Emotion Among Women With Psychopathy During Picture Perception

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Emotional reactions in women with psychopathy were examined in a mixed-picture paradigm using psychophysiological measures. Startle probes were presented at 2.0 or 4.5 s following onset of a 6-s picture presentation. At 2.0 s, nonpsychopaths exhibited the typical pattern of eyeblink reflex magnitude: unpleasant > neutral > pleasant. Psychopaths with high general levels of anxiety also exhibited this pattern. Psychopaths with lower anxiety exhibited attenuated reflex magnitudes during unpleasant pictures. Similarly, when focusing on psychopathy components, only individuals expressing high antisocial behavior and high emotional detachment exhibited smaller reflex magnitudes during unpleasant pictures. At 4.5 s, all groups exhibited normal, potentiated reflex magnitudes during unpleasant pictures. Group differences were not observed for other measures.

Psychopathic men are noted for their failure to regulate inappropriate behaviors, to experience a normal range and depth of emotion, and to form meaningful interpersonal attachments (Cleckley, 1976; Hare, 1991). Although the psychopathic individual's self-regulatory deficits are problematic, many researchers regard the "emotional deficit" as more fundamental (e.g., Hare, 1998; Mitchell & Blair, 2000; Patrick, 1994; Steuerwald & Kosson, 2000). Despite debate regarding the underlying nature of this emotion deficit (e.g., Lykken, 1995; Newman & Lorenz, 2002; Steuerwald & Kosson, 2000), there is consensus in the field that emotion processing abnormalities are characteristic of the psychopathic male. However, less is known about the emotion processing characteristics of psychopathic females. To explore this issue, we assessed emotional reactions during perception of unpleasant, neu-

tral, and pleasant pictures using a method similar to that of Patrick, Bradley, and Lang (1993). Hare's (1991) Psychopathy Checklist—Revised (PCL–R) was used to categorize female psychopaths and nonpsychopaths following the standard criterion used for men.

Emotion Processing in Psychopathy

Abnormal emotion processing in men with psychopathy has been demonstrated across a number of domains. Clinically, Cleckley (1976) observed that the affective reactions of psychopaths are limited in both degree and duration across a variety of discrete emotions. Laboratory explorations are consistent with Cleckley's observations. For example, psychopathic men have shown less electrodermal activity in anticipation of aversive stimuli than do nonpsychopathic men (e.g., Blair, 1999; Blair, Jones, Clark, & Smith, 1997; Fowles, 2000; Hare, 1978, 1982; Kilzieh & Cloninger, 1993). Psychopathic men also failed to show the standard facilitation when responding to emotional words in a lexical decision task (Lorenz & Newman, 2002; Williamson, Harpur, & Hare, 1991), as well as the standard increase in recall for the details of an emotional stimulus (e.g., Christianson et al., 1996). Furthermore, psychopathic men are less likely to inhibit previously rewarded responses that now result in punishment (e.g., Lykken, 1957; Newman & Kosson, 1986; Newman & Schmitt, 1998).

Recent research has shown that the personality and behavioral characteristics of female offenders categorized as psychopathic using the PCL–R (Hare, 1991) resemble those of psychopathic men (for a review, see Vitale & Newman, 2001b). However, it appears that other aspects of the syndrome observed in men may not be present in women. For example, psychopathic men exhibit detrimental response perseveration in a card-playing task (e.g., Newman, Patterson, & Kosson, 1987). In other words, men with psychopathy are poorer at inhibiting a previously rewarded behavior in response to negative outcomes. In contrast, Vitale and Newman (2001a) found that psychopathic women did not exhibit response perseveration. One possible explanation for this finding is that psychopathic women are not characterized by high levels of disinhibition. More generally, the results raise the possibility that women with psychopathy may not express the same emotion processing abnormalities as men.

The present study examined emotion processing in psychopathic and nonpsychopathic female offenders. The design followed that of Patrick et al. (1993) where a mix of unpleasant, neutral, and pleasant pictures were used to assess emotional reactions during picture perception by men classified as low, moderate, or high in psychopathy using the PCL–R (Hare, 1991). The primary index of emotion processing was the magnitude of the eyeblink reflex to a brief acoustic startle stimulus. Numerous studies have shown that pictures differing in affective tone modulate startle reflex magnitude (see Lang, 1995, or Bradley, 2000, for a review). Researchers consistently have found average reflex magnitudes greater during unpleasant pictures (e.g., snakes, mutilated bodies, weapons) than during pleasant pictures (e.g., baby animals, erotic scenes, adventure scenes). Patrick et al. administered startle probes between 3,500 and 5,500 ms following onset of the 6-s picture presentation. Startle reflex magnitudes were combined across the different probe times. Men with low and moderate PCL–R scores demonstrated a typical pattern of startle modulation (unpleasant greater than pleasant), whereas psychopathic individuals did not. The groups did not differ in terms of other psychophysiological indices of affective responding: heart rate deceleration, skin conductance response, and corrugator increase.

Patrick et al. (1993) also explored the influence of the two primary factors of the PCL–R on startle reflex modulation. They first selected individuals with Factor 2 (Antisocial Behavior) scores greater than the scale midpoint (predominantly individuals in the mixed and psychopathy groups), then split these individuals into two groups on the basis of Factor 1 (Emotional Detachment) scores. Those individuals relatively high on Factor 1 (primarily the psychopathy group) failed to exhibit startle potentiation in response to unpleasant pictures, whereas those individuals relatively low on Factor 1 (primarily the mixed group) showed the typical potentiation.

Levenston, Patrick, Bradley, and Lang (2000) replicated and extended this finding using a variation of the standard mixed-picture paradigm with a different set of probe times. At 250 ms following the onset of a picture, neither psychopathic nor nonpsychopathic men showed emotion modulation. At the 800-ms probe, nonpsychopaths exhibited the typical pattern of emotion modulation, whereas psychopaths (selected only if relatively high on both Factors 1 and 2) exhibited relatively small reflex magnitudes during unpleasant pictures. Psychopaths, however, exhibited evidence of normal startle potentiation during unpleasant pictures across later probe times (1,800 ms, 3,000 ms, and 4,500 ms combined) when the images depicted a direct threat (e.g., a gun pointed toward viewer).

