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Startle modulation in non-incarcerated men and women with psychopathic traits

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Abstract

Past research has demonstrated that individuals with psychopathic characteristics are under-responsive to aversive stimuli, however, much of this work has failed to include non-incarcerated samples, or to examine gender differences in this relationship. Additionally, few studies have examined the role of specific personality characteristics, as they relate to both psychopathic behavior and emotional responsiveness. The current study assessed emotional modulation of the startle response in a community sample of 108 men and women (99 with usable startle data) during perception of emotion-laden photographs. Consistent with previous work, men reporting high levels of psychopathy failed to show the typical increase in the startle response when exposed to aversive photographs, but only when responses were elicited relatively early in picture viewing (i.e., 2.0 s as compared to 4.5 s post-photograph onset). Additionally, both genders showed a significant effect of harm avoidance and anxiety on modulation of the startle response, such that individuals reporting low levels of each trait failed to show significant responses to aversive photographs. These results suggest that while deficits in emotional processing extend to non-incarcerated samples, the relationship may be influenced by additional factors including gender, personality, and attributes related to incarceration.

Keywords

Psychopathy; Gender; Personality; Emotion modulated startle

1. Introduction

A number of theorists have proposed that psychopathy is the result of a selective deficit in one's ability to experience negative emotion or process threatening cues (Lykken, 1995; Patrick, Bradley, & Lang, 1993). In support of this theory, psychopaths consistently demonstrate under responsiveness to a variety of aversive stimuli (e.g., electric shock, unpleasant photographs Hare, 1965; Patrick et al., 1993), however, most studies have focused exclusively on samples of incarcerated men. Given the increasing interest in psychopathic behavior in women and non-incarcerated, potentially more "successful" psychopaths, it seems appropriate to extend investigation to community samples of men and women.

The present study examined the relationship between psychopathy, personality characteristics related to psychopathy, and affective modulation of the eye blink startle response in a community sample of men and women. The affective startle response is a highly replicable psychophysiological measure of emotional processing in humans and other animals (for review see Bradley, Cuthbert, & Lang (1999); Davis, Walker, & Lee (1999)), as evidenced by a linear trend for affective valence, whereby startle is suppressed while viewing pleasant stimuli and

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heightened when processing aversive stimuli. Thus, the affective startle response is thought to reflect activation of the defensive motivational system, such that a "match" between an aversive foreground stimulus (e.g., a picture of an aimed gun) and the startle response (which also is aversive) will augment the startle response, whereas, a "mismatch" (e.g., startle elicited while viewing an attractive model) will inhibit the response (Lang, Bradley, & Cuthbert, 1998).

1.1. Psychopathy, personality, and emotional modulation of the startle response

In contrast with studies of non-psychopathic controls, recent work has reported that both incarcerated (Herpertz, Werth, Lukas, Qunaibi, & Schuerkens, 2001; Patrick et al., 1993) and community samples (Benning, Patrick, & Iacono, 2005; Vanman, Mejia, Dawson, Schell, & Raine, 2003) of psychopathic men fail to show a significant augmentation of the startle response when processing aversive stimuli. However, psychopathy is believed to be composed of two distinctive factors: emotional detachment (Factor-1 Hare, 1991, p. 76); and antisocial behavior (Factor-2 Hare, 1991, p. 76), with some evidence that the relationship between psychopathy and affective modulation of the startle response is related specifically to level of emotional detachment (Benning et al., 2005; Patrick et al., 1993). Therefore, deficits in affective processing might be more parsimoniously explained by the presence of a specific personality characteristic or set of characteristics instead of a general tendency toward psychopathic behavior.

Consistent with this idea, abnormal modulation of the startle response has been linked with Factor-1 related personality characteristics, including low levels of anxiety (Corr, 2002; Sutton, Vitale, & Newman, 2002), fearfulness (Cook, Hawk, Davis, & Stevenson, 1991), and harm avoidance (Corr, Kumari, & Wilson, 1997; Corr, Wilson, Fotiadou, Kumari, & Gray, 1995), with individuals endorsing low levels of these traits failing to show significant potentiation of the startle response to aversive stimuli. Conversely, little is known about the role of Factor-2 related personality characteristics. Two studies have reported that impulsivity is not significantly related to modulation of the startle response (Corr et al., 1995; Kumari, Corr, Wilson, Kaviani, & Thornton, 1996), however, there are no published investigations of the relationship between traits such as excitement seeking or social deviance and affective modulation of the startle response.

