

# Emotion in Criminal Offenders With Psychopathy and Borderline Personality Disorder

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**Background:** Criminal offenders with a diagnosis of psychopathy or borderline personality disorder (BPD) share an impulsive nature but tend to differ in their style of emotional response. This study aims to use multiple psychophysiological measures to compare emotional responses to unpleasant and pleasant stimuli.

**Methods:** Twenty-five psychopaths as defined by the Hare Psychopathy Checklist and 18 subjects with BPD from 2 high-security forensic treatment facilities were included in the study along with 24 control subjects. Electrodermal response was used as an indicator of emotional arousal, modulation of the startle reflex as a measure of valence, and electromyographic activity of the corrugator muscle as an index of emotional expression.

**Results:** Compared with controls, psychopaths were characterized by decreased electrodermal responsiveness, less facial expression, and the absence of affective startle modulation.

A higher percentage of psychopaths showed no startle reflex. Subjects with BPD showed a response pattern very similar to that of controls, ie, they showed comparable autonomic arousal, and their startle responses were strongest to unpleasant slides and weakest to pleasant slides. However, corrugator electromyographic activity in subjects with BPD demonstrated little facial modulation when they viewed either pleasant or unpleasant slides.

**Conclusions:** The results support the theory that psychopaths are characterized by a pronounced lack of fear in response to aversive events. Furthermore, the results suggest a general deficit in processing affective information, regardless of whether stimuli are negative or positive. Emotional hyporesponsiveness was specific to psychopaths, since results for offenders with BPD indicate a widely adequate processing of emotional stimuli.

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CURRENT research aims to identify psychological and psychopathologic dimensions underlying violent behavior in personality disorders.<sup>1</sup> In particular, the style of emotional response is regarded as one of the most important psychological mechanisms constituting normal and abnormal personality, including a person's interaction with the environment. Whereas the DSM-IV category of antisocial personality disorder<sup>2</sup> does not provide a description of specific emotional features, the classic diagnostic criteria for psychopathy by Cleckley<sup>3</sup> include a specific emotional style that can best be described as a generalized emotional deficit or emotional detachment.<sup>4,5</sup> Some data from experimental studies on emotions in criminal offenders with psychopathy already exist. However, to our knowledge, studies have not yet been conducted on the problem of diagnostic specificity. Therefore, this article focuses on investigating emotional responses, not only in psychopaths but also in criminal offenders diagnosed as having borderline personality disorder (BPD). Although individuals with BPD have been reported to be at risk for engaging in criminal, antisocial behavior,<sup>6-8</sup> experimental studies of emotion in offenders with BPD are hardly available.

With the exception of Arnett et al,<sup>9</sup> who examined appetitive response to reward cues, studies dealing with psychopaths focus on anxiety. Psychophysiological findings of decreased electrodermal responsiveness to anxiety- or punishment-related stimuli<sup>10-12</sup> are thought to indicate low levels of fear<sup>13,14</sup> and to lead to stimulus-seeking and hence risk-taking impulsive behavior.<sup>13,15</sup> Further studies on psychopaths have borne evidence of an absence of the so-called fear-potentiated startle reflex.<sup>16,17</sup>

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In contrast to electrodermal activity, which reflects the arousal dimension of emotion (activation vs calmness), the blink response to a sudden, intense acoustic

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## SUBJECTS AND METHODS

### SUBJECTS

Fifty male inmates from 2 high-security forensic treatment facilities underwent screening for participation in the study, 25 with a clinical diagnosis of psychopathy and 25 with BPD. All were convicted of capital crimes. Subjects were selected for 1 of the 2 study groups—psychopaths or BPD—based on their total scores in the screening version of the Psychopathy Checklist: Screening Version (PCL:SV<sup>22,23</sup>) and the number of International Personality Disorder Examination (IPDE)<sup>24</sup> BPD items that they fulfilled. The screening version of 12 items for a maximum score of 24 consists of the following 2 major dimensions: factor 1 includes characterological features such as emotional detachment, lack of empathy and remorse; factor 2 includes impulsiveness and antisocial behavioral style. The PCL:SV has high interrater agreement and internal consistency and correlates well with the Psychopathy Checklist–Revised (PCL-R).<sup>22,25</sup> According to the diagnostic cutoff criteria recommended by Hart et al,<sup>23</sup> psychopathic subjects scored at least 18 and subjects with BPD scored no more than 14 on the total PCL:SV. Borderline personality disorder was diagnosed in accordance with the cutoff given in the *DSM-IV* ( $\geq 5$  criteria).<sup>2</sup>

Two of us (S.C.H. and U.W.) who were unaware of the clinical diagnosis independently evaluated scores on the PCL:SV and on the IPDE. The PCL:SV evaluation included institutional data, ie, criminal record, psychiatric profile, and behavior reports. Only those subjects were included for whom both raters evaluated the required inclusion criteria. Individuals with mental deficiencies, dementia, schizophrenia, paranoid disorder, or current alcohol or other drug abuse were not included in the study. For at least 3 months, all subjects had been free of medication (eg, antidepressants, anticholinergics, anxiolytics, and antipsychotic agents) that could have influenced responses.

Twenty-five noncriminal male controls with no history of psychiatric treatment or diagnosis of antisocial or borderline personality disorder were additionally recruited through bulletin board announcements. This produced a control group composed of one third each of college students, nonacademic hospital staff, and vocational trainees. Of the 75 subjects undergoing screening for participation in the study, 18 subjects with BPD, 25 psychopaths, and 24 controls were eventually included. Group age and intelligence were highly comparable (**Table 1**). Nonsignificant differences in education ( $\chi^2_2 = 4.93$ ;  $P = .08$ ) may result from social maladjustment rather than from any lesser intelligence of criminal offenders compared with controls.

The type of criminal offenses and the offender-victim relationship were assessed. A standardized procedure based on formal records was also used to classify violent acts as impulsive or premeditated.<sup>27</sup>

All subjects underwent testing for basic measures of personality with the use of the Temperament and Character Inventory (TCI),<sup>29,30</sup> the Barratt Impulsiveness Scale (BIS-10),<sup>31</sup> and the Assessment of Factors of Aggressiveness (FAF).<sup>28</sup> The TCI describes the following 3 temperamental factors: novelty seeking, reward dependence, and harm avoidance (a disposition to respond strongly to aversive stimuli, leading the individual to inhibit behavior and avoid punishment). The FAF is a German adaptation of the Buss-Durkee Hostility Inventory.<sup>32</sup> Before experimentation, the emotional state of the subjects was assessed with regard to valence and arousal with the use of a visual analog scale called the Self-Assessment Manikin.<sup>33</sup> All subjects were paid for participating in the study and gave written informed consent after receiving a comprehensive description of the study.

