

Although deficits in emotion regulation capabilities have been posited to be a "prelude to violence" (Davidson, Putnam, & Larson, 2000), only a small number of studies have actually examined emotion regulation among individuals with psychopathic traits. These studies have yielded some evidence that affect-regulation processes among individuals with psychopathic traits are intact. In one study, psychopathic offenders were equally as effective as nonpsychopathic offenders and nonoffenders at generating appropriate facial expressions to films with emotional content when asked to upregulate and downregulate their emotions, and they showed expected cardiovascular changes when inhibiting emotions (Nentjes, Bernstein, Meijer, Arntz, & Wiers, 2016). In addition, individuals with psychopathic traits demonstrated activation in brain regions implicated in empathic reactivity to pain when they imagined themselves in unpleasant scenarios, but did not show activation in these areas when imagining another individual in the scenarios (Decety, Chen, Harenski, & Kiehl, 2013). Finally, individuals with elevated levels of coldheartedness demonstrated expected enhanced activation in frontal areas of the brain when decreasing their emotions by instruction during picture viewing (Harenski, Kim, & Hamann, 2009). Collectively, these studies suggest that individuals with psychopathic traits may be able to modulate their emotional responses in certain contexts.

However, given the dearth of research examining physiological and self-report indices of emotion regulation among individuals with psychopathic traits, there is a pressing need to further investigate whether these individuals have the capacity to alter their natural response to emotional stimuli. The current study examined emotion reactivity and regulation, using both electrophysiological and self-report measures, in participants preselected to vary in levels of fearless dominance (or boldness; Patrick, Fowles, & Krueger, 2009)—the component of psychopathy that has been most predictive of affective response deficits in nonoffender samples. EEG data were collected from participants instructed to respond naturally or regulate their emotions while viewing neutral and negative picture stimuli. Following the picture-viewing procedure, participants rated their emotional reactivity during trials of each type and the amount of effort that they exerted. Major study hypotheses were that

1. Psychopathic traits would be associated with blunted emotional reactivity to negative picture stimuli, as reflected by reduced LPP amplitude and lower self-reported emotional response.
2. Individuals high in psychopathic traits, like individuals low in such traits, would show significant alterations in emotional reactivity during "increase" and "decrease" conditions compared to conditions where they passively viewed the stimuli.

2 | METHOD

2.1 | Participants

Undergraduates from a large midwestern university participated for partial course credit. Participants were selected for EEG testing from a large online-questionnaire screening sample ($N = 1{,}200$), based on scores on the 19-item "boldness" scale of Patrick's (2010) Triarchic Psychopathy Measure (TriPM; $\alpha = .88$). The TriPM boldness scale measures tendencies toward assertiveness, persuasiveness, lack of social fear, confidence and optimism, emotional resilience, courage, and tolerance for uncertainty and danger—characteristics expected to relate to negative emotional reactivity and regulation. Items are answered using a 4-point scale (0 = *false*, 1 = *somewhat false*, 2 = *somewhat true*, 3 = *true*). TriPM boldness scores correlate approximately .8 with scores on the fearless dominance factor of the PPI (Drislane, Patrick, & Arsal, 2014; Sellbom & Phillips, 2013), which (as noted above) has been widely used as a measure of interpersonal-affective features of psychopathy in nonoffender samples. Other work (Patrick, 2010) has shown that the TriPM boldness scale correlates to a similar high degree, in reverse (i.e., $\sim -.8$), with a scale measure of general fear/fearlessness (Kramer, Patrick, Krueger, & Gasperi, 2012) that predicts physiological responses of various types to negative emotional stimuli, including brain-ERP reactivity (Vaidyanathan, Patrick, & Bernat, 2009; Yancey, Venables, & Patrick, 2016).

During the initial phase of EEG testing, males scoring above the 75th percentile and below the 50th percentile on the TriPM boldness scale were recruited for participation. This sampling strategy augmented statistical power by ensuring strong representation of low versus high bold individuals in the study sample. After testing had been completed on 38 participants selected in this manner, other males from the screening sample were invited to participate, regardless of boldness scores, as long as they met the inclusion criteria for EEG testing. This change in sampling strategy ensured representation of individuals across the full range of scores on boldness, which is necessary for dimensional analyses. Eligibility criteria for the EEG testing session included (a) normal or corrected-to-normal vision, (b) English as a native language, (c) no history of head trauma resulting in loss of consciousness for > 5 min, and (d) absence of a physical or cognitive defect that would prevent the understanding and following of instructions for a basic computer task.