1.2. Gender differences in psychopathic individuals

One study has partially replicated findings of a relationship between psychopathy and deficits in affective modulation of the startle response in a sample of incarcerated women. Sutton et al. (2002) reported that women who met diagnostic criteria for psychopathy failed to show an augmentation of the startle response to aversive stimuli, however, differences were present only when startle was elicited early in picture viewing (2.0 s post stimulus onset). At a later interval (4.5 s), psychopathic women showed the typical augmentation to aversive cues. The latter finding is inconsistent with studies of male psychopaths, which reliably report a lack of startle augmentation to aversive stimuli across startle probe times, however, previous studies typically average startle data across probe time, potentially blurring effects of probe time. Therefore, elucidation of potential gender differences in the relationship between psychopathy and affective processing likely requires separate analyses based on startle probe timing.

1.3. Current study

Two studies have investigated the relationship between psychopathy and emotion modulated startle in community samples (Benning et al., 2005; Vanman et al., 2003), however, neither investigated gender differences in this relationship. The present study investigated the relationship between gender, self-reported levels of psychopathy, and individual personality characteristics in modulating the affective startle response in a community sample. Study hypotheses predicted that individuals reporting elevated levels of psychopathy would fail to

show a significant augmentation of the startle response to aversive stimuli and that this deficit is specific to elevated levels of emotional detachment (i.e., high Factor-1 scores). It was further hypothesized that this effect would be replicated for the individual personality characteristics associated with Factor-1 scores (i.e., low levels of anxiety, fearfulness or harm avoidance), but not elevated Factor-2 scores (i.e., high levels of impulsivity, social deviance or excitement seeking). No gender differences were hypothesized for either set of analyses.

2. Method

2.1. Participants

Participants were 108 young adults between the ages of 18 and 35 (M = 22.39 years) recruited from the community via advertisements in local newspapers and flyers posted in the community (e.g., grocery stores, bars) and at the local courthouse. Ads were designed to elicit participants with a range of psychopathic personality traits (i.e., “Are you the ‘sensitive type’?”; “Are you rebellious?”; “Ever been called ‘heartless’?”). Participants were excluded if they were not fluent in English or had hearing difficulties. Nine participants were excluded from analyses due to unscorable startle data, leaving 99 participants (48 males) in the final analysis.

2.2. Personality Assessment

Participants completed nine self-report measures of personality. Anxiety was assessed using the Welsh Anxiety Scale (Welsh, 1956, 39 items) which commonly is used to identify low-anxious psychopaths. Fearfulness was assessed using the Fear Survey Schedule (Arrindell, Emmelkamp, & vander Ende, 1984, 52 items) which measures fearfulness in relation to discrete situations, as compared to the more generalized distress believed to characterize anxiety (Schmitt & Newman, 1999). Harm avoidance was measured using the harm avoidance subscale of the Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982, 28 items), which assesses propensity to engage in risky, adventuresome, and potentially dangerous behaviors (Watson & Clark, 1984).

Antisociality was assessed using the psychopathic deviate (Pd) scale of the Minnesota Multiphasic Personality Inventory-2 (MMPI-2: Hathaway & McKinley, 1989, 55 items). Both antisocial and psychopathic individuals report significantly higher scores on the MMPI-Pd scale than do controls (Dahlstrom, Welsh, & Dahlstrom, 1972), with high scores associated with poor judgment, rebelliousness, and antisocial behavior (Hathaway & McKinley, 1989). Diagnoses of antisocial personality disorder (ASPD) were ascertained using the Diagnostic Interview Schedule-Version IV (DIS-IV; Robins, Cottler, Bucholz, & Compton, 1995, 47 items).

Impulsivity was assessed using the impulsivity subscale of the Eysenck Impulsivity/Venturesomeness scale (Eysenck & Eysenck, 1978, 19 items) and the Control subscale of the MPQ (Tellegen, 1982, 23 items). High scores on the Eysenck I/V and low Control scores consistently are associated with antisocial behavior across a variety of studies and participant populations (e.g., Finn, Sharkansky, Brandt, & Turcotte, 2000; Sher & Trull, 1994). Excitement seeking was measured using the disinhibition and boredom susceptibility subscales of the Sensation Seeking Scale (Zuckerman, 1979), which are believed to reflect a common factor of pleasure or excitement seeking. This factor has been used in a number of recent studies examining excitement seeking behavior in antisocial individuals (Finn et al., 2000; Justus, Finn, & Steinmetz, 2000, 2001).