### EMOTIONAL MATERIAL AND DESIGN

Stimulus material consisted of 24 slides taken from the International Affective Picture System.<sup>34</sup> This standardized pool included 8 pleasant (romantic couples, family and sports scenes, erotica, and pets), 8 neutral (household objects and plants), and 8 unpleasant slides (crying and wounded children, mutilated bodies, people in despair, and violent scenes). The slides were selected to provoke a range of various qualities of negative and positive emotions. Slides appeared for 6 seconds each in random order. After each slide, subjects were asked to rate the intensity of their affective response using the Self-Assessment Manikin.<sup>33</sup> Self-report ratings (0-9) range from feeling extremely unpleasant or being in a state of very low emotional arousal to feeling extremely pleasant or being in a state of very high arousal.

### PHYSIOLOGICAL MEASUREMENTS

Physiological measurements of skin conductance and EMG activity were recorded using a modular system (ZAK Medical Technics, Marktheidenfeld, Germany), and the startle reflex was measured with a commercial startle system (San Diego Instruments, San Diego, Calif). Physiological signals were recorded using silver-silver chloride electrodes—miniature EMG electrodes and 1-cm skin conductance electrodes—filled with electrolyte paste (Spectra 360; Parker Laboratories, Fairfield, NJ). Impedances were kept below 5 k $\Omega$ .

tic probe is primarily considered to be a measure of valence (pleasure vs aversion). Previous research indicates that this primitive defensive reflex mirrors the underlying action disposition of an organism. Proceeding from a theoretical framework based on reciprocal motivational priming, Lang et al<sup>18</sup> postulated that the startle response is usually augmented when stimuli-inducing negative emotions are presented, since the negative valence of the reflex matches the valence of the ongoing motivational disposition of the organism (defense or withdrawal). Conversely, the startle response is decreased during pleasant states because of a mismatch be-

tween the defensive reflex and an ongoing appetitive (approach) disposition. Patrick et al<sup>5</sup> reported an absence of startle potentiation in psychopaths during the presentation of aversive slides. Since most of the unpleasant slides used by Patrick et al were evaluated as frightening by normal subjects,<sup>5</sup> these data suggest that psychopaths have a low capacity for experiencing fear when faced by threatening or punishing situations. For BPD, the emotional modulation of the startle response has only been studied in a clinical female sample, showing a normal modulation pattern in response to various slide valence categories.<sup>19,20</sup>

To record skin conductance activity, electrodes were centered on the thenar and hypothenar eminences of the nondominant hand; activity was sampled every 20 milliseconds. The magnitude of the skin conductance response (SCR) was defined as the largest increase standardized to the intraindividual maximum within 0.9 and 4.0 seconds of beginning each slide. It has been shown that range-corrected scores make SCR data more orderly and psychologically meaningful.<sup>35</sup> Finally, values were transformed logarithmically to improve the symmetry of the distribution curves.

Facial expression operationalized as corrugator EMG activity was recorded from the region of the frowning muscle above the right eye and sampled at 50 Hz. For data analysis, EMG activity was expressed as the mean change during a period of 0.5 to 3.0 seconds after slide onset, beginning from the 1-second baseline immediately preceding slide onset.

To measure the blink component of the startle reflex, EMG activity of the left orbicularis oculi muscle was recorded by means of 2 miniature electrodes placed under the left eye and below the outer canthus. The acoustic startle stimulus delivered binaurally consisted of a 50-millisecond burst of white noise; its intensity had been calibrated at 100 dB using an artificial ear. Startle probes were delivered randomly within 3.0 to 5.0 seconds of slide onset. The EMG activity was recorded in a 20- to 150-millisecond time window after startle probe onset. The software used for offline analysis stored the startle response values in arbitrary analog-digital units. A startle reflex was considered to have occurred when EMG activity surpassed the baseline level by at least 10 U. The criterion for startle nonresponders was defined as fewer than 25 U for the mean of response amplitudes.<sup>36</sup>

## DATA ANALYSIS

Before statistical analyses, all variables were tested for normal distribution. Group effects of most clinical and questionnaire data were tested using contingency tables, 2-tailed *t* tests, and analyses of variance (ANOVAs). Nonparametric procedures were used for clinical variables that were not normally distributed.

Within the experimental design, we applied repeated-measures ANOVAs to examine changes of self-ratings as a function of affective stimulus valence in addition to group effects. We used the diagnostic group for the between-subjects factor and the slide valence category (pleasant, neutral, or unpleasant) for the within-subject factor. Besides testing for overall stimulus valence effects, we performed pairwise comparisons of slide valence categories.

Apart from psychophysiological measurements, the corrugator electromyographic (EMG) (frown) response can be used as a further indicator of aversive emotional response,<sup>21</sup> reflecting the expressive dimension of emotion.

Abnormal emotional processing may not be restricted to fear, but may include negative and even positive emotions in general. This study aims to compare responses to standardized unpleasant and pleasant stimuli in male criminal offenders diagnosed as having psychopathy with those of offenders diagnosed as having BPD. We ran various psychophysiological tests re-

lated to the 2 basic emotional dimensions of valence and arousal. Our hypothesis was that psychopaths would show weaker modulation of the startle response magnitude while watching unpleasant and pleasant slides and weaker facial expression and lower autonomic responses compared with noncriminal control subjects. It was further expected that criminal offenders with BPD would—compared with controls—show decreased electrodermal responses, which are supposed to predispose respondents to stimulus-seeking and disinhibited, impulsive behavior.<sup>13,15</sup> They would, however, differ from psychopaths in the main aspects of emo-

Because distributions of mean raw scores across subjects failed to meet assumptions of normality with regard to all physiological response measures, nonparametric tests were used. To test for diagnostic group effects, we performed Kruskal-Wallis tests. We further analyzed group effects using post hoc Mann-Whitney tests for pairwise comparisons of independent samples. To examine changes of physiological parameters as a function of affective stimulus (slide) valence in addition to the group effects, we performed Friedman tests for repeated measures. We also performed post hoc pairwise comparisons of slide valence categories using Wilcoxon signed rank tests for paired samples. Based on a priori hypotheses, we tested the relationship between slide valence and psychophysiological measures separately for each diagnostic group.

