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Personality and Individual Differences 35 (2003) 2007–2021

PERSONALITY AND INDIVIDUAL DIFFERENCES

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Modification of the startle reflex in a community sample: do one or two dimensions of psychopathy underlie emotional processing?

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Received 2 July 2001; received in revised form 9 October 2002; accepted 30 December 2002

Abstract

Recent research on psychopathy has begun to explore two dimensions that possibly underlie psychopathy–one related more to emotional and interpersonal traits, and another related more to antisocial behaviors. A community sample of adults was assessed for psychopathy using Hare's (1991) Psychopathy Checklist-Revised (PCL-R). Eyeblinks elicited by startle probes were recorded while participants viewed pictures of emotionally-laden stimuli. Consistent with previous research, participants scoring high on PCL-R Factor 2 (''antisocial'') showed no affective modification of startle if they also scored high on PCL-R Factor 1 (''emotional detachment''). When the factor scores were analyzed together as continuous variables in a regression analysis, however, affective modification of startle was negatively related to Factor 1 but positively related to Factor 2. The results thus provide further support for a two-factor model of psychopathy.

Keywords: Emotion; Startle reflex; Psychopathy; Pcl-R; Affect; Eyeblink; Antisocial; Community sample

1. Introduction

Psychopathy is a personality disorder distinguished by distinct emotional and interpersonal traits and deviant social behaviors. Recent empirical and conceptual work has made use of Hare's

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0191-8869/03/$ - see front matter
doi:10.1016/S0191-8869(03)00052-7

Psychopathy Checklist-Revised (PCL-R; 1991), a 20-item measure that has a two-factor solution. Factor 1 measures core personality traits associated with psychopathy, such as grandiosity, glibness, and a lack of empathy, whereas Factor 2 measures more self-defeating and antisocial behaviors, such as poor behavioral controls, juvenile delinquency, and irresponsibility. Patrick, Bradley, and Lang (1993) have labeled Factor 1 ''emotional detachment'' and Factor 2 ''antisocial behavior.'' Others have argued that the two factors appear to map onto the distinction Karpman (1941) made between primary and secondary psychopaths (McHoskey, Worzel, & Szyarto, 1998).

The PCL-R is frequently used with incarcerated samples, but rarely with non-incarcerated samples, despite the greater external validity such studies might provide (see Lilienfeld, 1994, for a review). Regardless of the kind of sample, most researchers have focused on the total PCL-R score. However, differentiating the two factors that underlie psychopathy may have implications for assessing relations between psychopathy and other personality variables (Harpur, Hare, & Hakstian, 1989). For example, Patrick (1994) administered the PCL-R as well as the trait form of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), and the Emotionality-Activity-Sociability (EAS) Temperament Survey (Buss & Plomin, 1984) to a sample of male prisoners. Patrick computed partial correlations between each PCL-R factor with the other variables, while holding the other PCL-R factor constant. As expected, PCL-R Factor 1 scores were negatively related to the distress and fear subscales of the EAS, and to the negative affect subscale of the PANAS. However, more surprisingly, PCL-R Factor 2 scores were *positively* related to these same subscales. Using different measures of affect and a two-dimension model of psychopathy, similar relationships have also been found in incarcerated adults (Harpur et al., 1989), college students (McHoskey et al., 1998), and children (Frick, Lilienfeld, Ellis, Loney, & Silverthorn, 1999).

In the present study, we examined the relationships between the two PCL-R factors and a psychophysiological measure, modification of the startle reflex. Several investigators have demonstrated that the affective modification of the startle eyeblink reflex is a useful method to study emotional processes in humans and other animals (for reviews of this literature, see Bradley, Cuthbert, & Lang, 1999; Davis, Walker, & Lee, 1999). In a common paradigm with humans, participants view an affect-laden picture, such as a snake or an attractive nude model, during which there is a presentation of a loud, startling burst of white noise. The amplitudes of startle blinks that occur when the participant is viewing a negative picture are generally greater than when the picture is neutral or positive. This affective modification of startle is more likely to occur when the participant has had sufficient time to process the stimulus (i.e. greater than 1 s), although it can occur at lead intervals as short as 250 ms, depending on the task requirements (Vanman, Boehmelt, Dawson, & Schell, 1996). According to Lang and his colleagues (Lang, 1995; Lang, Bradley, & Cuthbert, 1997), this startle modification effect reflects an ''affect match,'' in that the startle reflex, which has a negative valence, is enhanced during a negatively valenced foreground stimulus (e.g. a picture of a burn victim), but diminished during a positively valenced one (e.g. a picture of beautiful scenery).

Patrick et al. (1993) examined the relationships of the PCL-R with startle modification with a sample of incarcerated participants. Participants viewed emotionally evocative and neutral pictures during which acoustic probes occurred between 4.5 and 6.5 s after picture onset. In one set of analyses, Patrick et al. used the total PCL-R score to form three equal groups: nonpsychopaths

(low PCL-R scores), a "mixed" group (middle scores on the PCL-R), and psychopaths (high PCL-R scores). Whereas the nonpsychopaths and the mixed group both showed normal patterns of startle modification (i.e. larger blinks during the presentation of negative pictures than during the presentation of positive pictures), the startle modification to the positive and negative pictures did not differ for the psychopaths. Patrick et al. hypothesized that this abnormal pattern in psychopaths (i.e. a failure to show differences between positive and negative slides) was related more to their emotional deficits (Factor 1) than to their antisocial behaviors (Factor 2).