Psychopathy was assessed using the short form of the Psychopathic Personality Inventory (PPI: Lilienfeld & Andrews, 1996, 56 items). We considered using the PCL-R (Psychopathic Checklist-Revised; Hare, 1991), as it is the measure most commonly used in studies of

psychopathy. However, its administration requires access to detailed interview and case history information, and that participants have an available criminal record, therefore, the PCL-R may be inappropriate for non-forensic populations such as those in the present study. The PPI is considered more appropriate for use with the current sample because it was designed and tested using community samples, yet is moderately to highly correlated with scores on the PCL-R (Poythress, Edens, & Lilienfeld, 1998) and ratings of antisocial behavior and psychopathy (Lilienfeld & Andrews, 1996). As with the PCL-R, two factors have been delineated on the PPI, a "fearless dominance" factor characterized by social competence and lack of fear or stress, highly correlated with PCL-R Factor-1, and an "impulsive antisociality" factor characterized by impulsiveness, egocentricity, and externalization of blame, highly correlated with PCL-R Factor-2 (Benning et al., 2005).

2.3. Procedure

Participants provided informed written consent then completed the questionnaires outlined above. Following electrode placement (see "Physiological data acquisition and reduction"), participants were informed that they would be viewing a series of pictures and that they should view each picture for the entire time that it appeared on the computer screen. They were further advised that they would occasionally hear a burst of noise presented over headphones, which should be ignored.

Participants viewed a series of 36 color photographs (12 pleasant, 12 neutral, and 12 unpleasant) selected from the International Affective Picture System (IAPS) based on normative ratings of arousal and pleasantness. Slides were selected to be comparable in valence extremity and arousal across gender and slide valence (Lang, Bradley, & Cuthbert, 2001)[1]. Each slide was presented for 6 s on a 13-inch (33.02 cm) color computer monitor, positioned 0.5 m from the participant. Slides were presented in six blocks of six pictures each, with two slides from each valence category presented per block in a fixed, pseudorandom order. Intertrial intervals were 15 s.

The startle stimulus was a 50 ms burst of 95 dB white noise with immediate rise time, presented binaurally through Maico headphones. Startle probes occurred at 2.0 and 4.5 s post picture onset, or intermittently between slides to reduce predictability. Within each valence category there were four exemplars with a startle probe at 2.0 s, four with a probe at 4.5 s, two with a probe during the inter-trial interval, and two with no startle probe.

2.4. Physiological data acquisition and reduction

Eye blink electromyogram (EMG) activity was measured from the orbicularis oculi muscle with two miniature Ag–AgCl electrodes placed adjacent to one another below the participant's left eye. EMG activity was recorded and scored using a commercial startle system (EMG - Startle Reflex [EMG-SR], San Diego Instruments). EMG data were digitally sampled at a rate of 1000 Hz for 50 ms before and 250 ms after probe onset. Raw EMG signals were bandpass filtered at 30 and 500 Hz, amplified, then full-wave rectified and smoothed using a recursive noise filter. Startle response magnitudes were calculated as the difference between the average EMG during the 50 ms baseline before startle probe onset and the maximum EMG generated between 21 and 120 ms post probe onset. If no response was detected or response onset was not within 120 ms of probe onset, a magnitude of zero was recorded for that trial. Trials with excessive baseline EMG activity were rejected, and participant data sets were discarded if the number of rejected trials or zero responses exceeded 25% of trials. Data were rejected for 10%

[1]Pleasant pictures (IAPS): 1440, 1650, 1710, 4650, 4660, 4680, 4690, 4800, 4810, 5700, 7270, and 8501; neutral: 2200, 2840, 5500, 6150, 7000, 7010, 7040, 7050, 7080, 7100, 7150, and 7490; unpleasant: 1050, 1300, 3000, 3100, 3150, 3170, 3530, 6230, 6350, 8480, 9250, and 9300.

of neutral, 5% of pleasant, and 8% of unpleasant trials for low psychopathic participants, and 8%, 4%, and 7%, respectively for the high psychopathic group.

2.5. Statistical analyses

Due to large between-subjects variability in the distribution of startle response values, all EMG data were standardized within subjects by computing *z*-scores using all scorable responses, then averaged within valence category. The first set of analyses examined the correlation between psychopathy and individual personality factors. Analyses were conducted to replicate previous findings of a relationship between psychopathy and the personality constructs studied. Independent samples *t*-tests were used to investigate gender differences.