The Role of Anxiety

Some research suggests that the influence of psychopathy on emotion is moderated by general levels of anxiety, distress, and related constructs. For example, Lykken (1957) found that "primary" sociopaths, defined on the basis of low levels of fear, demonstrated less punishment avoidance than did controls on a passive avoidance task. Subsequent studies suggest that poor passive avoidance is specific to psychopathic individuals lower in general (trait) levels of anxiety (e.g., Chesno & Kilmann, 1975; Newman & Schmitt, 1998). Furthermore, Lorenz and Newman (2002) showed that the deficient emotion facilitation demonstrated by male psychopathic offenders is most evident in those lower in anxiety.

General levels of anxiety and related constructs also have been shown to moderate the modulation of startle reflexes in response to unpleasant stimuli. Miller and Patrick (2000) found that under conditions of shock anticipation, individuals high in trait anxiety exhibited greater startle potentiation when viewing threatening words than when viewing pleasant words. In contrast, these individuals exhibited smaller startle reflexes to threatening words than to pleasant words when shock was not anticipated. Similarly, Wilson, Kumari, Gray, and Corr (2000) found that individuals high in Neuroticism exhibited greater startle responses than individuals low in Neuroticism under fear-eliciting conditions. In combination, these results suggest that attenuated reactions to unpleasant pictures will be strongest in psychopaths lower in anxiety.

The Current Study

Incarcerated women were categorized using the PCL–R (Hare, 1991) following the same criterion applied to men. Factor 1 (Emotional Detachment) and Factor 2 (Antisocial Behavior) scores also were computed. General levels of anxiety was assessed using the Welsh Anxiety Scale (Welsh, 1956). A standard version of the mixed-picture paradigm was used to assess emotional reactions to unpleasant, neutral, and pleasant pictures using several psychophysiological measures: acoustic startle eyeblink reflex magnitude, cardiac deceleration, skin conductance response, and corrugator increase. Each picture was presented for 6 s, with 14–21 s between pictures. Acoustic startle probes were presented either 2.0 or 4.5 s following picture onset, or in the middle of the interpicture interval. These probe times were selected to assess reactions subsequent to reliable picture perception, but at relatively distinct time points such that differences in the time course of an emotional reaction could be evaluated using a sufficient number of probes for each combination of picture category and time of probe.

On the basis of previous research with men, we predicted that women with psychopathy would show abnormal startle reactions to unpleasant pictures, particularly at the 2.0-s probe time. In addition, we predicted that such effects would be more prominent for psychopaths lower in anxiety. Furthermore, following Patrick et al. (1993), we predicted that such effects would be more robust for women with high scores on both PCL–R factors than for those with only high antisocial behavior scores. Women with psychopathy were not expected to differ from nonpsychopaths in terms of the other three psychophysiological measures.

Method

Participants

Participants were volunteers from a pool of 528 adult women incarcerated at the Taycheedah Correctional Institution in central Wisconsin. Each received $10 for completing an initial interview and several self-report measures. These sessions were held between 2 and 24 months prior to completion of the session where pictures were viewed. Interview participants were excluded on the basis of age (no participants over 45), current use of antipsychotic medication, academic level (minimum of 4th-grade reading and mathematical abilities), and estimated IQ less than 70 (see Vitale, Smith, Brinkley, & Newman, 2002, for more details).

One hundred seventy-two volunteers each received $25 for completing the session that included the current study. Participants ranged in age from 18 to 43. Table 1 presents descriptive statistics for the three psychopathy groups, along with *F* ratios from one-way analyses of variance (ANOVAs). There were no significant group differences for age and

Table 1
Descriptive Statistics for the Nonpsychopathy, Mixed, and Psychopathy Groups

Measure	Nonpsychopaths	Mixed	Psychopaths	*F* ratio
N (White/Black)[a]	94 (42/52)	54 (30/24)	24 (14/10)	
PCL–R				
M	14.3	24.4	31.5	234.68**
SD	4.9	2.7	1.4	
Age (years)				
M	29.5	29.2	27.9	<1.00
SD	6.4	6.3	5.2	
Estimated WAIS–R				
M	90.4	90.8	90.1	<1.00
SD	11.3	10.8	9.9	
Welsh Anxiety Scale				
M	17.1	21.5	20.6	4.39*
SD	8.8	9.5	9.7	

Note. For the PCL–R, age, and the Welsh Anxiety Scale, *df*s = (2, 169); for the WAIS–R, *df*s = (2, 163). PCL–R = Psychopathy Check List—Revised (Hare, 1991); WAIS–R = Wechsler Adult Intelligence Scale—Revised, estimated using the Shipley Institute of Living Scale (Zachary, 1986). Eight participants (*n*s = 3, 1, and 2) did not complete the WAIS–R. The Welsh Anxiety Scale is from Welsh (1956).
[a] "White" includes Caucasian and Hispanic participants.
* $p = .014$.　** $p < .0001$.

intelligence. In contrast, the groups differed in terms of general levels of anxiety. Nonpsychopaths reported significantly lower anxiety than did the mixed group participants, $t(144) = -3.00$. The difference between nonpsychopaths and psychopaths was marginally significant, $t(114) = -1.82$, $p < .08$.

Because of these group differences, different median split values were used to assign individuals to *relatively* low- and high-anxiety subgroups within each psychopathy group for analyses assessing the role of anxiety as a moderator of the influence of psychopathy on emotion processing. These values were 16 (and below) for nonpsychopaths (*n*s = 49 and 45), 23 for the mixed group (*n*s = 26 and 28), and 21 for psychopaths (*n*s = 12 and 12).[1] Whereas these subgroups are labeled *low* and *high,* it is noteworthy that each of these split values (as well as each group average) is relatively high in terms of published norms (e.g., Welsh, 1956). Therefore, it is important to emphasize the *relative* quality of these labels.