Therefore, in a subsequent analysis, a subsample of participants was chosen on the basis of PCL-R Factor 2 (antisocial behavior) scores as the "high" antisocial group (i.e. scores higher than 10 on Factor 2). This group was then divided into two subgroups based on their Factor 1 (emotional detachment) scores. Only those participants scoring high on Factor 2 and high on Factor 1 failed to show affective modification of startle. That is, they showed no differences in responses to positive and negative stimuli. Conversely, participants scoring high on the PCL-R Factor 2 but low on PCL-R Factor 1 displayed the normal pattern of emotional modification (smaller blinks for positive slides and larger blinks for negative slides). Patrick et al. (1993) concluded that "emotional detachment...appears to be the factor most pertinent to psychopaths' unusual startle pattern." (p. 323). However, it is noteworthy that, by analyzing only those participants with high Factor 2 scores, Patrick et al. did not actually examine the relation of Factor 2 to startle modification in their study.

Patrick (1994) conducted a follow-up investigation using a different sample as well as a different paradigm. On the basis of Hare's (1991) PCL-R scores, incarcerated participants comprised four groups of unequal size: nonpsychopath (low on both Factors 1 and 2), detached (high on Factor 1 but low on Factor 2), antisocial (low on Factor 1 but high on Factor 2), and psychopath (high on both Factors 1 and 2). In this study, some trials consisted of a visual cue that warned of an impending, loud, noxious noise blast. Startle probes were presented on some of these trials at long lead intervals. Although there were no group differences in baseline startle reactivity, the psychopath and detached groups showed *reduced* startle potentiation during the anticipation cues, compared to the nonpsychopath and antisocial groups. Patrick (1994) concluded that these results supported Patrick et al.'s (1993) conclusion that affective startle modification is specifically related to the affective and interpersonal symptoms of psychopathy. It is also important to note, however, that the antisocial group (i.e. high on Factor 2 only) evidenced a trend, although not significant due to a small sample size, of *increased* startle potentiation during the anticipation cues compared to the nonpsychopath group. Thus, the Patrick (1994) data suggest that PCL-R Factor 2, which seems to tap into traits associated with antisocial behavior, may also be related to affective modification of startle, but in a way that is the inverse of the Factor 1-startle modification relationship.

The present study employed an affective startle modulation paradigm with a sample consisting of volunteers from temporary employment agencies in the metropolitan community of Los Angeles. PCL-R scores for these participants were simultaneously examined with their affective startle patterns. For affective stimuli, we chose positive and negative pictures from the International Affective Picture System (IAPS; Center for the Study of Emotion and Attention [CSEA-NIMH], 1995). We did not include "neutral" pictures for the following reasons. First, it is clear that the major findings in the Patrick et al. (1993) study regarding the relationship of psychopathy to affective responses had to do with comparisons between positive and negative slides. Second,

because positive and negative pictures in the IAPS are usually rated higher in arousal than are neutral pictures (Lang et al., 1997), inclusion of neutral pictures in this paradigm would have confounded the valence dimension with the arousal dimension, thus rendering conclusions involving comparisons to neutral pictures unclear. Finally, by not including a neutral slide condition, we were able to present 33% fewer trials than might have been required otherwise, thus reducing habituation to the startle stimulus.

Our design also allowed us to include startle probe trials at time intervals earlier (i.e. less than 1 s) than were used by Patrick et al. (1993). Specifically, we included 300- and 800-ms probe conditions, in addition to a 4500-ms probe condition, to explore whether factors associated with psychopathy were related to differences in timing of the affective modification of startle. For example, Vanman, Dawson, and Brennan (1998), using a slightly different picture-viewing paradigm, found that participants scoring high on a depression scale showed effects of slide valence on startle as early as 120-ms, whereas Vanman et al. (1996, Study 2) reported such modification effects at 250 ms in a "normal" sample of participants (however, the task was different from the one used in the present study). Thus, although we had no a priori predictions regarding these two early probe positions, we chose to explore this early time interval.[1]

For the 4500-ms lead interval, we expected that Patrick et al.'s (1993) findings with respect to "emotional detachment" would be replicated as follows. That is, for the group with high scores on PCL-R Factors 1 and 2, no differences in startle patterns between positive and negative slides were predicted, whereas the group high in Factor 2 but low in Factor 1 was expected to show normal startle modification. In addition to conducting our analyses using groupings similar to Patrick et al.'s, we also examined the possible reciprocal suppression effects of Factors 1 and 2 that have been noted by others (e.g. McHoskey et al., 1998; Patrick, 1994).

A reciprocal suppression among two predictors occurs when one predictor is positively correlated with the criterion and the other is negatively correlated with the criterion, and the two predictors are positively correlated with one another. When reciprocal suppression occurs, both predictors may appear to have no relationship with the criterion when assessed separately in zero-order correlations (Conger, 1974). Thus, the rise in Factor 1 scores might be expected to lead to less emotional modification of startle (negative correlation between Factor 1 and modification). However, as Factor 1 rises, so does Factor 2 (positive correlation between the predictors), and Factor 2 may be positively correlated with startle modification. The decrease in modification due to an increase in Factor 1 is offset by the increase in modification due to the associated rise in Factor 2; Factor 1 and Factor 2, which would increase together, suppress and obscure each other's influence on emotional modification of startle. However, Factors 1 and 2 will have divergent relationships (i.e. one positive and the other negative) when assessed together in multiple regression (Cohen & Cohen, 1983).