Post hoc pairwise comparisons of diagnostic group effects (psychopath-control, BPD-control, and BPD-psychopath) and post hoc pairwise comparisons of slide valence categories (pleasant-neutral, neutral-unpleasant, and pleasant-unpleasant) were followed by Bonferroni-Holm type I error adjustment to identify which pair showed a significant effect for that variable. The Bonferroni-Holm<sup>37</sup> procedure maintains the overall error rate at the .05 level and tests pairwise effects at certain prescribed significance levels. Specifically, among the *P* values,  $P_i$ , is ordered from smallest ( $i=1$ ) to largest ( $i=3$ ) among the 3 comparisons. The groups or categories corresponding to  $P_i$  are declared to be significantly different at the overall .05 level if  $P_i \leq .05 / [(M+1) - i]$ , where *M* is the number of comparisons. The sequential procedure stops when a comparison has to be declared to be nonsignificant for the first time. To maintain consistency throughout the text, the prescribed significance level and consequently the quoted *P* value have been adjusted to correspond with error rate of .05 (ie,  $P_i \times [(M+1) - i]$ ).

Within-subject *t* tests were calculated in such a way that raw scores for each subject were deviated from the individual's mean score and divided by the subject's SD, producing a score distribution with a mean of 50 and an SD of 10 for each subject. Such standardization does not change the relationship between the intraindividual responses but establishes a common measure for the subjects and, thus, makes them comparable.<sup>9</sup> We performed repeated-measures ANOVAs on these individually standardized data and within-subject *t* tests on the basis of a priori hypotheses to assess startle modulation through various slide categories in each diagnostic group, again followed by Bonferroni-Holm type I error adjustment.

Figures include means and SEMs. Statistical analyses were performed with commercially available software (SAS 6.12; SAS Institute Inc, Cary, NC; or SPSS 9.01; SPSS Inc, Chicago, Ill).

**Table 1. Demographics, Personality Trait Data, and Diagnostic Data of the Sample\***

	Subjects			Group Effect	
	Psychopathic (n = 25)	BPD† (n = 18)	Control (n = 24)	Statistical Analysis	P
	<b>Demographics‡</b>				
Age, y	33.8 (8.2)	33.3 (6.9)	32.5 (10.8)	$F_2 = 0.13$	.87
Education, y	10.0 (1.4)	9.8 (1.3)	10.7 (1.6)	$\chi^2_2 = 4.93$	.08
IQ§	99.2 (9.7)	97.7 (12.1)	95.84 (5.8)	$F_2 = 0.84$	.43
	<b>Personality Trait Data‡</b>				
BIS total	73.32 (10.04)	79.55 (15.35)	67.39 (9.51)	$F_{2,64} = 5.61$	.005
FAF sum score	21.00 (9.22)	21.27 (10.04)	13.39 (8.94)	$F_{2,64} = 5.11$	.008
TCI					
Novelty seeking	21.92 (5.61)	21.47 (6.72)	19.65 (6.18)	$F_{2,64} = 0.89$	.41
Harm avoidance	15.84 (7.39)	19.93 (6.45)	13.68 (6.93)	$F_{2,64} = 3.56$	.03
Reward dependence	12.30 (5.02)	13.13 (5.56)	14.47 (2.95)	$F_{2,64} = 1.35$	.26
	<b>Diagnostic Data#</b>				
PCL:SV**					
Total score	19.84 (1.82)	10.94 (2.55)	...	$t_{41} = -12.47$	<.001
Factor 1	10.36 (1.32)	3.78 (1.59)	...	$t_{41} = -14.80$	<.001
Factor 2	9.48 (1.98)	7.17 (1.82)	...	$t_{41} = -3.90$	<.001
No. of fulfilled BPD criteria†	2.28 (1.10)	6.06 (1.01)	...	$t_{41} = 9.49$	<.001
No. of fulfilled APD criteria††	11.88 (3.56)	6.67 (4.81)	...	$t_{41} = -4.09$	<.001

\*Data are given as mean (SD) unless otherwise indicated. BPD indicates borderline personality disorder; BIS, Barratt Impulsiveness Scale (Barratt et al<sup>27</sup>); FAF, Assessment of Factors of Aggressiveness (Hampel and Selg<sup>28</sup>); TCI, Temperament and Character Inventory (Cloninger et al<sup>29</sup>); PCL:SV, Psychopathy Checklist: Screening Version (Hare et al<sup>22</sup> and Hart et al<sup>23</sup>); and APD, antisocial personality disorder.

†BPD was scored according to the International Personality Disorder Examination (Loranger et al<sup>24</sup>).

‡Group effects were analyzed using analysis of variance (Kruskal-Wallis test).

§Assessments are based on the Hamburg-Wechsler Intelligence Test–Revision (Tewes<sup>26</sup>). Subjects with an IQ <85 were excluded.

||For pairwise contrasts, BPD and psychopathic subjects scored higher than controls ( $P < .05$ ).

|||For pairwise contrasts, BPD subjects scored higher than psychotic subjects and controls ( $P < .05$ ).

#Group effects were analyzed using 2-tailed  $t$  test.

\*\*Score ranges for psychopathic subjects were as follows: total score,  $\geq 18$  and  $\leq 24$ ; factor 1,  $\geq 7$  and  $\leq 12$ ; and factor 2,  $\geq 6$  and  $\leq 12$ . For BPD subjects, score ranges were as follows: total score,  $\geq 6$  and  $\leq 14$ ; factor 1,  $\geq 1$  and  $\leq 6$ ; and factor 2,  $\geq 4$  and  $\leq 11$ . Factors are described in the "Subjects" subsection of the "Subjects and Methods" section.

††APD was scored according to the International Personality Disorder Examination (Loranger et al<sup>24</sup>).

tional response, showing a normal pattern of startle response and facial expression.