The final EEG test sample consisted of 65 male undergraduates, aged 18 to 26 ($M = 18.69$, $SD = 4.29$; racial/ethnic representation was as follows: 68.8% Caucasian, 18.3% Asian, 9.8% African American, 2.1% Latino, and 2.1% biracial. TriPM boldness scores in the sample ranged from 5 to 53 ($M = 30.56$, $SD = 10.52$). In order to ensure that an internally consistent LPP was obtained, 17 participants with fewer than 12 usable LPP trials were excluded from ERP analyses (Moran et al., 2013), resulting in a sample of 48 participants for these analyses. Notably, all participants who were included in the study had well over 12 usable LPP trials (increase block—look-neutral: $M = 23.48$, $SD = 4.58$; look-negative: $M = 24.25$, $SD = 4.68$; increase-negative: $M = 23.85$, $SD = 4.43$; decrease block—look-neutral: $M = 22.70$, $SD = 5.58$; look-negative; $M = 23.58$, $SD = 4.49$; decrease-negative; $M = 23.5$, $SD = 4.53$). However, due to the high participant exclusion rate, Mann-Whitney U and chi-square tests were conducted as appropriate to evaluate whether participants who were excluded from analyses due to insufficient usable LPP trials differed on demographic or psychopathy-related variables from participants who were included. Results indicated that participants who were lost to exclusion did not differ significantly from those included in the study analyses on any demographic or psychopathy-related measures ($ps > .18$).

2.2 | Picture stimuli

The picture stimuli used in the current study were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999), and included 60 higharousing negative pictures centered on themes of violence and human suffering, along with 30 low-arousing neutral pictures depicting unexpressive faces and nonemotional objects and scenes.[1] Negative and neutral pictures were selected to differ from each in IAPS normative ratings of valence (Ms = 2.33 and 4.97, respectively; $t(88) = 19.31$, $p < .001$, Cohen's $d = 4.12$) and arousal (Ms = 6.25 and 2.77; $t(88) = 20.39$, $p < .001$, $d = 4.35$).

2.3 | Emotion regulation task

Following the procedure of Moser et al. (2009), the emotion regulation task consisted of two blocks of trials, one comprising increase-negative trials and look trials (both negative and neutral), and the other decrease-negative trials along with look trials of each type. This design kept participants from having to alternate between two distinct emotion regulation strategies within one block, which could have confounded emotion regulation effects with task-switching effects (e.g., Monsell, 2003). Participants were given a break in between the two blocks. The order of the blocks (increase, decrease) was counterbalanced across participants. To equate picture content across task conditions, the same picture stimuli were used in the two types of blocks.

On each task trial, a visual cue was first presented for 2,000 ms on the computer screen to indicate which type of trial was forthcoming. The cue denoted the valence of the to-be-viewed picture stimulus ("neutral" or "negative") as well as an emotion regulation instruction word ("look," "increase," or "decrease"). Upon offset of the cue word, a blank screen appeared for 500 ms, followed by a fixation cross for 500 ms, and then the picture. The picture remained on the screen for 6,000 ms. A blank screen was then presented for 2,000 ms, followed by a fixation cross for 500 ms, and then the next cue word.

Instructions for the task mirrored those used in prior emotion regulation studies (Moser et al., 2009; Oschner et al., 2004). On look-neutral and look-negative trials, participants were instructed to passively view neutral and negative pictures without altering their natural emotions in any way. On increase-negative trials, participants were instructed to increase their emotions in a self-focused way by imagining themselves or someone they cared about being a part of the unpleasant scene. On decrease-negative trials, participants were instructed to decrease their emotions in a self-focused way by imagining the undesirable scene as being not real or part of a movie. Participants were specifically instructed not to view the scene in a situation-focused way (i.e., imagining the scene improving or worsening). They were also asked not to think of unrelated pictures during the course of the study (Moser et al., 2009; Oschner et al., 2004).

2.4 | Procedure

The procedures for the lab portion of the study were largely identical to those used in a previous study of unselected participants (e.g., Moser et al., 2009) and were approved by the university's Institutional Review Board. Written informed consent was first obtained from the participant. Then, EEG electrodes were attached, and the participant was given instructions for the task of regulating their emotions and completed two practice blocks, including one abbreviated block that was completed out loud, to ensure understanding of and compliance with the instructions. Pictures presented in the practice blocks did not appear in either of the actual task blocks.

Upon completion of the two task trial blocks, the experimenter reentered the room and removed the EEG sensors and cap, and instructed the participant to complete a set of questionnaire measures. The questionnaires included a demographic form and the full TriPM. The full TriPM was administered to provide for reassessment of boldness, the major construct of interest in the study, and also to permit exploratory analyses of effects for disinhibition and meanness facets of psychopathy as indexed by this inventory. The disinhibition subscale assesses tendencies toward impulsivity, irresponsibility, aggression, and antisociality (Patrick, 2010), and correlates approximately .7 with scores on the self-centered impulsivity factor of the PPI (Drislane et al., 2014; Sellbom & Phillips, 2013). Disinhibition scores in the present sample ranged from 5 to 34 ($M = 16.08$, $SD = 6.48$). The meanness subscale measures callousness, remorselessness, exploitiveness, and lack of regard for others (Patrick, 2010). As such, this scale taps callous-affective symptoms associated with Factor 1 of the PCL-R (Venables & Patrick, 2012) and is strongly related to the coldheartedness scale of the PPI, particularly in college student samples (Sellbom & Phillips, 2013). Meanness scores in the present sample ranged from 1 to 32 ($M = 13.40$, $SD = 7.40$).