Thus, we conducted regression analyses in which scores on the two PCL-R factors were treated as continuous variables. Based on Patrick et al.'s (1993) conclusions, one would expect to find that only PCL-R Factor 1 would be a significant predictor of startle modification when Factor 2 was included in the regression model. However, because this "antisocial behavior" factor is

[1] Soon after we completed data collection for this study, we learned of a recently published study that also included early startle probe positions (i.e. 300 and 800 ms) in an affective modification of startle study of psychopathy (Levenston, Patrick, Bradley, & Lang, 2000). The results of that study indicated that incarcerated psychopaths did not evidence affective modification of startle at these earlier probe positions.

positively related to negative affect when the effects of Factor 1 psychopathy are partialed out (McHoskey et al., 1998; Patrick, 1994), and because Patrick (1994) found evidence of a trend of increased startle potentiation among those scoring high on Factor 2, we predicted that the regression analyses would reveal both a *positive* relationship between Factor 2 and affective startle modification, and a *negative* relationship between Factor 1 and affective modification.

2. Method

2.1. Participants

A sample ($n = 90$) of adult males and females was derived from a larger study of 108 participants (Raine, Lencz, Bihrle, LaCasse, & Colletti, 2000), who were recruited from five temporary employment agencies in the greater Los Angeles area. Because participation in the larger study also included magnetic resonance brain imaging (see Raine et al., 2000), participants were excluded if they were under 21 or over 45 years of age, non-fluent in English, claustrophobic, or had a pacemaker, metal implants, or history of epilepsy. All participants were paid. The experimenters for the present study were blind to all scores and diagnoses (see later). Two participants were omitted from analyses due to equipment malfunction and one participant was omitted because his testing session was interrupted by a fire alarm in the building. In addition, seven participants were omitted due to inadequate baseline startle responsiveness to the stimuli (defined as having a mean baseline startle amplitude less than one microvolt). This left a total of 80 participants for the final analyses (70 men, 10 women). Of these remaining participants, 46 were White (57.5%), 22 were African-American (27.5%), 10 were Hispanic (12.5%), and two were of other race/ethnicity (2.5%). The median age was 30 years, ranging from 21 to 45 years.

2.2. Psychopathy assessment

Psychopathy was assessed using the Hare Psychopathy Checklist, Revised (PCL-R; Hare, 1991), which was supplemented by five other sources of collateral data available for each participant (see Ishikawa, Raine, Lencz, Bihrle, & Lacasse, 2001, for more details). The PCL-R consists of 20 items and taps into two factors: interpersonal/affective characteristics (e.g. glibness/superficial charm, pathological lying, shallow affect) and antisocial behavior (e.g. need for stimulation/proneness to boredom, impulsivity, juvenile delinquency), with total scores ranging from 0 to 40. PCL-R ratings were made by a PhD clinical graduate student supervised and trained by one of the authors (A.R.).

The five collateral data sources for assessing psychopathy were as follows: self-report criminal offending, official criminal records, the Interpersonal Measure of Psychopathy (IMP; Kosson, Steuerwald, Forth, & Kirkhart, 1997), and data derived from, and behavioral observations made during, the Structured Clinical Interview for the DSM-IV Mental Disorders (SCID I; First, Spitzer, Gibbon, & Williams, 1994) and the Structured Clinical Interview for the DSM-IV Axis II Personality Disorders (SCID II; First, Spitzer, Gibbon, Williams, & Benjamin, 1994). The IMP is an 18-item inventory on which an interviewer rates to what extent certain interpersonal behaviors

that characterize the psychopath describe the individual (e.g. interrupts, tests interviewer, possesses unusual calmness or ease, expresses narcissism, incorporates interviewer into personal stories). It has demonstrated construct validity with the PCL-R in a prison sample and has also been validated for use with a non-incarcerated sample (i.e. college students; Kosson et al., 1997). Cronbach's alpha for this sample was 0.87. The SCID I and II were administered by a PhD-level clinical graduate student who had undergone systematized training in diagnostic assessment (Ventura, Liberman, & Green, 1998).

Self-report criminal offending was measured using an adult extension of the self-report delinquency measure used in the National Youth Survey (Elliott, Ageton, Huizinga, Knowles, & Canter, 1983; Raine et al., 2000). It consisted of 44 items covering acts that ranged from minor acts (e.g. unruly in a public place, minor theft) to more serious offending (e.g. rape, assault on strangers causing bodily injury or trauma, or attempted/completed homicide). Full details of this instrument are available from one of the authors (A.R.) on request. To help minimize false negatives (denial of crime by truly criminal offenders), a certificate of confidentiality was obtained from the Secretary of Health, Education, and Welfare (D.H.H.S.), which protected one of the principal investigators (A.R.) under section 303 (a) of the Public Health Act 42 from being subpoenaed by any Federal, State, or local court in the USA to release the self-report crime data. Consequently, participants were protected from the possible legal action that could be taken against them for crimes they committed and admitted in interview, but which were not detected and punished by the criminal justice system. After giving signed, informed consent, participants were individually tested over 3 days at research laboratories at the University of Southern California.