Materials

Participants were categorized using the PCL–R (Hare, 1991). The PCL–R consists of 20 items that target personality characteristics and behavior patterns. Scoring is based on an hour-long semistructured interview and extensive file reviews. Information obtained through the file reviews for each participant included a presentencing investigation conducted for the court, and any conduct reports that had accumulated throughout the individual's incarceration. Interviewers and observers were Caucasian women and men who were either graduate students in clinical psychology or professional research assistants (for additional information, see Vitale et al., 2002). The Shipley Institute of Living Scale (Zachary, 1986) is a 40-item vocabulary test and a 20-item abstraction test. The measure was used to estimate Wechsler Adult Intelligence Scales—Revised (WAIS–R) scores (Zachary, 1986). The Welsh Anxiety Scale (Welsh, 1956) was used to measure general levels of anxiety, distress, and related constructs. This is a 39-item true/false questionnaire derived from the Minnesota Multiphasic Personality Inventory.

Pictures were drawn from the International Affective Picture System (IAPS; Center for the Study of Emotion and Attention, National Institute of Mental Health [CSEA–NIMH], 1999).[2] Pictures were selected on the basis of normative ratings collected at the University of Florida (unpleasant: negative valence and high arousal; neutral: neutral valence and low arousal; pleasant: positive valence and high arousal) as well as the level of appropriateness for the target prison population (e.g., no pictures of men

assaulting women). Original digitized IAPS pictures were redigitized at $800 \times 600 \times 256$ using Adobe Photoshop (Version 4.0), with black framing where needed.[3]

Apparatus

All psychophysiological signals were collected using an optically isolated, battery-powered Bio-amplifier (SA Instrumentation, San Diego, CA). Electromyographic (EMG) signals from the orbicularis oculi and corrugator supercilii muscle regions were detected using Ag/AgCl mini-

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[1] The median based on data from all participants was 18. Applying this cutoff value produced low- and high-anxiety subgroups of 59 and 35 for nonpsychopaths, 17 and 37 for the mixed group, and 9 and 15 for psychopaths. This uneven division presents the most substantial decrease in statistical power for the psychopathy group—the group with the smallest sample size. Therefore, we chose to use group-specific median splits.

The correlation between the PCL–R and anxiety scores was significant, $r(170) = .189$. To further clarify this relation, correlations among anxiety scores and the two PCL–R factor scores were assessed. The correlation with Factor 2 (Antisocial Behavior) was significant, $r(170) = .252$, whereas the correlation with Factor 1 (Emotional Detachment) was not, $r(170) = .068$. These two correlations were significantly different, $t(169) = 2.45$.

[2] The following lists the IAPS numbers (CSEA–NIMH, 1999) for the presented pictures by category. Practice pictures: 2791, 5030, 7004, 7010, 7040, 7050, 7185, 8041, and 9600. Neutral pictures: 2190, 2840, 5500, 5510, 5520, 6150, 7000, 7006, 7020, 7080, 7100, 7130, 7150, 7160, 7175, 7491, 7500, and 7950. Unpleasant pictures: 1120, 1201, 1300, 1930, 2730, 3051, 3140, 3150, 3230, 3400, 6230, 6260, 6570, 9140, 9250, 9300, 9410, and 9570. Pleasant pictures: 4470, 4510, 4572, 4660, 4680, 5450, 5621, 5626, 5629, 8030, 8080, 8161, 8180, 8190, 8200, 8400, 8490, and 8501. A list of the presentation order of pictures with probe times is available on request.

[3] We performed a preliminary study to verify that these pictures in this version of the mixed-picture paradigm would produce the typical pattern of affective modulation of the acoustic startle reflex magnitude. Nineteen unselected female undergraduates received course credit for participation. Ages ranged from 18 to 23 years old. The method was the same as for the psychopathy study. The data from one additional participant were dropped prior to data analysis because of insufficient eyeblink reflex magnitude data.

electrodes (In Vivo Metric, Rochester, NY) filled with a standard electro-lyte gel. Orbicularis electrodes were placed according to the procedure described in Lang (1995). Corrugator electrodes were placed according to Fridlund and Cacioppo (1986). An isolated ground electrode was placed in the middle of the forehead. Impedance values for all paired combinations of electrodes were below 20 kΩ. EMG signals were hardware filtered in two ways—a high-pass filter set at 1 Hz and a 60 Hz notch filter—before being amplified 5,000 times. Skin conductance was acquired using 1-cm Ag/AgCl electrodes (In Vivo Metric) filled with electrode paste (Fowles et al., 1981). EKG was recorded using 1-cm Ag/AgCl disposable electrodes (In Vivo Metric) placed on the upper portion of the left and right arms. Signals were amplified 500 times. All signals were digitized at 500 Hz using a 12-bit analog-to-digital board (James Long Co., Caroga Falls, NY). Digitized values were displayed and stored using SnapStream software (HEM Data Corp., Springfield, MI) on a standard personal computer.

Stimulus display and data acquisition was controlled using STIM software and computer-to-computer hardware (James Long Co.) on a standard personal computer. Digitized pictures displayed on a 17-inch Optiquest color monitor that was connected to the computer's primary monitor port. The acoustic startle probe was played through a 12-bit digital-to-analog board before being amplified by a standard stereo receiver (Radio Shack Model STA-3850) and presented through headphones (Radio Shack Model Optimus Pro-40). Sound levels were calibrated at the start of each session using a Radio Shack digital sound meter (Radio Shack Model 33-2055). The digitized acoustic startle stimulus was created using SOUNDGEN (James Long Co.). This stimulus was 102 dB of white noise presented for 50 ms, with immediate onset. The signal was created and played at 20,000 Hz.

Procedure

The experimenter was one of three Caucasian women approximately 22 years of age. All were paid research assistants who had recently completed a bachelor's degree program. All were blind to psychopathy categorization.