Group differences in affective modulation of the startle response were examined using repeated measures analyses in which group (e.g., psychopathic versus non-psychopathic; gender) was the between-subjects variable and startle responses to each slide valence category was the repeated measures factor. Based on previous findings of a significant effect of psychopathy when startle is elicited at 2.0, but not 4.5 s post-stimulus onset in incarcerated women (Sutton et al., 2002), separate analyses were conducted both when collapsing across startle probe timing and examining each time separately. Greenhouse–Geisser corrections were applied to main effects or interactions identified, and correction epsilon (ε) values are reported where appropriate. Planned contrasts were conducted for significant effects.

3. Results

3.1. Relationship between psychopathy and personality

Analyses illustrated a significant relationship between total psychopathy score and self-reported levels of fear, harm avoidance, excitement seeking, antisociality, and impulsivity. A differential pattern of correlations between personality and the separate factors of psychopathy also was present (Table 1).

3.2. Gender differences in personality

Compared to women, men reported significantly higher levels of psychopathy (total: $t(97) = 3.46$, $p < 0.01$; PPI-1: $t(97) = 3.25$, $p < 0.01$), excitement seeking ($t(97) = 2.33$, $p = 0.02$), and antisocial behavior (DSM-IV: $t(97) = 3.19$, $p < 0.01$), and significantly less harm avoidance ($t(96) = 2.86$, $p < 0.01$). However, when participants were grouped based on level of psychopathy, gender differences were evident primarily for those reporting low levels, with men reporting higher levels of psychopathy (total: $t(46) = 3.40$, $p < 0.001$; Factor-1: $t(46) = 2.76$, $p < 0.01$), excitement seeking ($t(46) = 2.08$, $p < 0.05$), and DSM-IV antisociality ($t(46) = 2.36$, $p = 0.02$), and lower levels of, harm avoidance ($t(46) = 2.45$, $p = 0.02$), than did women. The only significant difference present at elevated levels of psychopathy was for impulsivity, with women reporting significantly higher levels than men, ($t(48) = 2.21$, $p < 0.05$).

3.3. Relationship between psychopathy and startle

When data were collapsed across startle probe time, no significant main effects or interactions with psychopathy were evident.

3.3.1. Acoustic probes at 2 s—There was a significant psychopathy × gender × valence interaction, for total PPI ($F(2,142) = 3.51$, $p < 0.05$, $\varepsilon = 0.76$; Fig. 1), and Factor-1 scores ($F(2,142) = 4.50$, $p < 0.05$, $\varepsilon = 0.78$; Fig. 2). Follow up analyses indicated that a significant linear response pattern was present for both men ($F(1,48) = 12.34$, $p < 0.01$) and women ($F(1,48) = 48.21$, $p < 0.001$). However, psychopathy only influenced responsiveness in men (total score: $F(2,67) = 4.86$, $p < 0.05$, $\varepsilon = 0.73$; Factor-1: $F(2,69) = 4.88$, $p < 0.05$, $\varepsilon = 0.74$). Specifically,

men reporting high levels of psychopathy failed to show an augmentation of the startle response to aversive stimuli as compared to neutral stimuli (total score: $t(30) = 0.20$, $p = 0.85$; Factor-1: $t(27) = 0.76$, $p = 0.45$), while men reporting low levels of psychopathy showed the expected augmentation (total score: $t(16) = -2.78$, $p < 0.05$; Factor-1: $t(20) = -2.27$, $p < 0.05$). There were no significant effects of Factor-2 scores.

3.3.2. Acoustic probes at 4.5 s—Analyses demonstrated significant psychopathy × valence interactions for total psychopathy and Factor-1 scores (total: $F(2,164) = 4.60$, $p < 0.05$, $\varepsilon = 0.88$; Factor-1: $F(2,161) = 3.15$, =0.05, $\varepsilon = 0.88$; See Figs. 3 and 4), but no significant interaction with gender. Specifically, individuals reporting high levels of psychopathy showed an augmentation of the startle response to aversive as compared to neutral stimuli (total: $t(49) = 2.09$, $p < 0.05$; Factor-1: $t(48) = 1.90$, $p = 0.06$), while those reporting low levels of psychopathy failed to show a significant augmentation. There were no significant effects of Factor-2 scores.