2.3. Procedure

The testing session for the present study began with a hearing screening test, testing the participant's hearing at 1000, 1500, and 2000 Hz. All participants passed the screening test. A brief introduction was then presented on an audiotape followed by the attachment of electrodes for the recording of startle eyeblink. The testing session began with a tone length-judging task designed to produce attentional modification of startle (Filion, Dawson, & Schell, 1993) and the completion of three questionnaires assessing emotional regulation, the results of which are not reported here because they are not relevant to the purposes of the present study. Participants were then presented with audiotape instructions stating that their task was to watch an upcoming series of slides during the entire time that each was presented. Participants were also told that brief loud static noise bursts would be presented occasionally during the slide presentations but that these could be ignored.

The subsequent testing session involved the participant sitting alone in a comfortable easy chair while the experimenter sat in another room with the recording equipment and viewed the participant through a one-way mirror. Participants viewed a total of 24 (12 pleasant and 12 unpleasant) slides, selected from the IAPS to be comparable in valence extremity and arousal.[2] Several

[2] For pleasant pictures, the IAPS identification numbers are: 1600, 1750, 2340, 2530, 4650, 4680, 5200, 7350, 8030, 8180; for men, 4210 and 4290; for women, 4470 and 4490. According to materials that accompany the IAPS (CSEA-NIMH, 1995), the mean normative pleasantness rating (on a 9-point scale, where 1 is most negative and 9 is most positive) for the pictures viewed by the men was 7.53 (S.D. = 0.45), whereas those viewed by the women was 7.00 (S.D. = 0.55). For unpleasant pictures the identification numbers are: 1070, 1120, 2730, 3000, 3120, 3140, 3180, 3230, 6200, 6230, 8230, and 9040. The mean normative pleasantness rating for these pictures was 2.43 (S.D. = 0.86).

of these slides were also used by Patrick et al. (1993), and the mean normative ratings of pleasantness and arousal of the stimuli used here were nearly equivalent to the ratings of the positive and negative slides used in the Patrick et al. study. Each slide was presented in a dimly lit room for 6 s on a wall approximately 2 m in front of the participant. The viewable image was approximately 0.6 m wide and 0.4 m tall. The 24 slides were organized into three blocks of eight slides each, four positive and four negative in a fixed, mixed order. Two of the slides in each block (one positive and one negative) were unprobed. The order of lead intervals (i.e. the interval between the onset of the slide and the onset of the startle stimulus) in the remaining six slides was varied in three sequences so that each lead interval appeared equally often in each ordinal position for each valence of slide within a trial block (300 ms positive, 300 ms negative, 800 ms positive, 800 ms negative, 4500 ms positive, 4500 ms negative). Intertrial intervals ranged from 10 to 30 s.

The startle stimulus consisted of a 40-ms, 104-dB (A) white noise that was generated by a Grason-Stadler 901B noise generator and gated at a near instantaneous rise/fall time. All of the auditory stimuli were presented binaurally through headphones (Telephonics TDH-49P). Startle stimuli were presented during 18 of the inter-trial intervals (ITIs), six occurring during each trial block. These stimuli were presented at random intervals between 10 and 20 seconds after slide offset. The startle-blink magnitudes elicited by probes presented during the ITIs served as baseline measures with which to compare blink magnitudes to the same startle stimuli presented during the slides.

2.4. Recording and scoring of dependent variables

The primary dependent variable was the modification of the startle eyeblink magnitude produced during the probed slides at the 300, 800, and 4500 ms lead intervals. Startle eyeblink amplitude was measured as electromyographic activity (EMG) from two miniature electrodes (4 mm in diameter) placed over the *orbicularis oculi* muscle of the left eye, one electrode centered below the pupil and the other approximately 10 mm lateral to the first. The EMG signal was fed to a Grass 7P3 wide band integrator/preamplifier and a 7DA-driver amplifier. The EMG signal was digitized at a rate of 2000 Hz for 200 ms before and 300 ms following the presentation of each startle-eliciting loud noise. The raw rectified EMG signal was scored off-line using a custom written program developed at USC. In the program, the amplitude of each EMG response is scored in microvolts as the difference between the mean EMG activity in the 200 ms preceding the onset of the startle probe and the peak of the response to the startle probe. The peak of the response is defined as the highest microvolt average calculated across a 1.5 ms moving window. Only peaks occurring between 40 and 110 ms post startle stimulus onset were scored. In addition, blinks were discarded if the data were too noisy to be scored by the computer or the experimenter noted excessive movement at the time the startle probe was presented.