Participants completed informed consent at the start of the session. Following a brief overview of the procedures and electrode placement, there was a 10-min resting period. Approximately one half of participants then completed a count-to-noise task; the rest completed the picture procedure before the other task.[4]

The participant was told that she was going to view a series of pictures presented on the monitor and that she would occasionally hear a short burst of noise through the headphones. She was instructed to concentrate on the pictures and ignore the noise bursts. Each picture was presented for 6 s, with a variable interpicture interval of 14 to 21 s. Acoustic startle probes (see above) were presented at either 2.0 s or 4.5 s post-picture onset, or midway through the interpicture interval. All participants received the same quasi-random order of pictures and probes. Pictures and probe times were paired in order to balance picture content and probe time within a picture category as well as to balance overall serial position of picture category and probe time.

A set of 9 practice pictures/trials (generally neutral valence with moderate arousal ratings) were used to acclimate the participant to the procedure and to provide an opportunity for initial habituation of the eyeblink reflex to the startle probe. This lasted 3.5 min, with a total of eight startle probes. During the test procedure, there were 18 exemplars from each of the three picture categories. For each category, there were 6 exemplars with a startle probe at 2.0 s, 6 exemplars with a startle probe at 4.5 s, 4 exemplars with a startle probe during the subsequent interpicture interval, and 2 exemplars with no startle probe. The presentation of the 54 test pictures lasted 21 min, with a total of 48 startle probes.

Psychophysiology Data Reduction

Digitized psychophysiological data were further processed off-line using software from the James Long Company. For startle responses, recorded orbicularis oculi EMG signals were converted to microvolts, then band-pass filtered at 30 Hz and 240 Hz, then rectified. The rectified signal was smoothed using a 60-Hz low-pass filter. For each acoustic startle probe (trial), a baseline level of activity was computed by averaging values for 50 ms prior to the onset of the probe. On a per subject basis, trials with baseline averages greater than 6 μV and more than three standard deviations above the mean baseline value for the subject were dropped from further processing. This occurred on less than 2% of all trials across all participants.

The largest microvolt value between 40 and 90 ms after probe onset was selected as the response peak.[5] Response values were computed by subtracting the trial's baseline from peak value. Peak values less than three standard deviations above the trial's baseline value were deemed nonresponses and were assigned a response value of 0 μV.

Because of the large between-subjects variability in the distribution of response values as recorded in microvolts, these values were standardized within subjects across the 48 startle probes. These z scores denote the relative magnitude of a single response to an acoustic startle probe within each subject. Standardized values were averaged within each combination of the six Picture Category × Probe Time conditions. Interpicture interval responses also were averaged. Data from 16 participants (ns = 7, 6, and 3) were dropped before analyses because of experimenter error or a lack of scorable responses.

Digitized corrugator EMG signals were first converted to microvolts, then band-pass filtered at 30 Hz and 240 Hz, then rectified. The rectified signal was then smoothed using a 60 Hz low-pass filter. Once rectified signals were smoothed, second-by-second microvolt averages were computed. Corrugator increase was computed by subtracting the average level of activity during the 3 s before picture onset from the average level of activity for the 6 s of picture presentation. Negative corrugator difference scores were set to zero. Data from 2 participants (1 from nonpsychopathy group, 1 from mixed group) were dropped prior to analysis because of experimenter error.

Digitized skin conductance levels were first converted to microSiemens prior to computation of second-by-second averages. Skin conductance response was computed by subtracting the average skin conductance level across the 4 previous seconds from the peak skin conductance level 2 or more seconds after picture onset. Negative skin conductance response values were set to zero. Data from 6 participants (5 from nonpsychopathy group; 1 from mixed group) were dropped prior to analysis because of experimenter error or unusually high levels of skin conductance levels and responding.

Cardiac activity was indexed using interbeat intervals derived from the digitized EKG signal. After computing prorated second-by-second averages, interbeat interval increase (heart rate decrease) was computed by subtracting the maximum interbeat interval during the 3 s following picture onset from the average interbeat interval during the 3 s before picture onset.

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[4] The count-to-noise task focuses on anticipation of an unpleasant stimulus. In brief, for the first of six trials, the participant was told to listen to the numbers presented through the headphones. Following a 10-s delay, the participant heard the numbers 1 through 9 (digitized female voice), one number presented every 3 s. There was a 40-s quiet period following the last number. For the second through fifth trials, the participant was told that a loud noise would be presented immediately following the number 5. The digitized loud noise was 110 dB and 500 ms of mostly white noise. On the sixth trial, the participant was told that there would be no loud noise. Following the last trial, the participant then completed a brief questionnaire concerning thoughts and feelings during these trials.

[5] Visual inspection of computerized peak detection confirmed the presence of a clear, single peak on more than 95% of all trials. In a few instances, a second peak occurred earlier and was at least 90% of the magnitude of the maximum value. However, no adjustments were made to the computerized peak detection.

Table 2
Means and Standard Deviations of Startle Reflex Magnitudes

| | Picture category | | | | | | | |
| | Unpleasant | | Neutral | | Pleasant | | Interpicture | |
Group/probe time	M	SD	M	SD	M	SD	M	SD
Nonpsychopathy (n = 87)								
2.0-s probe	.23	.40	.02	.35	−.23	.33	−.05	.23
4.5-s probe	.22	.37	−.16	.29	−.07	.35		
Mixed (n = 48)								
2.0-s probe	.10	.44	−.01	.42	−.19	.32	−.05	.25
4.5-s probe	.25	.37	−.15	.27	.00	.31		
Psychopathy (n = 21)								
2.0-s probe	−.05	.39	.07	.35	−.24	.26	−.07	.20
4.5-s probe	.30	.49	−.03	.42	.01	.38		

Note. Presented values are averages following within-subjects standardization, with means of 0.0 and standard deviations of 1.0.

Negative change values were set to zero. Data from 3 participants (2 from nonpsychopathy group, 1 from mixed group) were dropped prior to analysis because of experimenter error or unusually short interbeat intervals.

For corrugator, skin conductance, and interbeat interval measures, averages were computed across the 18 exemplars for each picture category prior to analysis.