Participants also completed a brief inventory containing four short-response and four multiple-choice questions. The multiple-choice questions asked participants to rate their emotion reaction during each type of trial (i.e., look-neutral, look-negative, increase-negative, decrease-negative) on a scale from 1 (*very weak*) to 7 (*very strong*). Participants were

[1]Negative IAPS pictures: 1201, 2345.1, 2710, 2716, 2753, 2799, 2800, 2811, 3010, 3053, 3060, 3080, 3100, 3110, 3120, 1050, 3130, 3150, 3225, 3250, 3500, 6020, 6210, 6211, 6212, 6213, 6230, 6244, 6260, 6312, 6313, 6350, 6360, 6510, 6520, 6530, 6550, 6560, 6570, 6821, 9040, 9042, 9075, 9220, 9250, 9253, 9254, 9400, 9410, 9413, 9414, 9419, 9425, 9435, 9452, 9570, 9592, 9530, 9913, 9921. Neutral IAPS pictures: 2190, 2480, 2570, 2840, 2880, 5390, 5531, 5740, 6150, 7000, 7002, 7004, 7009, 7020, 7025, 7031, 7035, 7040, 7090, 7130, 7140, 7150, 7175, 7205, 7211, 7217, 7233, 7235, 7595, 7950.

also asked to report how much effort they used during trials of each type on a scale from 1 (*very little*) to 7 (*very much*). As well, participants answered four open-ended questions that asked them to report how they regulated their emotions during each type of trial.

2.5 | EEG recording and offline processing

EEG data were recorded from 64 Ag-AgCl electrodes using an ActiveTwo Biosemi system (Biosemi, Amsterdam, The Netherlands). Sensors were placed on the left and right mastoids. Electrooculogram (EOG) activity generated by eye movements and blinks was recorded from four electrodes, positioned at the left frontoparietal (FP1) scalp site and at sites inferior to the left pupil and at the left and right outer canthi. During data acquisition, the common mode sensor active electrode and driven right leg passive electrode served as ground referents, per Biosemi's design specifications. EEG signals were digitized at 1024 Hz, and a low-pass filter was applied with a cutoff of 104 Hz. Prior to analysis, data were downsampled to 512 Hz.

Offline processing of EEG signal data was performed using BrainVision Analyzer 2 (Brain Products, Gilching, Germany). Scalp electrode recordings were rereferenced to the mean of the mastoids and band-pass filtered (cutoffs: 0.01–20 Hz; 12 dB/oct roll-off). Ocular artifacts were corrected using the method developed by Gratton, Coles, and Donchin (1983). EEG data were segmented into epochs extending from 500 ms before picture onset to offset of the picture 6,000 ms later, for each trial type separately (decrease block: look-neutral, look-negative, decrease-negative; increase block: look-neutral, look-negative, increase-negative). Consistent with other studies examining the LPP (e.g., Moran et al., 2013; Moser, Hartwig, Moran, Jendrusina, & Kross, 2014), artifacts in the EEG signal were detected using a computer-based algorithm, such that trials meeting any of the following criteria were rejected: a voltage step exceeding 50 μV between contiguous sampling points, a voltage difference of 300 μV within a trial, or a maximum voltage difference of less than 0.5 μV within 100-ms successive intervals.

The LPP was quantified across a set of pooled parietal sites, centered around electrode site Pz (CPz, P1, Pz, P2, POz). Signal activity was baseline-corrected by subtracting the average activity within the prepicture window (-500 to 0 ms) from each data point subsequent to stimulus onset. The LPP was then quantified at multiple time windows after picture onset: 450–1,000 ms, 1,000–2,000 ms, and 2,000–6,000 ms.

2.6 | Data analyses

All data analyses were performed using SPSS software (version 21.0). For the LPP, separate repeated measures analyses of variance (ANOVAs) were undertaken for each time window. The analysis used to test for simple picture-viewing effects consisted of a 2 (Block Type: increase, decrease) × 2 (Trial Type: look-neutral, look-negative) repeated measures ANOVA. The analysis examining effects for emotion regulation consisted of a 2 (Block Type: increase, decrease) × 2 (Trial Type: look-negative, increase/decrease-negative) repeated measures ANOVA. Effects for psychopathy were examined by incorporating each TriPM scale separately as a covariate into each ANOVA. To ensure that random assignment was successful, a between-subjects factor of order (decrease first vs. increase first) was included in a preliminary version of the analysis—and confirmed that differences in the order of emotion regulation strategy did not affect the results. Thus, this factor was not included in analyses reported below.