Rather than conducting our analyses on the raw amplitudes of the startle responses, the amplitude of each startle response at each lead interval was expressed as a percent change from the mean of the baseline (ITI) startle alone response. A positive startle eyeblink modulation score indicated startle facilitation relative to baseline, whereas a negative score indicated startle inhibition relative to baseline. One advantage of this method is that percent change scores are less

confounded by individual differences in response to baseline startles (Berg & Balaban, 1999; Jennings, Schell, Filion, & Dawson, 1996).[3]

3. Results

3.1. Overview of statistical analyses

Fig. 1 depicts a scatterplot of scores on PCL-R Factor 1 (“emotional detachment”) plotted against scores on PCL-R Factor 2 (“antisocial behavior”). Consistent with previous research

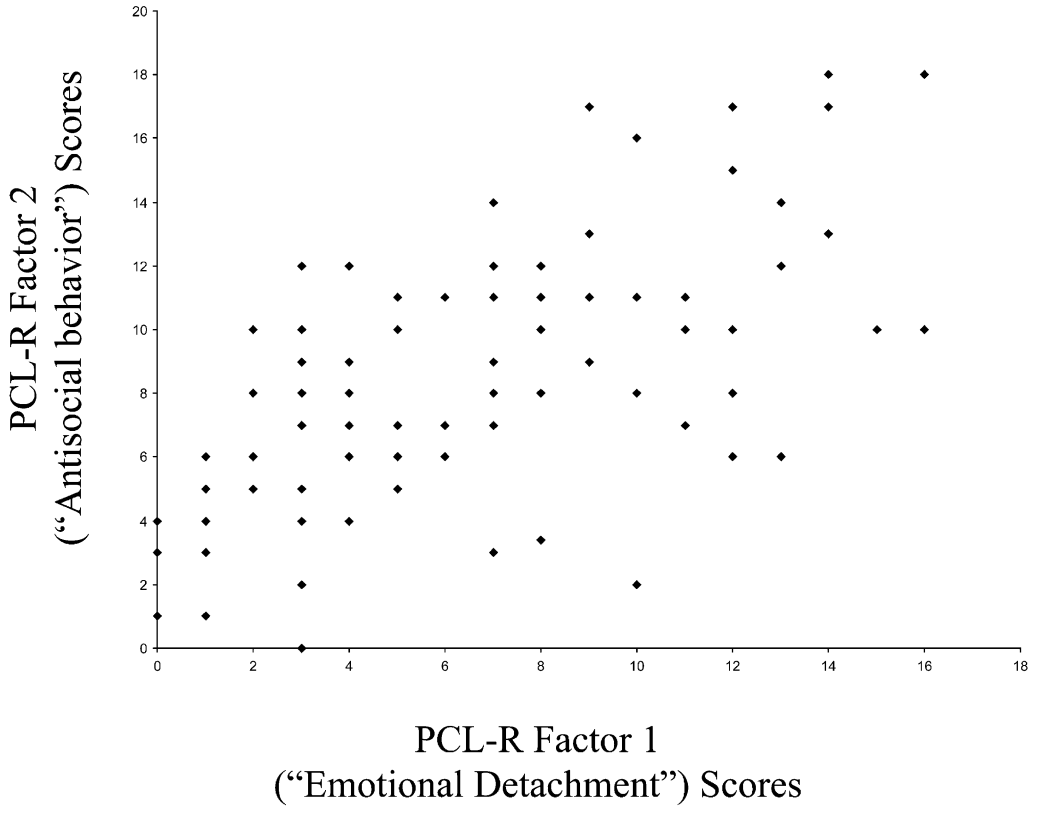

Fig. 1. Scatterplot depicting the relationship between PCL-R Factor 1 and Factor 2 Scores for the 80 participants in this study. Some points represent multiple observations. For ease of interpretation, we use the factor labels suggested by Patrick et al. (1993).

[3] In response to a reviewer’s suggestion, we examined the correlations between the baseline startle response and (a) the percent change and (b) the raw startle for all probe positions and for both positive and negative slides. No significant relationships were found between these variables, nor did they differ as a function of PCL grouping. Thus, these results provide further support for our decision to use the percent change scores.

(Harpur et al., 1989), the two factors were strongly and positively related, r (78) = 0.61, $P < 0.001$. Means (and standard deviations) for Factor 1, Factor 2, and total PCL-R were 6.50 (4.34), 8.56 (4.06), and 18.53 (8.42), respectively. Based on a total PCL-R cut-off score of 30, which is recommended in the PCL-R manual for clinical use with incarcerated populations (Hare, 1991), 16.25% of the participants (12 men and one woman) would be classified as "psychopaths." Others (e.g. Intrator, Hare, Stritzke, & Brichtswein, 1997) have recommended a lower cut-off score of 25 when conducting research, which would mean that 22.5% of the participants (17 men and one women) would be classified as psychopaths by this criterion. Race and gender of the participants, whether analyzed as covariates or separately as grouping variables, were not found to be related significantly to any of the main outcomes, so analyses reported here collapsed across these variables. For the main hypotheses tested, we report three sets of analyses. First, we analyzed the startle modification data from all participants, regardless of PCL-R scores, as a function of slide valence and probe position. In the second set of analyses, we analyzed startle modification as a function of slide valence and PCL-R scores by creating dichotomous groups based on scores on each of the PCL-R factors, and then comparing the High Factor 1/High Factor 2 group to the Low Factor 1/High Factor 2 group. This set of analyses therefore paralleled those of Patrick et al. (1993). In the third set of analyses, we treated PCL-R Factors 1 and 2 as continuous variables in a regression model, where the amount of affective modification of startle served as the outcome variable. An alpha level of .05 was used for all statistical analyses, which included two-tailed tests whenever it was possible to do so (e.g. t-tests). We also report effect sizes as Cohen's d for t-tests, and η^2 for ANOVAs.