Data Analysis

Analyses were planned in order to target interactions among specific sets of picture categories and psychopathy groups. The majority of analyses contrasted the nonpsychopathy and psychopathy groups. For analyses emphasizing picture valence, planned contrasts compared the unpleasant and pleasant picture categories. Complementary analyses compared the unpleasant and neutral picture categories. Predictions concerning relatively low versus high general levels of anxiety initially focused on contrasts within each psychopathy group, with follow-up analyses incorporating contrasts across psychopathy groups.

Predictions concerning Factor 1 and Factor 2 of the PCL–R (Hare, 1991) were assessed two ways. First, following Patrick et al. (1993), ANOVA was performed after subgroups were created. Individuals with Factor 2 scores above 10 were divided into relatively low and high groups on Factor 1 using a cutoff at 11. There were 43 low Factor 1 individuals: 6 nonpsychopaths, 28 mixed, and 9 psychopaths. There were 16 high Factor 1 individuals: 4 mixed and 12 psychopaths. Average Factor 1 scores were significantly different (M_{low} = 7.9, SD_{low} = 2.4, M_{high} = 13.0, SD_{high} = 1.0), $t(57)$ = −8.37, whereas average Factor 2 scores were not (M_{low} = 13.4, SD_{low} = 2.1, M_{high} = 13.5, SD_{high} = 1.8), $t(57)$ = −0.26. The influences of Factor 1 and Factor 2 were more broadly assessed using multiple regression, with a dependent measure based on a specific Picture Category × Probe Time condition.

The significance level was set at .05 for all analyses. Greenhouse–Geisser corrections for degree of sphericity were used as needed in all ANOVAs (Geisser & Greenhouse, 1959). Epsilon values are reported where appropriate. Reported *p* values reflect the correction.

Results

Startle Eyeblink Reflex Magnitude

Table 2 presents means and standard deviations for the three psychopathy groups for each picture type and probe time.[6] Average reflex magnitudes during the interpicture interval were not significantly different ($F < 1$). An omnibus Picture Category (unpleasant vs. neutral vs. pleasant) × Probe Time (2.0 vs. 4.5 s)

within-subjects ANOVA revealed a significant interaction, $F(2, 310)$ = 17.63, $\varepsilon > .99$, supporting the a priori plan to assess the 2.0- and 4.5-s probe times separately.

Probes at 2.0 s. A Valence (unpleasant vs. pleasant) × Group (nonpsychopathy vs. psychopathy) mixed-design ANOVA revealed a significant ordinal interaction, $F(1, 106)$ = 4.19. Average startle magnitudes were greater during unpleasant than pleasant pictures for nonpsychopaths, $t(86)$ = 7.94. For psychopaths, the difference was marginally significant, $t(20)$ = 1.87, $p < .08$. Furthermore, the group difference in average magnitude during unpleasant pictures was significant, $t(106)$ = 2.78. A comparable ANOVA contrasting unpleasant and neutral pictures revealed a significant disordinal interaction, $F(1, 106)$ = 5.58. Average startle magnitudes were greater during unpleasant than neutral pictures for nonpsychopaths, $t(86)$ = 3.30. For psychopaths, the difference was not significant, $t(20)$ = −1.10.

To assess the influence of general levels of anxiety, ANOVAs were performed within a psychopathy group contrasting low- and high-anxiety subgroups.[7] For nonpsychopaths, the Valence × Anxiety interaction was not significant, $F(1, 85)$ = 2.55. For psychopaths, the Valence × Anxiety interaction was significant, $F(1, 19)$ = 4.79. As can be seen in Figure 1, low-anxiety psychopaths had a lower average magnitude during unpleasant pictures than during pleasant pictures. In contrast, high-anxiety psycho-

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[6] Analyses of data from the college study showed full emotion modulation of startle magnitude. A Picture Category × Probe Time ANOVA revealed a significant main effect for picture category, $F(2, 36)$ = 23.06, $\varepsilon = .80$. Average response magnitude during unpleasant pictures ($M = .37$, $SD = .32$) was significantly greater than during both neutral ($M = −.04$, $SD = .06$) and pleasant pictures ($M = −.25$, $SD = .16$), $ts(18) > 3.76$, and the average response magnitude during neutral pictures was significantly greater than during pleasant pictures, $t(18)$ = 3.17. There also was a marginally significant main effect for probe time, $F(1, 18)$ = 4.25, $p > .05$, with the average response magnitude to the 2.0-s probe ($M = −.06$, $SD = .19$) being less than the average response magnitude to the 4.5-s probe ($M = .12$, $SD = .219$). The interaction was not significant ($F < 1$, $\varepsilon = .79$).

[7] Analyses also were performed after applying a cutoff value of 21 (the median for the psychopathy group) to divide nonpsychopaths into low- and high-anxiety groups ($ns = 63$ and 31, respectively). The results paralleled those with the group-specific split values.
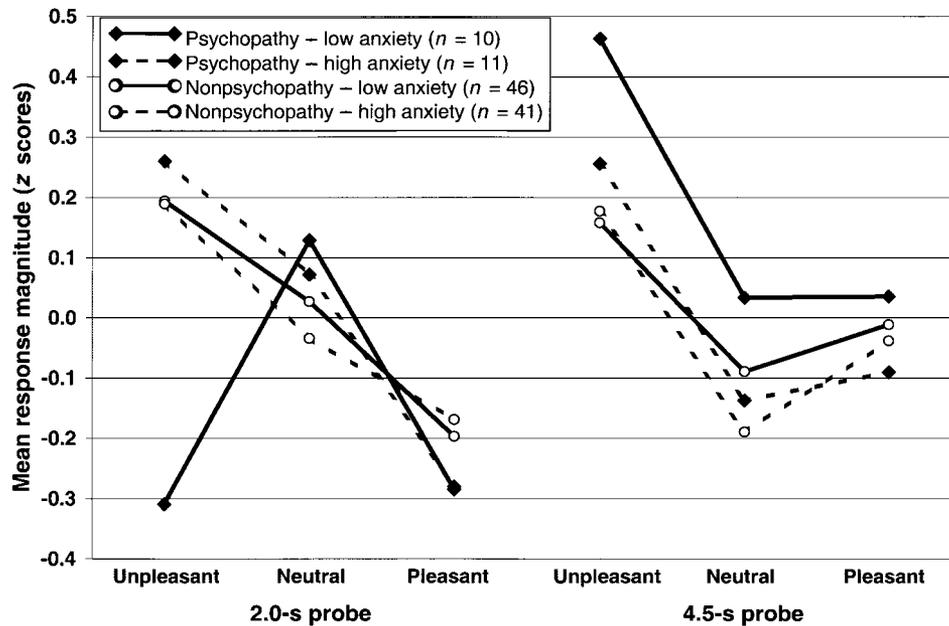
Figure 1. Mean startle response magnitude (*z* scores) for the four groups defined by psychopathy and anxiety category. The left half of the figure displays values for each of the three picture categories at the 2.0-s probe time. The right half of the figure displays values by picture category at the 4.5-s probe time.