## RESULTS

### DIAGNOSTIC DATA

To compare diagnostic data between both groups of criminal offenders, we used 2-tailed  $t$  tests. By design, psychopaths were characterized by PCL:SV factor 1 and 2 scores that were significantly higher than those assessed for subjects with BPD. Regarding IPDE criteria, subjects with BPD were characterized by a higher number of fulfilled BPD criteria ( $P < .001$ ), whereas psychopaths showed a higher number of antisocial criteria ( $P < .001$ ) (Table 1).

Using an exact version of a  $3 \times 2$  contingency table test for homogeneity of behavior characteristics across groups, no differences were found between the 2 groups of criminal offenders with regard to type of crime, type of relationship to the victim, or length of imprisonment or forensic hospitalization. With the use of Mann-Whitney tests, a higher degree of premeditated aggression was found within the psychopathy group ( $P = .05$ ), but no clear difference was shown in the degree of impulsive aggression ( $P = .12$ ) (Table 2).

One-way ANOVA results of the questionnaire variables demonstrated group-specific effects in impulsiveness and aggressiveness. Both groups of criminal offenders scored higher than controls but did not differ from each other on the BIS and FAF. An additional group effect was found in relation to harm avoidance. Subjects with BPD scored higher than the psychopaths and the controls on this TCI subscale. No group differences were found for the novelty-seeking or reward-dependence TCI subscales (Table 1).

### SELF-REPORT RATINGS OF EMOTIONAL RESPONSES

According to data from 1-way ANOVA, self-ratings showed that the emotional state did not differ among the 3 groups before the onset of the experiment (valence,  $F_2 = 0.76$  [ $P = .47$ ]; arousal,  $F_2 = 1.57$  [ $P = .21$ ]).

The slides selected from the IAPS were suitable for inducing different self-report ratings, since repeated-measures ANOVAs showed a strong overall slide valence effect (valence,  $F_{2,128} = 304.61$  [ $P < .001$ ]) with post hoc contrasts indicating that pleasant slides were rated significantly higher and unpleasant slides significantly lower than neutral slides in valence. An additional overall slide valence affect was found for arousal ratings

**Table 2. Characteristics of Criminal Offenses\***

	Subjects		Statistical Analyses
	Psychopathic (n = 25)	BPD (n = 18)	
Type of offenses, No. (%)†			<i>P</i> = .15
Murder	6 (24)	2 (11)	
Manslaughter	6 (24)	2 (11)	
Sexual offenses	6 (24)	6 (33)	
Robbery	3 (12)	0	
Grievous bodily injury	4 (16)	6 (33)	
Other (not otherwise classified)	0	2 (11)	
Relationship to the victim, No. (%)†			<i>P</i> = .11
Unknown	14 (56)	9 (50)	
Casual	4 (16)	1 (6)	
Victim is member of the peer group	1 (4)	3 (17)	
Close	6 (24)	2 (11)	
Not otherwise classified	0	3 (17)	
Mean (SD) ratings of impulsive vs premeditated aggression (index offenses)‡			
Impulsive aggression	2.08 (1.38)	2.72 (1.22)	$z_1 = -1.51; P = .12$
Premeditated aggression	2.40 (1.47)	1.55 (1.33)	$z_1 = 1.87; P = .05$
Mean (SD) incarceration in forensic hospital (index offense), y§	6.6 (4.3)	6.9 (4.4)	$z_1 = -0.18; P = .85$
Mean (SD) incarceration in prison and forensic hospital (lifetime), y§	8.1 (5.0)	8.3 (6.3)	$z_1 = -0.16; P = .86$

\*BPD indicates borderline personality disorder.

†Statistical analyses were determined using an exact version of a 3 × 2 contingency table test.

‡Ratings are based on a standardized procedure to classify violent acts as impulsive or premeditated (Barratt et al<sup>27</sup>). Ratings ranged from 0-4 on each dimension.

§Statistical analyses were determined using the Mann-Whitney test for independent samples.

**Table 3. Group Means for Self-report Ratings\***

	Subjects, Mean (SD)			Group Effect		Group × Slide Valence Effect	
	Psychopathic (n = 25)	BPD (n = 18)	Control (n = 24)	$F_{2,64}$	<i>P</i>	$F_{4,128}$	<i>P</i>
Valence ratings†							
Pleasant	7.30 (0.86)	6.63 (1.01)	7.15 (0.88)	1.38	.25	0.97	.41
Neutral	5.53 (1.05)	5.35 (0.78)	5.19 (0.82)				
Unpleasant	2.92 (1.17)	2.88 (1.08)	2.69 (1.08)				
Total score	5.25 (0.64)	4.95 (0.64)	5.01 (0.63)				
Arousal ratings†							
Pleasant	5.39 (1.77)	4.63 (1.71)	5.46 (1.41)	0.36	.69	1.54	.19
Neutral	2.16 (0.99)	2.64 (1.08)	2.34 (1.44)				
Unpleasant	6.04 (1.57)	6.18 (1.65)	6.38 (1.23)				
Total score	4.53 (1.10)	4.48 (0.95)	4.73 (0.95)				

\*BPD indicates borderline personality disorder.

†Units of measurement are self-report ratings (0-9) ranging from feeling extremely unpleasant or being in a state of very low emotional arousal to feeling extremely pleasant or being in a state of very high arousal.

( $F_{2,128} = 159.12 [P < .001]$ ) with significantly higher scores for pleasant and unpleasant slides than for neutral slides. Self-report data did not demonstrate group effects or group × slide valence interaction effects (**Table 3**).

## PHYSIOLOGICAL MEASURES

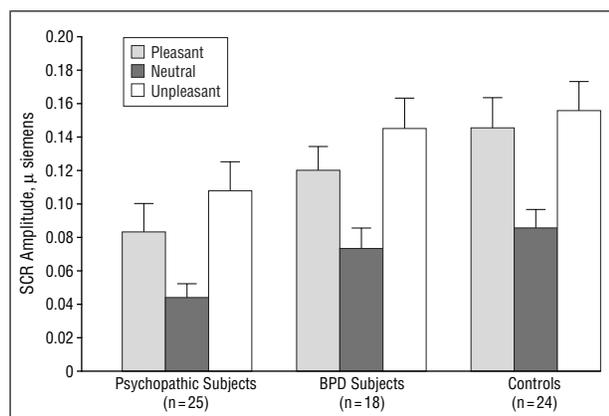
### Skin Conductance Response

As expected, the Friedman test for repeated measures showed that the electrodermal response was sensitive to the arousal dimension of the slides. The SCR amplitudes changed as a function of the slide valence in the

overall group ( $P < .001$ ), with post hoc Wilcoxon signed rank tests showing that SCRs were higher when viewing pleasant ( $P < .001$ ) and unpleasant slides ( $P < .001$ ) than when viewing neutral slides. A slide valence effect was also found in each diagnostic group ( $P < .001$ ). By using the Kruskal-Wallis test, an overall diagnostic group effect was identified ( $P = .006$ ), with post hoc Mann-Whitney tests, indicating that psychopaths had significantly decreased electrodermal responses compared with controls ( $P = .02$ ) and subjects with BPD ( $P = .04$ ); however, subjects with BPD and controls did not differ from each other ( $P = .73$ ). Means and SEMs are shown in **Figure 1**, the test statistics, in **Table 4** and **Table 5**.