3.2. Overall affective modification of startle

The effects of slide valence on startle modification were tested at each lead interval separately using paired t-tests. For the 300-ms lead interval, there was no difference between positive and negative slides, $t(79) = -0.437$, $P = 0.663$, $d = -0.05$. For the 800-ms lead interval, a small, but not significant, effect of slide valence occurred, $t(79) = -1.58$, $P = 0.119$, $d = -0.18$, with negative slides ($M = 9.58$, SE = 10.33) eliciting larger blinks than positive slides ($M = 1.55$, SE = 10.44). At the 4500-ms lead interval, a significant effect of slide valence occurred, $t(79) = -3.20$, $P = 0.002$, $d = -0.36$, with negative slides ($M = 45.39$, SE = 10.58) again eliciting larger blink than positive slides ($M = 17.61$, SE = 10.47).

3.3. Analyses of participants with high PCL-R Factor 2 scores only

Following the procedures of Patrick et al. (1993), for these analyses we selected only participants ($n = 24$) with high "antisocial" scores (i.e. above the midpoint of the Factor 2 scale). We divided these participants into two equal subgroups based on their "emotional detachment" (i.e. Factor 1) scores. We then conducted Factor Group X Slide Valence analyses at each lead interval separately. No significant main effects or interactions were found at either the 300- or 800-ms lead intervals. However, at 4500 ms, a main effect of valence was found, F (1,22) = 10.63, $P = 0.004$, $\eta^2 = 0.33$, in which greater startle amplitude occurred for negatively-valenced slides (see Fig. 2). In addition, a significant Factor Group X Slide Valence interaction occurred, $F(1,22) = 7.61$, $P = 0.011$, $\eta^2 = 0.26$. Post hoc tests revealed that participants with low PCL-R Factor 1 scores

exhibited "normal" affective modification of startle (i.e. greater startle amplitude for negatively-valenced slides), t (11) = −3.40, P = 0.006, d = −0.98, whereas participants high on Factor 1 showed no difference between positively- and negatively-valenced slides, t (11) = −0.54, P = 0.602, d = −0.16. Thus, these results are consistent with those of Patrick et al. (1993).

3.4. Regression analyses

To conduct a multiple regression analysis on the amount of affective modification of startle, a modification difference score was first computed for each participant by subtracting the amount of modification for positive slides from the amount of modification for negative slides. Thus, greater modification difference scores indicated larger blinks to negative slides in comparison to positive slides. This difference variable seemed to capture the key contrast between psychopaths and non-psychopaths as reported by Patrick et al. (1993) in a single number amenable to standard regression analyses. Also, given that blink modification was not significant at 300 or 800 ms,

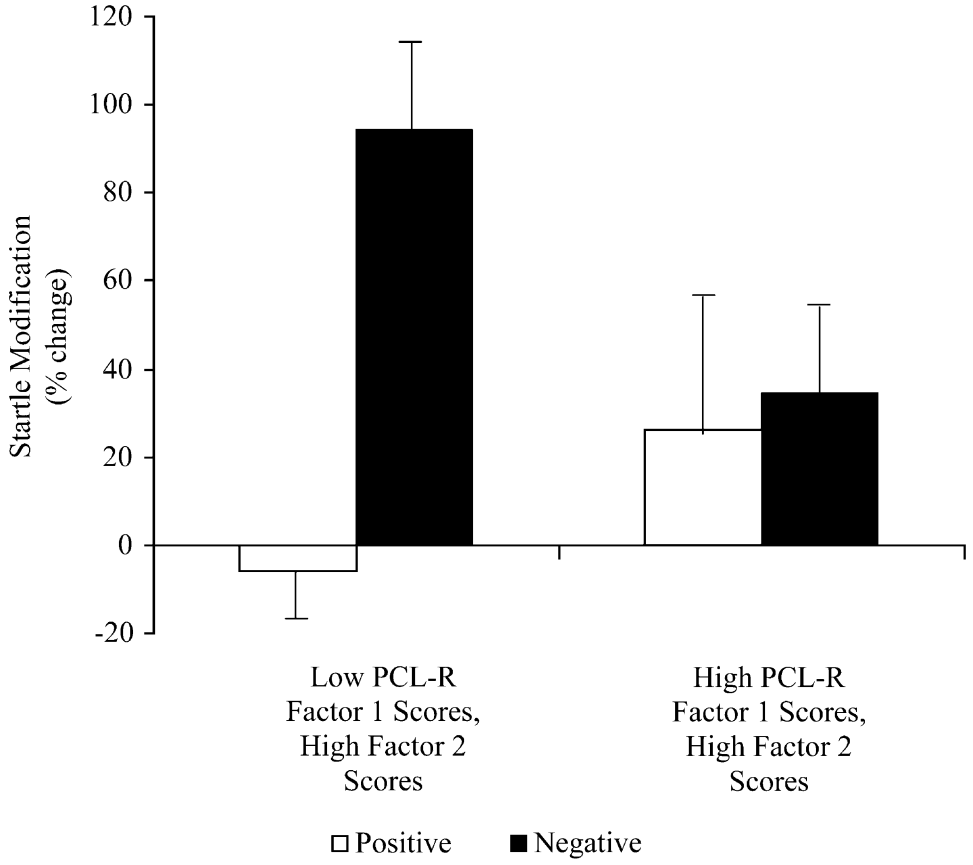

Fig. 2. Affective modification at the 4500-ms lead interval as a function of Slide Valence and PCL-R Factor 1 Group (n = 12 for each), only for those participants with high PCL-R Factor 2 scores. Error bars represent standard errors.

we confined these analyses to the 4500-ms lead interval. This, of course, is the lead interval most comparable to the one analyzed by Patrick et al.