paths and both nonpsychopathy subgroups had higher average magnitudes during unpleasant pictures than during pleasant pictures.[8]

Probes at 4.5 s. The Valence × Group interaction was not significant ($F < 1$). The interaction for the comparable ANOVA contrasting unpleasant and neutral pictures also was not significant ($F < 1$). Furthermore, for both groups, the Valence × Anxiety interaction was not significant ($Fs < 1.22$). As can be seen in Figure 1, average magnitudes for both psychopathy and nonpsychopathy groups were greater during unpleasant pictures than during neutral pictures ($ts > 2.28$) and pleasant pictures ($ts > 2.37$).[9]

PCL–R factors. Given the results above, the influences of Factor 1 (for individuals with high Factor 2 scores) on reflex magnitudes focused on responses to the 2.0-s probe. Unlike Patrick et al. (1993), the interaction of valence and Factor 1 was not significant ($F < 1$). However, when contrasting unpleasant and neutral pictures, the interaction was significant, $F(1, 57) = 6.55$. The low Factor 1 group had greater average startle magnitude during unpleasant pictures than during neutral pictures ($M = 0.19$, $SD = 0.65$), whereas the high Factor 1 group exhibited the opposite pattern ($M = -0.27$, $SD = 0.50$).

The influence of Factors 1 and 2 was more broadly assessed using multiple regression, with reflex magnitudes during unpleasant, neutral, and pleasant pictures separately regressed on Factor 1, Factor 2, and their interaction. For unpleasant pictures, the regression model was significant, $F(3, 152) = 3.06$, $R^2 = .04$, with a significant interaction component, $\beta = -0.65$, $t(152) = -2.14$. Similarly, the regression model was significant for pleasant pictures, $F(3, 152) = 4.26$, $R^2 = .06$, with a significant interaction component, $\beta = -0.61$, $t(152) = -2.02$, and a significant Factor 1 component, $\beta = 0.60$, $t(152) = 3.15$. In contrast, the regression model was not significant for neutral pictures ($F < 1$). These

results suggest that the combination of high levels of both antisocial behavior and emotional detachment (as expressed by the interaction term) is the primary determinant of attenuated blink magnitudes during unpleasant and pleasant pictures.

Corrugator Activity

Table 3 presents means and standard deviations for corrugator activity by picture category and group. A within-subjects ANOVA revealed a significant main effect for picture category, $F(2, 338) = 47.73$, $\varepsilon = .52$.[10] Across all participants, the typical pattern of corrugator activity increase in response to unpleasant pictures was observed. Average corrugator activity was greater during unpleasant pictures than during neutral and pleasant pictures, $ts(169) > 6.56$, whereas average corrugator activity during neutral

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[8] A Picture Category × Probe Time × Group × Anxiety mixed-design ANOVA revealed a marginally significant four-way interaction, $F(2, 208) = 3.03$, $p = .053$, $\varepsilon = .96$, further supporting the results of these analyses.

[9] The failure to exhibit startle reflex attenuation to pleasant pictures at the 4.5-s probe was further investigated by comparing average responses by prisoners with those of the undergraduates in the college study. A 2 (neutral vs. pleasant) × 2 (college vs. prison) mixed-design ANOVA revealed a significant interaction, $F(1, 125) = 4.77$, but no significant main effects ($Fs < 1$). More specifically, the pleasant minus neutral difference in average reflex magnitude in the undergraduates ($M = -.18$, $SD = .43$) was significantly different than the pleasant minus neutral difference in average reflex magnitude in the prisoners ($M = .09$, $SD = .50$).

[10] Given this low value for epsilon, a multivariate analysis of variance was performed to verify the reported results of the repeated-measures ANOVA. The main effect for picture category was significant, $F(2, 168) = 22.87$.

Table 3

Means and Standard Deviations of Cardiac Deceleration, Skin Conductance Response, and Corrugator Increase

	Picture category						
	Unpleasant		Neutral		Pleasant		
Group/measure	M	SD	M	SD	M	SD	n
Nonpsychopathy							
Interbeat interval	28.21	25.84	13.02	15.88	19.16	18.26	91
Skin conductance	.08	.15	.02	.04	.03	.08	88
Corrugator	1.59	2.79	.18	.33	.20	.38	92
Mixed							
Interbeat interval	25.82	26.43	9.59	10.77	17.00	16.66	54
Skin conductance	.05	.12	.01	.03	.03	.08	54
Corrugator	1.52	2.46	.12	.21	.12	.21	54
Psychopathy							
Interbeat interval	31.70	28.90	17.74	16.47	22.17	20.67	24
Skin conductance	.02	.05	.00[a]	.00[a]	.01	.02	24
Corrugator	2.84	5.33	.19	.33	.36	1.10	24

Note. Interbeat interval increase (heart rate deceleration) is in milliseconds and is the maximum increase during the first 3 s following picture onset, relative to the average of the 3 s prior to picture onset. Skin conductance response is in microSiemens and is the maximum increase during 2–6 s after picture onset, relative to the average over the prior 4 s. Corrugator activity increase is in microvolts and is the average during the 6 s of picture presentation minus the average of 3 s prior to picture onset.
[a] The average and standard deviation are .001 and .003, respectively.

and pleasant pictures was not significantly different, $t(169) = -0.96$. The interaction for the Valence × Group mixed-design ANOVA was not significant, $F(1, 114) = 2.62$. Similarly, the interaction for the comparable ANOVA contrasting unpleasant and neutral pictures was not significant, $F(1, 114) = 2.50$.