For the self-report ratings of emotion processing, paired samples *t* tests were used to assess for differences under simple viewing conditions (i.e., for look-negative vs. look-neutral trials). Effects of emotion regulation on ratings were assessed using a 2 (Block Type: increase, decrease) × 2 (Trial Type: look-negative, increase/decrease) repeated measures ANOVA. Then, to test for effects of psychopathy on emotion ratings, each TriPM scale was added separately as a covariate to these analyses.

3 | RESULTS

3.1 | ERP results

3.1.1 | Emotion condition effects

Descriptive statistics for the ERP data are presented in the upper part of Table 1. The two-way ANOVAs for simple viewing of pictures (Trial Type (look-negative/look-neutral) × Block Type) during the three LPP time windows revealed main effects of trial type for each window: 450–1,000 ms: $F(1, 47) = 50.65$, $p < .001$, $\eta_p^2 = .52$; 1,000–2,000 ms: $F(1, 47) = 17.93$, $p < .001$, $\eta_p^2 = .28$; 2,000–6,000 ms: $F(1, 47) = 7.33$, $p < .01$, $\eta_p^2 = .14$. No main effect of block type was evident for any of these time windows, $Fs(1, 47) = 0.35$, 0.27, and 0.93, respectively, $ps > .34$. Inspection of the data indicated that participants showed enhanced LPP response when viewing negative compared to neutral pictures across blocks and time windows, consistent with previous ERP studies of emotion processing (e.g., Cuthbert et al., 1995; Hajcak, Weinberg, MacNamara, & Foti, 2011; Schupp et al., 2000).

Separate two-way ANOVAs were performed for each time window to examine whether participants in the sample as a whole were able to effectively regulate their emotional responses by instruction; as noted above, these consisted of Block Type (increase, decrease) × Trial Type (look-negative

TABLE 1 ERP and self-report data presented as mean (standard deviation)

	Increase block			Decrease block		
Measure	**Look-neutral**	**Look-negative**	**Increase-negative**	**Look-neutral**	**Look-negative**	**Decrease-negative**
LPP (μV)						
450–1,000 ms	0.61 (4.54)	4.57 (4.99)	6.44 (4.94)	0.97 (5.06)	4.83 (5.86)	4.88 (6.54)
1,000–2,000 ms	−1.80 (5.44)	1.63 (5.64)	2.85 (5.38)	−1.40 (6.76)	1.94 (5.41)	1.63 (5.88)
2,000–6,000 ms	−2.39 (7.27)	0.42 (7.14)	−0.09 (7.29)	−3.28 (9.11)	−0.65 (6.75)	−0.64 (8.50)
Self-report measures						
Emotional reactivity	2.17 (.63)	4.17 (1.33)	5.58 (1.05)	2.17 (.63)	3.56 (1.30)	3.08 (1.43)
Effort	2.69 (2.01)	3.69 (1.70)	4.88 (1.76)	2.69 (2.01)	3.40 (1.55)	3.88 (1.47)

vs. increase/decrease-negative) repeated measures ANOVAs. A main effect of trial type was observed for the 450–1,000 ms time window, $F(1, 47) = 5.79$, $p < .05$, $\eta_p^2 = .11$, indicating that "regulate" trials as a whole (e.g., both increase and decrease trials) elicited larger LPP responses than look trials, $t(47) = 2.41$, $p < .05$, $d = .70$. From examining the waveforms, it appeared that the increase-negative trials were driving this relationship, and separate analyses for increase and decrease trials revealed that the LPP was significantly enhanced during increase-negative trials relative to look-negative trials, $t(47) = 3.11$, $p < .01$, $d = .91$, whereas decrease-negative trials did not differ from look-negative trials ($p > .5$). There were no effects for the later time windows (*p*s > .28).

3.1.2 | Psychopathy effects

To test for hypothesized effects of boldness, the same repeated measures ANOVAs were conducted with TriPM boldness scores added as a covariate (i.e., analysis of covariance, ANCOVA, see Moser et al., 2014, for a similar methodological approach). In the ANOVA examining effects for simple viewing during the 450–1,000 ms time window, a significant Boldness × Trial Type interaction was evident, $F(1, 46) = 4.31$, $p < .05$, $\eta_p^2 = .09$. As shown in Figure 1, a follow-up correlational analysis indicated the expected negative relationship for boldness with the difference in LPP amplitude between look-negative and look-neutral trials ($r = -.29$, $p < .05$)—that is, with a blunting of response to negative picture stimuli. These effects were not observed in the later time windows (*F*s < .48; *p*s > .49). Supplemental analyses examining effects for TriPM disinhibition and meanness, through inclusion of scores for each as covariates in place of boldness, revealed no counterpart interaction for either of these scales within the 450–1,000 ms time window or in subsequent windows: Trial Type × Disinhibition, *F*s < 1.36, *p*s > .25; Trial Type × Meanness, *F*s < 1.81, *p*s > .18.