Zero-order correlations between PCL-R Factor 1, PCL-R Factor 2, and the blink modification difference scores were computed. As already noted, Factors 1 and 2 were positively correlated, but the correlation between Factor 1 and the modification difference score was not significant, r (78) = −0.053, $P = 0.644$, nor was the correlation between Factor 2 and the modification difference score, although it did approach significance, r (78) = 0.207, $P = 0.065$. Thus, neither PCL-R factor, when analyzed alone, was a predictor of blink modification. To examine the possibility that the two factors were reciprocal suppressors (Conger, 1974), a standard multiple regression was performed, with the modification difference score as the criterion variable and PCL Factor 1 and PCL Factor 2 scores entered at once as the predictor variables. R for regression was significantly different from zero, F (2,77) = 3.94, $P = 0.023$. The standardized regression coefficient for PCL Factor 1 was significant, $\beta = -0.28$, t (78) = −2.06, $P = 0.043$, as was the one for PCL Factor 2, $\beta = 0.38$, t (78) = 2.77, $P = 0.007$. Together, 9.3% (6.9% adjusted) of the variability in startle modification was predicted by the scores on the two PCL factors. Thus, both PCL factors were significant predictors of affective modification of startle, but their relationships to the modification of difference scores were in the opposite direction. Higher scores on Factor 1 were related to less affective modification of startle, whereas higher scores on Factor 2 were related to more affective modification[4]. In an exploratory analysis, we also examined the interaction effect of the two PCL factors on affective modification. When included as a second step in the regression, 16.3% (13% adjusted) of the variability was predicted, $F(3,76) = 4.94$, $P = 0.003$. The standardized regression coefficient for the interaction factor was significant, $\beta = -0.93$, $t(78) = -2.53$, $P = 0.013$, indicating that those with the highest scores on both PCL Factor 1 and Factor 2 showed the least amount of affective modification of startle.

4. Discussion

The present study examined the relationship of affective modification of startle to psychopathy in non-incarcerated community volunteers. As one might expect, overall PCL-R scores for this sample were somewhat lower than those in Patrick et al.'s (1993) study, which investigated similar relationships with incarcerated participants. Indeed, our sample was probably more heterogeneous (with respect to PCL-R scores, gender, and race/ethnicity) than the ones used by Patrick et al. and others. We also did not include a neutral slide condition and used slightly different procedures to score blink procedures in comparison to the Patrick et al. study. Thus, it was important to establish first that we could replicate the main findings of that earlier study. By using the same PCL-R factor cutoffs as Patrick et al., we had a sufficient number of high scores on PCL-R Factor 2 to examine differences between subgroups on the basis of the Factor 1 scores.

[4] We also conducted regression analyses in which (a) the baseline startle, (b) the startle responses to positive slides, or (c) the startle responses to negative slides served as the criterion variable. In none of these analyses was R significant for the regression. Thus, the relationship of the two PCL-R factors to startle appears to be confined to the difference in startle modification between the positive and negative slides.

Our results indeed replicated those of Patrick et al. Using an analysis based on group comparisons revealed that high scores on the emotional detachment factor (Factor 1) are characterized by less affective modification of startle. This finding supports the distinction that Hart and Hare (1997) have made between psychopathy and antisocial personality disorder, as defined by the *Diagnostic and Statistic Manual of Mental Disorders* (American Psychiatric Association, 1994)—namely, that antisocial behavior is distinct from one's emotional and interpersonal characteristics when assessing for psychopathic traits.

Now that we had established that our data could yield results similar to those of Patrick et al. (1993), we explored whether treating the two PCL-R variable as continuous variables would further demonstrate that Factor 1 was primarily important in understanding the relationship between startle modification and startle, a question not really examined by Patrick et al. because they did not look at both the relationships of both PCL-R factors to startle. Importantly, the regression analysis here indicated that *both* dimensions of psychopathy are related to emotional responding. When simultaneously assessing their relationships to startle modification, a reciprocal suppression effect was revealed: higher PCL-R Factor 1 scores were related to *less* startle modification, but higher PCL-R Factor 2 scores were related to *more* startle modification. Thus, these results qualify Patrick et al.'s (1993) conclusion that the most pertinent factor to psychopaths' startle patterns is emotional detachment. Indeed, the standard regression coefficient for Factor 2 (i.e. $\beta = 0.38$) was larger than the coefficient for Factor 1 (i.e. $\beta = -0.28$).

One might argue that the lack of a neutral slide condition in our study would have been critical in establishing the extent to which the lack of affective modification of startle is due to less startle potentiation to negative stimuli or less startle inhibition to positive stimuli or both. We instead used a percent change score that measured affective modification of startle with respect to a startle stimulus presented during the ITI. In this way, we operationally defined startle potentiation as a startle amplitude greater than the mean response to an ITI startle probe, and startle inhibition as a startle amplitude less than the ITI. Interestingly, the results depicted in Fig. 2 show that at 4500 ms participants were mainly evidencing differences in startle potentiation (in comparison to the ITI startle) as they viewed positive and negative slides, a finding consistent with our earlier work using unselected student samples (Vanman et al., 1996, 1998).