The possible influences of anxiety and the PCL–R factors on corrugator activity were assessed by performing analyses matching those used to investigate eyeblink reflex magnitudes. The ANOVAs failed to reveal any significant interactions. The regression models were not significant.

Cardiac Deceleration

Table 3 presents means and standard deviations for interbeat intervals. Note that an increase in interbeat interval represents cardiac deceleration (i.e., a decrease in heart rate). A within-subjects ANOVA revealed a significant main effect for picture category, $F(2, 336) = 58.04$, $\varepsilon = .88$. Across all participants, the typical pattern of interbeat interval increase was observed. The average increase was greater during unpleasant pictures than during neutral and pleasant pictures, ts$(168) > 6.19$, and the average increase during pleasant pictures was greater than during neutral pictures, $t(168) = 5.38$. The interaction for the Valence × Group mixed-design ANOVA was not significant ($F < 1$). Similarly, the interaction for the comparable ANOVA contrasting unpleasant and neutral pictures was not significant ($F < 1$). As with corrugator activity, analyses investigating the possible influences of anxiety and the PCL–R factors on interbeat intervals failed to reveal any significant interactions or regression models.

Skin Conductance Response

Table 3 presents means and standard deviations for skin conductance response. A within-subjects ANOVA for picture category revealed a significant main effect, $F(2, 330) = 18.34$, $\varepsilon = .68$.[11] Across all participants, the typical pattern of skin conductance response was observed. Average response was greater during unpleasant pictures than during neutral and pleasant pictures, ts$(164) > 3.96$, and average response during pleasant pictures was greater than during neutral pictures, $t(164) = 2.72$. The interaction for the Valence × Group mixed-design ANOVA was not significant, $F(1, 110) = 1.78$. Similarly, the interaction for the comparable ANOVA contrasting unpleasant and neutral pictures was not significant, $F(1, 110) = 2.20$. In contrast to the corrugator and interbeat interval data, the main effect for group was at least marginally significant, $F(1, 110) = 3.49$, $p = .064$, and $F(1, 110) = 4.01$, $p = .048$. Psychopaths exhibited generally smaller skin conductance responses to all picture categories.

For unpleasant pictures, the regression model with the interaction term was marginally significant, $F(3, 162) = 2.34$, $p = .076$, adjusted $R^2 = .024$. None of the components were significant, $|t$s$(163)| < 1.38$. The model without the interaction term was significant, $F(2, 163) = 3.13$, adjusted $R^2 = .025$. However, neither component was significant, ts$(163) = -1.29$. For neutral pictures, the model without the interaction term was marginally significant, $F(2, 163) = 2.80$, $p = .064$, adjusted $R^2 = .021$, with a significant Factor 1 component, $\beta = -0.17$, $t(163) = -2.00$. These results are consistent with the results reported above that

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[11] Before testing hypotheses concerning psychopathy, we conducted preliminary analyses to assess whether or not the between-groups factor, race (Blacks vs. Whites), significantly interacted with picture category in a way that would qualify interpretations of results. A Picture Category × Race ANOVA revealed a significant main effect for race, $F(1, 164) = 4.73$, with Blacks exhibiting significantly lower average responses ($M = .02$, $SD = .06$) than Whites ($M = .04$, $SD = .08$). The interaction was not significant, $F(2, 328) = 1.49$.

psychopaths, in general, had smaller skin conductance responses. Finally, as with corrugator activity and interbeat intervals, ANOVAs investigating the possible influences of anxiety and Factor 1 levels on skin conductance responses failed to reveal any significant interactions.

Discussion

Women classified as psychopathic using the PCL–R showed an abnormal pattern of startle responses to unpleasant pictures. This abnormal pattern was most prominent at the 2.0-s probe time for psychopaths with lower general levels of anxiety. More specifically, at the 2.0-s probe, nonpsychopaths exhibited the typical pattern of affect modulation of the acoustic startle eyeblink reflex magnitude. Similarly, psychopaths with high anxiety scores exhibited the typical pattern of responding. In contrast, psychopaths lower in anxiety exhibited a distinct, attenuated response to unpleasant pictures. This group difference disappeared at the 4.5-s probe where all groups—nonpsychopaths as well as low- and high-anxiety psychopaths—exhibited startle reflex potentiation during unpleasant pictures.

Analyses focusing on the antisocial behavior and emotional detachment factors of the PCL–R highlight the importance of both factors in the expression of an abnormal response to unpleasant pictures. Those individuals with relatively high antisocial behavior factor scores exhibited lower blink magnitudes to the 2.0-s probe during unpleasant pictures (relative to neutral pictures) only if they also had relatively high emotional detachment factor scores. Furthermore, regression analyses using factor scores showed that these blink magnitudes were lowest for those individuals with relatively high scores on both factors (significant interaction component).

Typical patterns of corrugator increase, cardiac deceleration, and skin conductance response during unpleasant, neutral, and pleasant pictures were observed. For corrugator increase and cardiac deceleration, there were no group differences in response patterns. For skin conductance, there was evidence of smaller responses to all picture categories by psychopaths. There were no specific influences for anxiety or the PCL–R factors on these three measures.