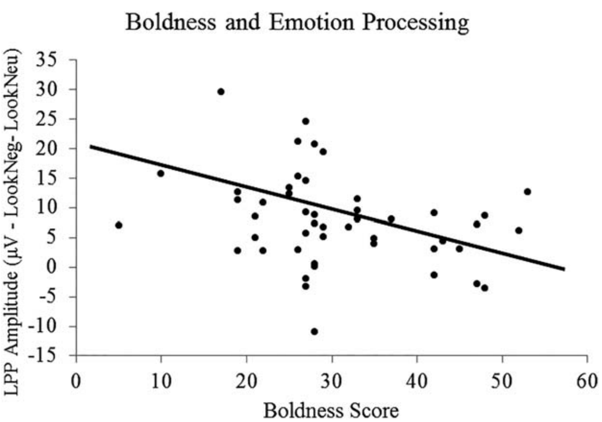

FIGURE 1 LPP response difference for look-negative trials versus look-neutral trials during the 450–1,000 ms time window as a function of TriPM boldness scale scores

We next evaluated how psychopathic traits related to emotion regulation. The LPPs for regulation trials were unrelated to boldness, as there were no significant interactions between scores on this TriPM scale and either trial type or block type for any of the time windows (*F*s < 1.70; *p*s > .20). Figure 2 depicts ERP waveforms for the increase-negative condition together and the look-negative and look-neutral conditions, by boldness score level; it also depicts waveforms, by boldness score level, for the decrease-negative condition along with the look-negative and look-neutral conditions. Supplemental analyses also revealed no significant interactions for TriPM disinhibition (*F*s < 1.70; *p*s > .20) or TriPM meanness (*F*s < 2.42; *p*s > .13).

3.2 | Self-report

3.2.1 | Reported emotion reaction

Descriptive statistics for self-report measures are presented in the lower part of Table 1. The ANOVA examining effects for simple viewing of pictures revealed a main effect of trial

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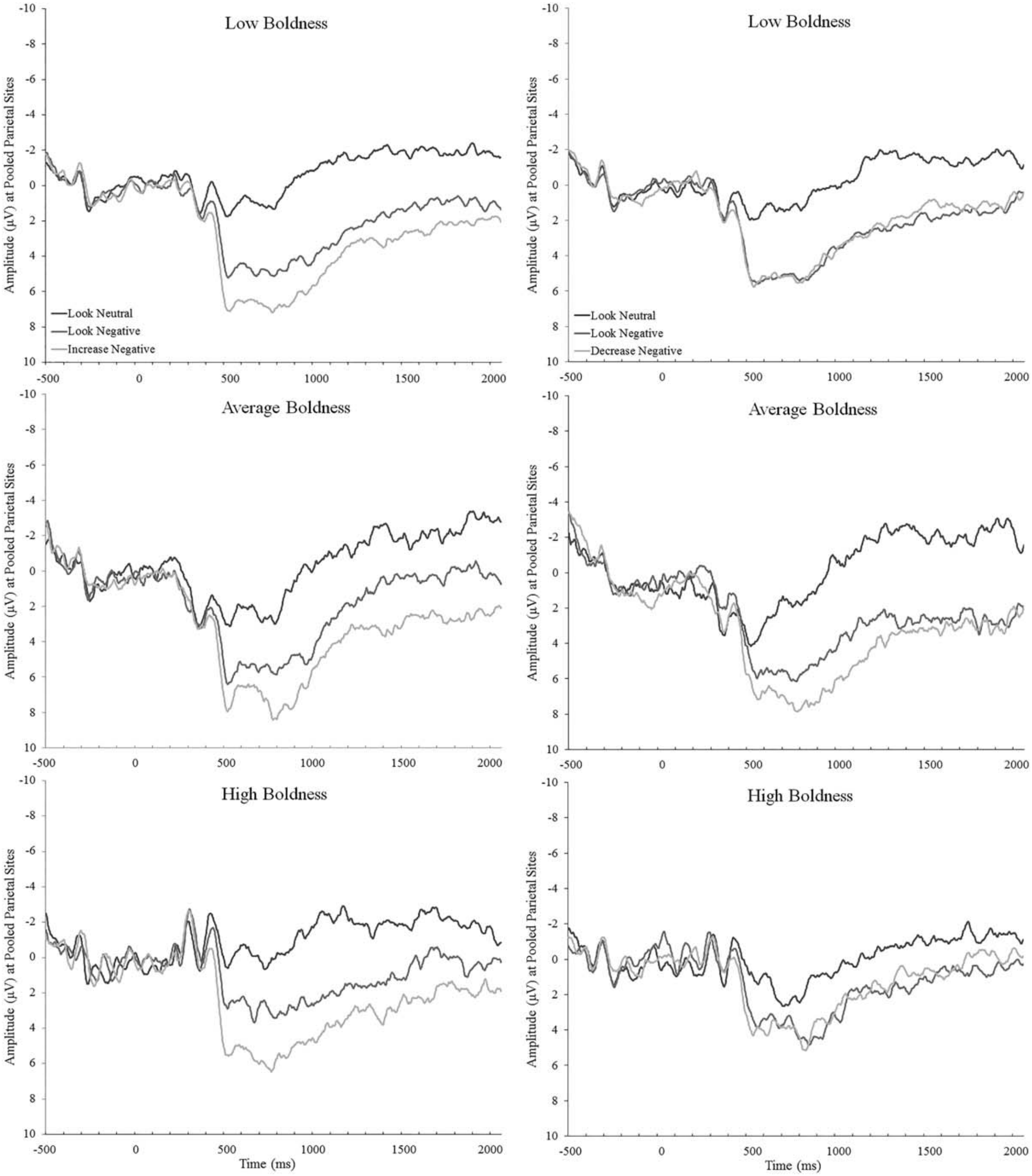