What are the implications of these results for our understanding of psychopathy? The answer depends in part on which aspects of psychopathy each of the PCL-R factors represents. For example, one might not consider these findings to be terribly surprising, when one considers relevant research using questionnaire data. Antisocial behavior, as measured by PCL-R Factor 2 scores, is positively related to negative affect (Frick et al., 1999; McHoskey et al., 1998; Patrick, 1994). Greater differentiation of startle modification occurred in this study for those scoring high on this factor, which might reflect greater sensitivity to differences between negatively- and positively-valenced stimuli. Or, perhaps anxiety plays an important mediator role in the startle/psychopathy relationship. Increased affective modification has also been found with high-fear and high-anxiety participants (Cook, Hawk, Davis, & Stevenson, 1991), which suggests that Factor 2 might be related to anxiety. Interestingly, Schmitt and Newman (1999) recently concluded that psychopathy, as assessed by Hare's PCL-R, is not related to anxiety. However, those authors may have overlooked the reciprocal suppression effect of the two PCL-R factors, in that their analyses did not examine the relationship between each factor and anxiety while controlling for the other factor. Due to the limitations of our study, we can only speculate about the roles of negative

affect, anxiety, or other personality variables in the affective responses of psychopaths. It is clear, however, that researchers interested in these emotional underpinnings of psychopathy should consider the reciprocal suppression effect of the two PCL-R factors in their analyses.

Three relatively minor points can also be made about our results. First, we found no overall effects of slide valence on startle modification at 300 or 800 ms, which is consistent with other research using a similar paradigm (Bradley, Cuthbert, & Lang, 1993; Vanman et al., 1996). We also did not observe any group differences when we conducted the two-group analyses for the 300- and 800-ms probe positions. This lack of a group difference for early probe positions is consistent with the results recently reported by Levenston et al. (2000). Second, we had no a priori predictions about whether PCL Factors 1 and 2 would have a moderating relationship on the affective modification of startle, but we did find a significant Factor 1 × Factor 2 interaction in our regression analysis. It is unclear what to make of this interaction, given that the two factors were independently related to startle in a reciprocal suppression effect. Future research should investigate the extent to which such an interaction is replicable, although what it ultimately means in this context may be difficult to infer (Cronbach, 1975). Third, it is important to note that we were not able to address the role of gender as a possible mediator of the psychopathy–startle relationship due to the low number of women in our study. Future studies of psychopathy should include equal numbers of men and women, which should be easier to do when using community samples to provide sufficient power to explore the relationship of gender to psychopathy and emotional responding.

As noted in the introduction, several authors (e.g. Harpur et al., 1989; Lilienfeld, 1994; McHoskey et al., 1998) have recommended that, to better understand psychopathy, the two dimensions that appear to underlie it should be studied by assessing the influence of each independently. By taking such an approach, evidence arises from this study and others that it is better to conceptualize PCL-R Factor 1 as being related to emotional *detachment*, and Factor 2 as being related to emotional *sensitivity*. This finding may appear counterintuitive. Cleckley (1941), for example, described the psychopath has having personality traits that were largely devoid of emotion (e.g. guiltlessness, failure to form close emotional bonds, low anxiety). However, by adopting a two-dimension approach to psychopathy, Cleckley's psychopath appears to represent only one of these dimensions—emotional detachment. Although the other dimension has been labeled by Patrick et al. (1993) as "antisocial behavior," one should note that some antisocial behaviors, such as juvenile delinquency and early behavioral problems, are probably driven by heightened emotional responses (e.g. getting into a fight at the slightest provocation). Whether there are actually multiple subtypes of psychopaths or just one is an issue that is beyond the scope of our research (see Lilienfeld, 1994, for a discussion of this issue). Moreover, Cooke and Michie (2001) have even proposed that there might be three distinct factors to psychopathy: (1) an arrogant and deceitful lifestyle, (2) deficient affective experience, and (3) an impulsive and irresponsible behavioral style. We did not analyze our data with respect to such a reconceptualization of the PCL-R, but it is important to note that each of the three factors proposed by Cooke and Michie involve some aspect of emotion, and thus one might predict that all three would be related, albeit in different directions, to the affective modification of startle. Regardless of which model of psychopathy researchers in the field finally settle on, our finding that more than one facet of psychopathy is involved in emotional processing has implications for both clinical and theoretical perspectives of psychopathy.

Acknowledgements

This article is based in part on a master's thesis submitted to University of Southern California by Veronica Y. Mejia. This research was supported by a grant (R01 MH46433) and a Research Development Award (K02 MH01086) from the National Institute of Mental Health to Michael Dawson, and a grant (5 RO3 MH50940-02) and a Research Development Award (K02 MH01114-01) from the National Institute of Mental Health to Adrian Raine, as well as a grant from the Wacker Foundation to Adrian Raine. The authors wish to thank Scott Lilienfeld for helpful comments on a draft of this manuscript. We also thank Kim Kelly, Lorretta Abbott, Andreas Böhmelt, Jonathan Wynn, Susan Bihrle, Shari Mills, Joseph Ventura, Lori LaCasse, Todd Lencz, and Bill Troyer for their assistance during data collection and scoring.

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