## Corrugator EMG Response

With the use of the Friedman test, EMG activity of the corrugator muscle showed a slide valence effect within the sample as a whole ( $P = .03$ ). Testing each diagnostic group separately, subjects with BPD ( $P = .02$ ) and controls ( $P = .03$ ) also showed a significant change in corrugator EMG responses compared with slide valence categories, whereas psychopaths did not ( $P = .44$ ). Post hoc Wilcoxon signed rank tests indicated that only controls showed larger EMG responses to unpleasant slides compared with their responses to pleasant ones ( $P = .01$ ), whereas subjects with BPD showed no difference in their response to unpleasant or pleasant slides ( $P = .46$ ). Instead, subjects with BPD exhibited significant changes in corrugator activity in response to unpleasant slides ( $P = .01$ ) and a nonsignificant change to pleasant slides ( $P = .06$ ) compared with neutral slides. As shown by the Kruskal-Wallis test, a clear group effect was also found ( $P < .001$ ) with post hoc Mann-Whitney tests, indicating that controls exhibited more facial expression than BPD ( $P = .02$ ) and psychopathic subjects ( $P < .001$ ). Means and SEMs are presented in **Figure 2**; test statistics, in Tables 4 and 5.



**Figure 1.** Skin conductance response (SCR) during presentation of pleasant, neutral, and unpleasant slides to psychopaths, subjects with borderline personality disorder (BPD), and control subjects. In addition to overall slide valence effect, group effect is seen, with subjects with BPD and controls showing higher SCRs than psychopaths. Means and SEMs (error bars) are presented.

## Startle Response

Nine psychopaths, along with 1 BPD subject and 2 controls, were shown to be nonresponders to the startle probe, ie, psychopaths failed more frequently to respond, irrespective of the valence of the slides presented (exact version of a  $3 \times 2$  contingency table,  $P = .01$ ).

As expected, the Friedman test for repeated measures showed a slide valence effect in the total sample ( $P < .001$ ), with post hoc Wilcoxon signed rank tests showing that startle amplitudes differed across all 3 slide valence categories (pleasant-neutral,  $P < .001$ ; neutral-unpleasant,  $P = .05$ ; pleasant-unpleasant,  $P < .001$ ). Taking each diagnostic group separately, Friedman tests yielded slide valence effects across the 3 categories in the control group ( $P = .002$ ) and in the BPD group ( $P = .03$ ), but not in the psychopaths, which failed to show any slide valence effect ( $P = .77$ ). Post hoc Wilcoxon pairwise comparisons of slide valence categories indicated that subjects with BPD and controls showed higher startle amplitudes when viewing unpleasant rather than pleasant (BPD group,  $P = .009$ ; control group,  $P < .001$ ) and neutral (BPD,  $P = .04$ ; controls,  $P = .08$ ) slides and lower startle amplitudes when viewing pleasant rather than neutral slides (BPD group,  $P = .03$ ; control group,  $P = .002$ ). No overall group difference of raw startle amplitude was found when the Kruskal-Wallis test was used ( $P = .22$ ) (Table 4).

Analysis of the standardized blink magnitude scores by repeated-measures ANOVAs produced an overall group effect ( $F_{2,52} = 3.18$ ;  $P = .04$ ); however, a group  $\times$  slide valence interaction was not found ( $F_{4,104} = 1.25$ ;  $P = .29$ ). Otherwise, analyses of the standardized blink magnitude scores produced very similar results (**Figure 3**).

### COMMENT

This is the first study, to our knowledge, to compare emotional processing in psychopathic subjects and subjects with BPD in a forensic setting using different psychophysiological emotional correlates. The findings for psychopaths confirmed our hypotheses. Compared with controls and offenders with BPD, psychopaths showed

**Table 4. Group Effects of Psychophysiological Data\***

Effects	Group Comparisons							
	Overall Group Effect†		Psychopathic vs Controls‡		BPD vs Controls‡		Psychopathic vs BPD‡	
	$\chi^2_2$	<i>P</i>	$z_1$	<i>P</i>	$z_1$	<i>P</i>	$z_1$	<i>P</i>
SCR	8.67	.006	-2.67	.02§	-0.34	.73	-2.25	.04¶
Corrugator EMG response	14.10	<.001	-3.76	<.001§	-2.18	.02#	-1.00	.30
Startle response	3.02	.22	...	...	...	...	...	...

\*BPD indicates borderline personality disorder; SCR, skin conductance response; EMG, electromyographic; and ellipses, since pairwise group comparisons were performed as post hoc tests, data are given only if the overall group effect was significant.

†Determined using Kruskal-Wallis test.

‡Determined using post hoc Mann-Whitney *U* test for pairwise comparisons of independent samples, followed by Bonferroni-Holm type I error adjustment.

§For comparisons of diagnostic groups, changes of psychopathic subjects were significantly weaker than those of controls.

||For comparisons of diagnostic groups, differences were not significant.

¶For comparisons of diagnostic groups, changes of psychopathic subjects were significantly weaker than those of BPD subjects.

#For comparisons of diagnostic groups, changes of BPD subjects were significantly weaker than those of controls.