FIGURE 2 Grand-averaged waveforms for the increase-negative blocks, along with waveforms for look-negative and look-neutral blocks, for individuals scoring high, average, and low on boldness (based on tertiary split for illustrative purposes only) are presented on the left side. Grand-averaged waveforms for the decrease-negative block, along with waveforms for look-negative and look-neutral blocks, for individuals scoring high, average, and low on boldness (based on tertiary split for illustrative purposes only) are presented on the right side

type, with participants as a whole reporting enhanced emotional reactivity when viewing negative compared to neutral pictures, $t(47) = 7.08$, $p < .001$, $d = 1.03$. In the ANOVA examining reported reactivity when regulating emotions to negative images, main effects were evident for both block type, $F(1, 47) = 82.19$, $p < .001$, $\eta_p^2 = .64$, and trial type, $F(1, 47) = 23.38$, $p < .001$, $\eta_p^2 = .33$. There was also a Block Type × Trial Type interaction, $F(1, 38) = 35.18$, $p < .001$, $\eta_p^2 = .43$, in which, as expected, participants reported greater emotional reactivity for increase-negative trials relative to look-negative trials, $t(47) = 8.86$, $p < .001$, $d = 1.31$, and lower emotion reactivity for decrease-negative trials compared to look-negative trials, $t(47) = 2.28$, $p < .05$, $d = 0.66$. Notably, the difference in self-reported emotional reaction between increase-negative trials and look-negative trials was greater than the difference in self-reported emotion reaction between decrease-negative and look-negative trials, $t(47) = 4.84$, $p < .001$, $d = 1.41$.

In terms of reported emotional reactivity on simple viewing (look) trials, boldness was not associated with differential self-reported emotional reactivity to negative pictures relative to neutral pictures ($r = -.04$, $p = .77$). However, in terms of reported reactivity when regulating emotions, a Boldness × Trial Type interaction was evident, $F(1, 47) = 4.77$, $p < .05$, $\eta_p^2 = .09$. A follow-up correlational analysis indicated that higher boldness was associated with a larger difference in emotion ratings for regulate trials (across increase and decrease conditions) relative to look-negative trials ($r = .31$, $p < .05$), such that individuals scoring high on boldness reported greater emotional reactivity when regulating (i.e., both increasing and decreasing) negative emotions. Self-reported emotion reactivity was not significantly related to either disinhibition (Fs < 3.56; $ps > .07$) or meanness (Fs < 2.75; $ps > .10$).

3.2.2 | Reported effort

In the ANOVA examining effects for simple viewing, participants as a whole reported utilizing more effort when viewing negative pictures compared to neutral pictures, trial type main effect, $t(47) = 4.17$, $p < .001$, $d = 0.61$. In the ANOVA examining effects for regulation of emotion to negative pictures, main effects were found for both block type, $F(1, 47) = 9.18$, $p < .01$, $\eta_p^2 = .16$, and trial type, $F(1, 47) = 15.04$, $p < .001$, $\eta_p^2 = .24$. There was also a Block Type × Trial Type interaction, $F(1, 47) = 5.39$, $p < .05$, $\eta_p^2 = .10$, with participants reporting greater effort on increase-negative trials relative to the look-negative trials, $t(47) = 3.92$, $p < .001$, $d = 0.57$, and on decrease-negative trials compared to look-negative trials, $t(47) = 2.21$, $p < .05$, $d = 0.32$. However; the difference in self-reported effort between increase-negative trials and look-negative trials was greater than the difference between decrease-negative and look-negative trials, $t(47) = 2.32$, $p < .05$, $d = 0.68$.