Psychopathy and Emotion Processing

These results generally replicate those of Patrick and his colleagues assessing emotional responding during picture perception in psychopathic men (Levenston et al., 2000; Patrick et al., 1993). Male and female psychopaths expressing antisocial behavior and emotional detachment have exhibited abnormal, attenuated startle reflex magnitudes during the presentation of unpleasant pictures. It also appears that both male and female psychopaths can exhibit more traditional patterns of affect modulation when probes are presented relatively later during the picture presentation. For men, this pattern is most prominent for those unpleasant images that depict a direct threat (Levenston et al., 2000). Therefore, the abnormality in responding to unpleasant pictures by psychopaths appears to be a delayed emotional response rather than a lack of an emotional response. Such findings indicate the importance of qualifying statements regarding the emotion deficit of psychopathic individuals and highlight the broader concept of individual differences in emotional reactivity.

Differences in emotional reactivity to unpleasant stimuli and threats are likely to have profound consequences for emotion regulation and adaptive responding more generally. A delay in the processing of unpleasant cues may be sufficient to engender many of the behavioral, affective, and interpersonal symptoms that characterize psychopathy (Hare, 1996). Therefore, it is important to evaluate whether this delay is a direct consequence of an inefficient (e.g., slow-responding) threat motivational system or reflects some other, less direct process that interferes with efficient processing of such information (e.g., Newman & Lorenz, 2002).

It is also important to investigate individual and group differences in emotion processing more broadly to better understand the components of emotion processing and their relation to psychopathy. One approach is to use the PCL–R (Hare, 1991) or other measures of the expression of psychopathic characteristics in nonincarcerated populations. For example, Sutton and Seay (2001) recently assessed emotional reactivity in college students scoring relatively low and high on the Self-Report Psychopathy Scale (Levenson, Kiehl, & Fitzpatrick, 1995). Results were similar to those reported here: The low group exhibited full emotion modulation at the 2.0-s probe time, whereas the high group did not exhibit potentiation during unpleasant pictures. This approach to the study of psychopathy, as well as other aspects of personality and temperament, provides relatively easy access to a diverse population that should enhance investigations of emotion processing components.

This study extended previous research by including general levels of anxiety as a factor. Psychopathic women who also reported lower anxiety exhibited a prominently attenuated startle responses at the 2.0-s probe time during unpleasant pictures. One interpretation of this finding is that anxiety and psychopathy have opposing influences on emotional reactions to unpleasant pictures, and that the influence of anxiety prevails over the influence of psychopathy at the 2.0-s probe time. This influence may be particularly important when assessing differences in the expression of psychopathy in men and women given that, as self-report data suggest, men are less likely to experience anxiety than women in response to threatening situations (e.g., Carver & White, 1994). However, these statements must be qualified by the fact that the high-anxiety psychopathy group reported very high Welsh Anxiety Scale scores ($M = 28.60$, $SD = 4.12$; Welsh, 1956). In any case, these data strongly suggest that future research focusing on psychopathy, anxiety and related constructs, or emotional reactivity in general should include multiple factors to assess potential interactions.

Psychopathy in Women and Men

To our knowledge, the current study represents the first laboratory demonstration of the etiological validity of PCL–R (Hare, 1991) assessments in women. Previous research with women (e.g., Rutherford, Cacciola, Alterman, & McKay, 1996; Strachan, 1993; Vitale et al., 2002; Weiler & Widom, 1996) has demonstrated that the PCL–R is related to a variety of measures assessing the personality and behavioral correlates of psychopathy (e.g., impulsivity, poor perspective taking, past criminal behavior, substance abuse). However, prior laboratory assessments (e.g., MacCoon & Newman, 2002; Vitale & Newman, 2001a) of the attentional and behavioral processes theorized to contribute to the development and maintenance of the syndrome in men (e.g., response persev-

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eration, poor passive avoidance) have failed to demonstrate differences between psychopathic and nonpsychopathic women. Such inconsistent findings raised the possibility that, although PCL–R psychopathy in women may resemble the syndrome in men at a descriptive level, the processes underlying the personality and behavioral symptoms of the disorder are not similar. However, the results from this study suggest that abnormalities in emotional responding theorized to contribute to the psychopathy syndrome in men also underlie psychopathy in women.

One potential explanation for the inconsistency in the studies across gender stems from the opportunities for regulation afforded by the different laboratory paradigms. Two tasks that have failed to discriminate psychopathic and nonpsychopathic women, the Card Perseveration Task (CPT) and the Passive Avoidance Task (PAT), used computerized games where participants' responses resulted in clear monetary rewards and punishments. In contrast, picture perception does not require any voluntary response from the participant and, although pleasant and unpleasant, the stimuli are not connected to concrete rewards and punishments. These procedural differences may provide self-regulation opportunities that differ for men and women. For example, psychopathic women may be less motivated than psychopathic men by the monetary rewards central to the CPT and PAT, thus making it less likely that such stimuli will result in disinhibited responding. Another possibility is that psychopathic women work more effortfully to self-regulate while performing these tasks, even though they are equally motivated by reward stimuli. This argument is consistent with evidence that women are less likely than men to exhibit behavioral dysregulation, as suggested by the lower percentages of women who meet diagnostic criteria of the *Diagnostic and Statistical Manual for Mental Disorders* (4th ed.) for the "syndromes of disinhibition," for example, antisocial personality disorder, conduct disorder, attentional deficit with hyperactivity disorder, and substance abuse (American Psychiatric Association, 1994; Robins, 1999; Rutherford, Alterman, Cacciola, & Snider, 1995). In contrast, differences among psychopathic and nonpsychopathic women could emerge during picture perception because factors associated with effortful self-regulation and sensitivity to reward are less relevant to the evoked responses.

Conclusion

These and other laboratory data strongly support the clinical observation that one key component of psychopathy in men and women is abnormal emotion processing, especially in response to unpleasant or threatening stimuli. The implications for such a fundamental deficit are profound. Further investigation should aim to clarify the processes underlying psychopathic individuals' abnormal response to these stimuli. This will provide opportunities for a better understanding of psychopathy and may be important for developing process-based interventions for the treatment and prevention of the disorder. More broadly, investigating individual differences in emotion processing in the general population by these methods presents excellent opportunities for understanding fundamental components of emotion and motivation. These components may underlie dimensions of temperament and personality as well as confer a vulnerability for the development of psychopathology in more extreme cases.

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