**Table 5. Stimulus Valence Effects of Psychophysiological Data\***

Effects	Group							
	Overall Group (df = 2)		Psychopathic (df = 1)		BPD (df = 1)		Controls (df = 1)	
	$\chi^2/z$	P	$\chi^2/z$	P	$\chi^2/z$	P	$\chi^2/z$	P
<b>SCR</b>								
Over all slides†	83.94	<.001	38.96	<.001	16.44	<.001	31.08	<.001
Pleasant vs neutral‡	-6.30	<.001§	-4.10	<.001§	-2.94	.002§	-3.88	<.001§
Neutral vs unpleasant‡	-6.80	<.001	-4.37	<.001	-3.24	<.001	-4.25	<.001
Pleasant vs unpleasant‡	-3.28	<.001¶	-3.02	.001¶	-1.85	.03¶	-1.60	.05¶
<b>Corrugator EMG response</b>								
Over all slides†	6.77	.03	1.71	.44	7.65	.02	6.70	.03
Pleasant vs neutral‡	-0.67	.25#	...	**	-1.83	.06#	-1.09	.12#
Neutral vs unpleasant‡	-3.51	<.001	...	...	-2.40	.01	-2.68	.006
Pleasant vs unpleasant‡	-2.51	.008¶	...	...	-0.11	.46#	-2.46	.01¶
<b>Startle response raw scores</b>								
Over all slides†	13.12	<.001	0.50	.77	6.95	.03	12.09	.002
Pleasant vs neutral‡	-3.28	<.001††	...	...	-1.87	.03††	-3.03	.002††
Neutral vs unpleasant‡	-1.63	.05	...	...	-1.91	.04	-1.38	.08#
Pleasant vs unpleasant‡	-3.90	<.001¶	...	...	-2.48	.009¶	-3.23	<.001¶

\*Abbreviations are given in the first footnotes to Tables 1 and 4.

†Compared using Friedman test.

‡Compared using post hoc Wilcoxon signed rank tests for paired samples followed by Bonferroni-Holm type I error adjustment.

§Responsiveness was increased for pleasant vs neutral slides.

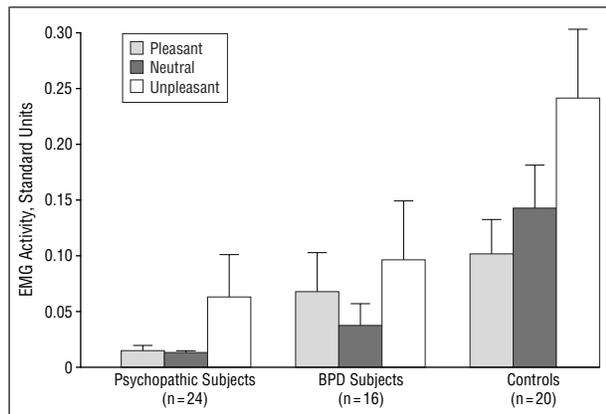
||Responsiveness was increased for unpleasant vs neutral slides.

¶Responsiveness was increased for unpleasant vs pleasant slides.

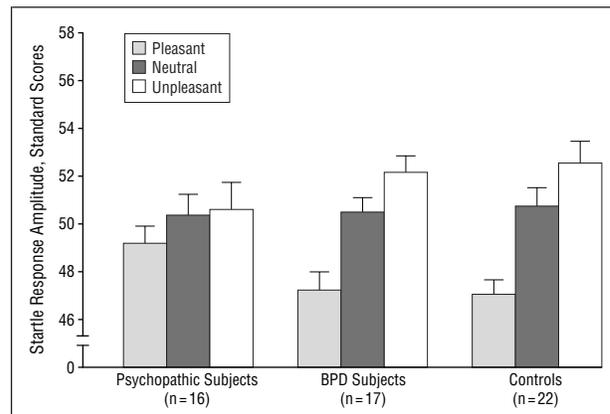
#Differences in responsiveness were not significant.

\*\*Post hoc pairwise comparisons of slide valence categories were performed only if the overall slide valence effect was significant.

††Responsiveness was decreased for pleasant vs neutral slides.



**Figure 2.** Electromyographic (EMG) activity of the corrugator muscle during presentation of pleasant, neutral, and unpleasant slides to psychopaths, subjects with borderline personality disorder (BPD), and controls. Group effect is seen, with controls showing higher EMG activity than subjects with BPD and psychopaths. Slide valence effect is seen in controls and subjects with BPD but not in psychopaths. Means and SEMs (error bars) are presented.



**Figure 3.** Standardized startle response amplitude scores during presentation of pleasant, neutral, and unpleasant slides in psychopaths, subjects with borderline personality disorder (BPD), and controls. In addition to overall group effect, slide valence effect is seen in controls and subjects with BPD, but not in psychopaths. Means and SEMs (error bars) are presented.

decreased electrodermal responses to emotional slides, and a higher percentage of psychopathic subjects failed to show any startle reflex. By focusing on differential patterns of response within each diagnostic group, we demonstrated that psychopaths were the only group to show no modulation of startle response in relation to any kind of emotional stimulus. Finally, the corrugator muscle response of psychopaths indicated rare aversive facial expression. Although all psychophysiological data suggest emotional hyporesponsiveness, this deficiency was not reflected in the self-reports by psychopaths of

their emotional responses. This dissociation between self-report and physiological data, also reported for other forensic and nonforensic populations,<sup>5,19,38</sup> suggests that questionnaire data tend to reflect intact associative processing faculties allowing for “text-appropriate self-report ratings” rather than emotional experiences per se.<sup>38</sup>

Criminal offenders with BPD exhibited a response pattern very similar to that of controls, ie, they showed no electrodermal hyporesponsiveness and an adequate emotional modulation of startle response. However, like

psychopaths, offenders with BPD showed less frowning muscle activity than did controls, who vividly expressed their negative emotions. In contrast to psychopaths, however, offenders with BPD showed a significant increase of the frowning EMG activity when viewing emotional compared with neutral slides, but their facial expressions were remarkably uniform regardless of whether pleasant or unpleasant slides were being shown. Although the implications of this result are far from clear, these data may tend to reflect a restrictive, negatively biased communication of emotions.