Boldness did not interact with self-reported effort ($ps > .16$), indicating that participants reported similar levels of effort exertion, regardless of boldness scores. However, a significant Disinhibition × Trial Type interaction was found, $F(1, 46) = 4.10$, $p < .05$, $\eta_p^2 = .08$, with higher scores on disinhibition predicting greater reported effort during regulate trials (i.e., increase-negative and decrease-negative trials) compared to look trials ($r = .29$, $p < .05$). A significant Meanness × Block Type interaction was also evident, $F(1,46) = 5.51$, $p < .05$, $\eta_p^2 = .11$, with participants high on meanness reporting lower exertion of effort in the increase block relative to the decrease block ($r = -.33$, $p < .05$).

4 | DISCUSSION

Although a number of studies have examined how psychopathy relates to emotional reactivity (Anderson et al., 2011; Anderson & Stanford, 2012; Baskin-Sommers et al., 2013; Levenston et al., 2000), little attention has been devoted to how this personality dimension relates to emotion regulation. The current study sought to fill this gap by assessing emotion reactivity and emotion regulation capabilities among individuals with psychopathic traits using a multimethod approach. The electrophysiological data indicated that boldness, but not meanness or disinhibition, was related to reduced LPP to negative versus neutral pictures during passive viewing trials. However, none of these psychopathy facets showed an association with LPP amplitude during emotion regulation (increase or decrease emotional responses). The self-report data revealed a different pattern: Boldness was unrelated to subjective ratings of emotional reactivity during passive viewing trials, but was associated with greater perceived emotional reactivity during the regulation trials. Disinhibition and meanness, by contrast, were unrelated to ratings of emotional reactivity for trials of either type, but did show associations (positive and negative, respectively) with reported effort exertion. Here, we discuss these findings with regard to the theoretical and empirical work on psychopathy.

During passive viewing of pictures, individuals who scored high on boldness demonstrated reduced LPP to negative versus neutral trials, a finding in line with previous studies that have likewise found higher levels of primary psychopathy (i.e., high boldness/fearless dominance, low trait fear) to be associated with a blunted LPP (Anderson et al., 2011; Anderson & Stanford, 2012; Venables et al., 2015; Yancey et al., 2016). Despite showing reduced physiological reactivity during passive viewing, participants scoring high on boldness reported similar modulation of perceived emotional reactivity during passive viewing to those low on boldness. The disconnect between physiological and self-report indicators of emotional reactivity among individuals with psychopathy fits with classic clinical descriptions of this condition. In particular, Cleckley's (1955) conceptualization of psychopathy centers on discordance between linguistic and physiological components of emotion (cf. Patrick et al., 1993). The current study is the first to show that this discordance between physiology and self-report is also present when individuals are asked to regulate their emotional reactivity. Specifically, boldness was associated with greater self-reported emotional activation on increase/decrease trials, but was unrelated to physiological responding on these trials.

Notably, boldness was associated with greater perceived affective reactivity, as indexed by self-report of emotion, for regulation trials of both types (i.e., both increase and decrease) even though participants as a whole were only effective at increasing their LPP response. The tendency for individuals with higher scores on boldness to report greater emotional reactivity during decrease trials, as well as on increase trials, may reflect different possible influences. One possibility is that individuals scoring high on boldness may have overreported their level of emotional reactivity during decrease-negative trials in an effort to conceal their blunted emotional responses. This explanation would be consistent with the manipulative tendencies among individuals with psychopathic traits.

The increase in emotion reporting during regulation trials of both types may also reflect enhanced cognitive-attentional processing in high-bold participants. In the present study, the decrease instruction required participants to attend to and reinterpret emotional content. It is possible that enhanced attention to the emotional content of the picture during decrease trials led high-bold individuals to report greater emotional reactivity than on passive viewing trials. This explanation is consistent with previous studies, which have found that the blunted processing of affective stimuli in psychopathy may be partially due to reduced attention to emotional content (Anderson & Stanford, 2012). Glass and Newman (2006), for example, reported that individuals with psychopathic traits did not differ from controls in recognizing facial expressions when instructed to actively attend to facial stimuli.

Cognitive-attentional models may also help to explain the physiological results of the study. Previous studies have demonstrated that asking individuals with psychopathic traits to attend to information is associated with increases in brain activity (Anderson & Stanford, 2012; Baskin-Sommers et al., 2013; Krusemark, Kiehl, & Newman, 2016; Larson et al., 2013). Thus, the enhanced LPP on increase trials among high-bold individuals may reflect allocation of attention to the emotional content of the images by participants, rather than enhancement of emotional response. This framework may also explain why we were unable to replicate past research demonstrating reduced LPP during the decrease-negative trials (e.g., Hajcak & Nieuwenhuis, 2006; Moser et al., 2009). It is possible that the self-focused regulation instruction for decreasing emotions in this study ("Try to imagine the scene as not real or part of a movie") led participants to attend more to the emotional content of the pictures. To evaluate this possibility, it will be helpful in future studies to compare results for different emotion regulation instructions, including strategies that involve limited attentional demands.