Our results of low autonomic responsivity in psychopaths correspond with those of a number of earlier studies.<sup>9,11,14</sup> Two theoretical interpretations have been proposed to explain hypoarousal in psychopaths. The first proposes that low arousal is experienced as strongly aversive and results in stimulus-seeking and disinhibited behavior to restore arousal levels.<sup>13,15</sup> The second theory suggests that low autonomic arousal is a marker of low levels of fear that predisposes subjects to antisocial behavior inasmuch as it renders them unable to learn from punishment.<sup>13,14,39,40</sup> Since autonomic hypoarousal was not found in BPD, our data did not support the hypothesis that autonomic hypoarousal is related to a disinhibited behavioral style that psychopaths share with subjects with BPD. To our knowledge, the current study is the first to demonstrate a more general pattern of weak electrodermal response to emotional stimuli in psychopaths, suggesting that autonomic hyporesponsiveness is not restricted to fear-related stimuli but occurs regardless of valence.

The lack of any startle reflex in more than a third of the psychopaths suggests a deficit of automated self-protective behavior and, thus, underlines the significance of fearlessness in psychopathy. Consistent with startle data by Patrick et al<sup>5,41</sup> the diagnostic group  $\times$  slide valence interaction was not significant in our study, but the expected pattern of results was obtained in the a priori hypothesis tests for the individual groups, with psychopaths showing an absence of startle potentiation when viewing aversive slides. In contrast to Patrick et al,<sup>5</sup> who reported a clear startle inhibition in psychopaths when viewing pleasant stimuli, psychopaths in our study showed no modulation of their startle response to stimuli related to feelings of fear or threat or to those related to joy or affection for others. This discrepancy may result from differences in the population and the emotional material selected. Although Patrick et al<sup>5</sup> used mainly erotic pictures as pleasant stimuli for a group of sexual offenders, our study used happy interpersonal events along with sports and erotic scenes for a group of psychopaths convicted of various criminal offenses. Low emotional arousal in psychopaths may also contribute to the lack of affective modulation of startle responses, since this effect is particularly pronounced with highly arousing stimuli.<sup>42</sup>

In summary, our data support the theory that psychopaths are characterized by a pronounced lack of fear toward aversive, frightening events. Beyond that, the results suggest a general deficit in processing affective information, regardless of whether the stimuli are of aversive or appetitive valence. In contrast to findings in psychopaths, offenders with BPD showed a startle re-

sponse pattern identical to that of controls. This finding is of particular interest because it suggests an intact capacity in offenders with BPD for aversive affective states to prime aversion actions, in this case to increase the strength of a defensive reflex, but also probably a broader tendency to avoid situations involving pain or danger.<sup>5</sup> Distinct types of emotional responsiveness might be attributed to differences between subjects with BPD and psychopaths on the harm avoidance scale. Furthermore, differences in emotional responsiveness may be associated with differences in violent crimes, since psychopaths showed a higher degree of premeditated aggression than offenders with BPD.

Limitations of this study concern sample characteristics. First, test groups were rather small and of different sizes. Nevertheless, sample size was comparable to those in other psychophysiological studies,<sup>5,18,41</sup> and much care was taken to recruit rather distinct diagnostic groups of psychopathic subjects and subjects with BPD underlined by highly significant differences in PCL:SV scores. Second, sample representativeness is limited by recruiting subjects from psychiatric inpatient facilities who were found to have diminished responsibility for the index crime because of a substantial impairment of their control capacity. Data on criminal offenses may be different among prison inmates; however, sample characteristics do not attenuate the experimental findings, since group differences between psychopaths and subjects with BPD tend to be greater rather than smaller in prison populations, which are more likely to include psychopaths convicted of highly premeditated crimes. Third, because of the forensic recruitment context, the BPD group showed rather pronounced antisocial features. This problem corresponds to objections often raised for the *DSM-IV* criteria for antisocial personality disorder, which claim that they fail to distinguish between simple antisocial behavior and a specific pervasive personality disturbance.<sup>43</sup> Finally, it cannot be ruled out that controls differed on psychophysiological measures because of their nonincarcerated status rather than because of the absence of a personality disorder diagnosis. Differences in emotional responsiveness, however, were not only found between controls and offenders but also between the criminal subgroups.

## CONCLUSIONS

Hypoemotionality in psychopaths may predispose them to violence, because it prevents them from experiencing emotions that naturally inhibit the execution of violent impulses.<sup>44,45</sup> Although a basically normal processing of emotional stimuli was found in offenders with BPD, this result might be different for stimuli identified by individuals as specific stressors. Further research is needed to understand the psychological roots of violent behavior in personality disorders.