Importantly, in the present study, individuals scoring high on disinhibition or meanness did not demonstrate blunted emotional reactivity, as indexed by self-reported emotional reactivity or the LPP. The lack of effects for disinhibition and meanness may reflect the fact that the present study used a college student sample that was preselected only for variations in boldness. Consequently, the study sample had a more limited range of disinhibition scores (5–34) and meanness scores (1–32) than boldness scores (5–53). Accordingly, the lack of reactivity difference for disinhibition and meanness should be considered in the context of this sampling strategy.

Notwithstanding this sampling issue, it should be noted that the finding of emotional blunting for boldness, but not disinhibition, is consistent with the two-process theory of psychopathy (Patrick & Bernat, 2009), which posits that different facets of psychopathy have distinct neurophysiological profiles. For example, previous work has shown that Factor 1 features of psychopathy are associated with a blunted LPP but an intact P3 response, whereas Factor 2 symptoms tend to be associated with blunted P3 response but intact LPP (Venables et al., 2015). Another study found Factor 1 but not Factor 2 features to be associated with blunted startle potentiation during viewing of aversive scenes (Vaidyanathan, Hall, Patrick, & Bernat, 2011). Future studies should continue to investigate distinct neural correlates in relation to distinct symptom facets (and diagnostic subtypes; e.g., Hicks, Markon, Patrick, Krueger, & Newman, 2004) of psychopathy.

The lack of significant interaction effects for meanness appears less consistent with the literature on affective deficits in relation to callous-unemotional features of psychopathy (cf. Frick, Ray, Thorton, & Kahn, 2014). Given that the TriPM meanness scale indexes such tendencies (Drislane et al., 2014; Venables & Patrick, 2012), it is surprising that decreased emotional reactivity was not observed in relation to this psychopathy facet. One possibility is that emotional reactivity in a picture-viewing context as indexed by the LPP and self-report may be more related to the affective resilience and social dominance seen in boldness than the callousness and lack of empathy seen in meanness. Follow-up studies with samples containing participants with a broader range of scores on both dimensions, such as community samples preselected for psychopathic traits or forensic samples, may help clarify these findings.

4.1 | Limitations and conclusions

Findings from the current study should be considered in the context of certain limitations. First, as noted above, data were drawn from college students who varied on the personality dimension of boldness; formal personality disorder diagnostic criteria were not assessed. However, college students are by no means immune to psychological problems (Hunt & Eisenberg, 2010), and accumulating research indicates that psychopathology can be conceptualized as a continuum rather than on categorical terms (Krueger & Eaton, 2010; Krueger, Markon, Patrick, & Iacono, 2005). By documenting the presence of a continuous score association for one distinct facet of psychopathy (i.e., boldness) with emotional reactivity and regulation, current findings extend past studies focusing on discrete groups (e.g., imprisoned vs. nonimprisoned individuals).

Additionally, the negative picture stimuli more frequently involved people and complex scenarios, whereas more of the neutral pictures depicted simple scenes, such as buildings and household objects. Because prior research has shown that factors including visual complexity of images (Sadeh & Verona, 2012) and the presence of people in depicted scenes (Weinberg & Hajcak, 2010) can influence LPP magnitude, the conclusions that can be drawn from the current study are limited. Future studies should match IAPS images on complexity to ensure that the results are due to emotional content, rather than scene complexity.

Finally, as noted above, the study also had a relatively high participant exclusion rate due to poor ERP quality. Although the high exclusion rate resulted in loss of statistical power in the present study, findings indicated that excluded participants did not differ significantly from included participants on demographic or psychopathy-related variables, suggesting that sample representativeness was maintained. However, in future studies of this kind, we recommend that investigators collect more trials per condition than the number used here (i.e., 30) to ensure sufficient numbers of analyzable trials following exclusion of unusable data.

Notwithstanding these limitations, the current study provides a novel look into how individual differences in psychopathy relate to affective reactivity and regulation. In particular, the multimethod approach used in this study allowed us to examine psychopathy-related effects on these distinct aspects of emotional processes in terms of electrophysiological and subjective self-report ratings—a critical methodological advantage when it comes to psychopathy. The findings illustrate that the discordance between physiology and self-report among individuals with psychopathy also extends to affect regulation, and point to this aspect of emotional processing as a promising area for future research on psychopathy. Further understanding of the mechanisms giving rise to the disconnect between physiology and experiential report as related to emotional processing may help to pave the way for novel conceptualizations and interventions for this population.

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