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## REFERENCES

1. Herpertz S, Sass H. Personality disorders and the law, with a German perspective. *Curr Opin Psychiatry*. 1999;12:689-693.
2. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*. Washington, DC: American Psychiatric Association; 1994.
3. Cleckley H. *The Mask of Sanity: An Attempt to Clarify Some Issues About the So-called Psychopathic Personality*. 5th ed. St Louis, Mo: Mosby-Year Book Inc; 1976.
4. Hare RD. *Without Conscience: The Disturbing World of the Psychopaths Among Us*. New York, NY: Simon & Schuster; 1993.
5. Patrick CJ, Bradley MM, Lang PJ. Emotion in the criminal psychopath: startle reflex modulation. *J Abnorm Psychol*. 1993;102:82-92.
6. Coid JW. *DSM-III diagnosis in criminal psychopaths: a way forward*. *Criminal Behav Ment Health*. 1992;2:78-94.
7. Else L, Wonderlich SA, Beatty WW, Christie DW, Staton RD. Personality characteristics of men who physically abuse women. *Hosp Commun Psychiatry*. 1993;44:54-58.
8. Raine A. Features of borderline personality and violence. *J Clin Psychol*. 1993;9:277-281.
9. Arnett PA, Smith SS, Newman JP. Approach and avoidance motivation in psychopathic criminal offenders during passive avoidance. *J Pers Soc Psychol*. 1997;72:1413-1428.
10. Hare RD. *Psychopathy*. New York, NY: John Wiley & Sons Inc; 1970.
11. Hare RD. Electrodermal and cardiovascular correlates of psychopathy. In: Hare RD, Schalling D, eds. *Psychopathic Behavior: Approaches to Research*. New York, NY: John Wiley & Sons Inc; 1978:107-143.
12. Hare RD. Psychopathy and electrodermal responses to nonsignal stimulation. *Biol Psychol*. 1978;6:237-246.
13. Raine A. Autonomic nervous system factors underlying disinhibited, antisocial, and violent behavior. *Ann N Y Acad Sci*. 1996;794:46-59.
14. Arnett PA. Autonomic responsivity in psychopaths: a critical review and theoretical proposal. *Clin Psychol Rev*. 1997;17:903-936.
15. Zuckerman M. *Sensation-Seeking: Beyond the Optimal Level of Arousal*. Hillsdale, NJ: Lawrence A Erlbaum Associates; 1979.
16. Brown JS, Kalish HI, Farber IE. Conditioned fear as revealed by magnitude of startle response to an auditory stimulus. *J Exp Psychol*. 1951;41:317-328.
17. Davis M. Pharmacological and anatomical analysis of fear conditioning using the fear-potentiated startle paradigm. *Behav Neurosci*. 1986;100:814-824.
18. Lang PJ, Bradley MM, Cuthbert BN. Emotion, attention, and the startle reflex. *Psychol Rev*. 1990;97:377-395.
19. Herpertz S, Kunert HJ, Schwenger UB, Sass H. Affective response in borderline personality disorder: a psychophysiological approach. *Am J Psychiatry*. 1999;156:1550-1556.
20. Herpertz SC, Schwenger UB, Kunert HJ, Lukas G, Gretzer U, Nutzmann J, Schuerkens A, Sass H. Emotion in borderline personality disorder: experimental data in comparison to avoidant personality disorder. *J Personal Disord*. 2000;14:339-351.
21. Greenwald MK, Cook EW III, Lang PJ. Affective judgment and psychophysiological response: dimensional covariation in the evaluation of pictorial stimuli. *Psychophysiology*. 1989;3:51-64.
22. Hare RD, Cox DN, Hart SD. *Manual for the Psychopathy Checklist: Screening Version*. Toronto, Ontario: Multi-Health Systems Inc; 1994.
23. Hart SD, Cox D, Hare RD. *Manual for the Hare Psychopathy Checklist: Screening Version (PCL:SV) mit deutschsprachiger Handbuchbeilage*. Freese R, trans. Toronto, Ontario: Multi-Health Systems Inc; 1995.
24. Loranger AW, Susman VL, Oldham HM, Russakoff LM. *International Personality Disorder Examination (IPDE): A Structural Interview for DSM-IV and ICD-10 Personality Disorders*. Mombour W, Zoudig M, Berger P, Gutierrez K, Berner W, Berger K, von Cranach M, Giglhuber O, von Bose M, trans. Bern, Switzerland: Hans Huber Verlag; 1999.
25. Hart SD, Hare RD. Psychopathy and the big 5: correlations between observers' ratings of normal and pathological personality. *J Personal Disord*. 1994;8:32-40.
26. Tewes U. *Hamburg-Wechsler-Intelligenztest für Erwachsene-Revision [Hamburg-Wechsler Intelligence Test for Adults-Revised]*. Göttingen, Germany: Huber Verlag; 1991.
27. Barratt ES, Stanford MS, Dowdy L, Liebman MJ, Kent TA. Impulsive and premeditated aggression: a factor analysis of self-report acts. *Psychiatry Res*. 1999;86:163-173.
28. Hampel R, Selg H. *FAF-Fragebogen zur Erfassung von Aggressivitätsfaktoren*. Göttingen, Germany: Hogrefe Verlag; 1975.
29. Cloninger CR, Przybeck TR, Svrakic DM, Wetzel RD. *The Temperament and Character Inventory (TCI): A Guide to Its Development and Use*. St Louis, Mo: Center for Psychobiology of Personality; 1994.
30. Richter J, Brandstroem S, Przybeck T. Assessing personality: the Temperament and Character Inventory in a cross-cultural comparison between Germany, Sweden, and the USA. *Psychol Rep*. 1999;84:1315-1330.
31. Barratt ES. Impulsiveness subtraits: arousal and information processing. In: Spence JT, Izard CE, eds. *Motivation, Emotion, and Personality*. Amsterdam, the Netherlands: Elsevier Science Publishers; 1985:137-146.
32. Buss AH, Durkee H. An inventory for assessing different kinds of hostility. *J Consult Clin Psychol*. 1957;21:343-349.
33. Lang PJ. Behavioral treatment and bio-behavioral assessment: computer applications. In: Sidowski JB, Johnson JH, Williams TA, eds. *Technology in Mental Health Care Delivery Systems*. Norwood, NJ: Ablex; 1980:119-137.
34. Lang PJ, Bradley MM, Cuthbert BN. *International Affective Picture System (IAPS): Technical Manual and Affective Ratings*. Gainesville: University of Florida, Center for Research in Psychophysiology; 1999.
35. Lykken DT, Rose R, Luther B, Maley M. Correcting psychophysiological measures for individual differences in range. *Psychol Bull*. 1996;66:481-484.
36. Braff DL, Grillon C, Geyer MA. Gating and habituation of the startle reflex in schizophrenic patients. *Arch Gen Psychiatry*. 1992;49:206-215.
37. Holm S. A simple sequentially rejective multiple test procedure. *Scand J Stat*. 1979;6:65-70.
38. Cook EW III, Davis TL, Hawk LW, Spence EW, Gautier CH. Fearfulness and startle potentiation during aversive visual stimuli. *Psychophysiology*. 1992;29:633-645.
39. Lykken DT. A study of anxiety in the sociopathic personality. *J Abnorm Psychol*. 1957;55:6-10.
40. Lykken DT. *The Antisocial Personalities*. Hillsdale, NJ: Lawrence A Erlbaum Associates; 1995.
41. Patrick CJ, Cuthbert BN, Lang PJ. Emotion in the criminal psychopath: fear image processing. *J Abnorm Psychol*. 1994;103:523-534.
42. Cuthbert BN, Bradley MM, Lang PJ. Probing picture perception: activation and emotion. *Psychophysiology*. 1996;33:103-111.
43. Cunningham MD, Reidy TJ. Antisocial personality disorder and psychopathy: diagnostic dilemmas in classifying patterns of antisocial behavior in sentencing evaluations. *Behav Sci Law*. 1998;16:333-351.
44. Hart SD, Hare RD. Psychopathy and risk assessment. *Curr Opin Psychiatry*. 1996;9:380-383.
45. Hart SD, Dempster RJ. Impulsivity and psychopathy. In: Webster CD, Jackson MA, eds. *Impulsivity: Theory, Assessment, and Treatment*. New York, NY: Guilford Publications; 1997:212-232.