3.4. Relationship between personality and startle

When data were collapsed across startle probe interval, no significant main effects or interactions of personality were evident. Analyses at 2 s probe times indicated a significant interaction between slide valence and both harm avoidance [$F(2,145) = 3.44$, $p < 0.05$, $\varepsilon = 0.77$; Fig. 5] and anxiety [$F(2,147) = 5.46$, $p < 0.01$, $\varepsilon = 0.78$; Fig. 6]. Participants reporting elevated levels of either trait showed a significant augmentation of the startle response to aversive as compared to the neutral stimuli (harm avoidance: $t(49) = 4.12$, $p < 0.001$; anxiety: $t(48) = 4.18$, $p < 0.001$), while those reporting low levels of either trait failed to show a significant augmentation. No significant main effects or interactions were evident for the other personality factors assessed, nor for any at the 4.5 s probe time.

4. Discussion

Our findings suggest that gender, self-reported level of psychopathy, harm avoidance, anxiety, and startle probe timing all interact to influence affective modulation of the startle response in non-incarcerated individuals. Consistent with previous studies (Patrick et al., 1993; Vanman et al., 2003), men reporting high levels of psychopathy failed to show the typical augmentation of the startle response when viewing aversive stimuli. This deficit was specific to levels of emotional detachment, offering further evidence that psychopathic men have difficulty processing aversive information, and that this effect extends to non-incarcerated men.

Inconsistent with both study hypotheses and previous work, this deficit did not persist into the later probe time. This inconsistency suggests that while men with elevated levels of psychopathic characteristics generally have difficulty processing aversive information, there are additional factors, such as type or severity of psychopathic symptoms or a myriad of other individual differences that further separate responses in community versus incarcerated samples. These factors might help explain why incarcerated men with elevated levels of psychopathy show a complete deficit in their ability to process aversive information, while (presumably healthier) community samples appear to show slowed, but not completely deficient processing. This could also account for inconsistencies with Sutton et al. (2002) finding that psychopathic women showed a deficit in processing at 2.0, but not 4.5 s probe intervals, while women in the current study showed normal responding across probe times and level of psychopathy. Unfortunately it is impossible to directly compare type or severity of psychopathy between the present sample and previous, incarcerated samples, as the change in sample in this study necessitated a change in the method of assessing psychopathy. Therefore, it is difficult to substantiate this explanation without further study.

Taken together, these data suggest that gender differences exist in the point where psychopathic characteristics interfere with affective processing. In the present study, women reporting elevated levels of psychopathy did not significantly differ from their male peers in number of psychopathic or related characteristics reported, yet they failed to show the same deficits in modulation of the startle response. Past research has indicated that while the construct of psychopathy is applicable to female samples, the factor structure differs substantially between males and female inmates (Salekin, Rogers, & Sewell, 1997), thus potentially suggesting that women must experience greater severity or a different cluster of symptoms than do men, to produce a noticeable difficulty with affective processing. This could explain the discrepancies within the present study, as well as those between previous studies of male (Herpertz et al., 2001; Patrick et al., 1993) and female inmates (Sutton et al., 2002). Discussion of potential mechanisms for gender differences, such as differences in socialization or biological make-up, are beyond the scope of this study, but warrant further investigation.

A second discrepancy is non-psychopaths' lack of startle potentiation to the 4.5 s probe. Existing literature consistently reports a linear trend in affective startle response when blinks are elicited between 800 and 5500 ms. However, most studies average data across probe time, thus, it is possible that the same effect is present across studies, but cancelled in the averaging process. In support of this idea, the present study found a significant linear trend when the startle data were averaged across lead time for the low psychopathy group when considered alone, $F(2,84) = 19.58$, $p < 0.001$, $\varepsilon = 0.92$, and for all participants, $F(2,189) = 53.06$, $p < 0.001$, $\varepsilon = (0.96)$. It was only when the data were separated by probe time that the inconsistency became apparent.

Results also indicated a relationship between individual personality characteristics and emotional modulation of the startle response. These findings extend recent research (Vanman et al., 2003) beyond a simple relationship between emotion modulated startle and psychopathy, and provides additional support for the contention (e.g., Patrick et al., 1993) that deficits in emotional modulation of startle are specific to characteristics associated with emotional detachment (Factor-1). Specifically, deficits were related to low levels of anxiety and harm avoidance (associated with Factor-1), but not social deviance, impulsivity, or excitement seeking (associated with Factor-2). Additionally, this effect was present for both men and women, suggesting that the influence of personality on emotional processing is similar across gender.

In closing, some limitations should be acknowledged. While researchers suggest that psychopathy may be adequately assessed via self-report, and have reported moderate correlations with the PCL-R (Lilienfeld & Andrews, 1996; Poythress et al., 1998), the PPI may assess a different component of psychopathy that is differentially related to affective modulation of the startle response. Future work should include both clinician-rated (e.g., PCL-R) and self-report measures of psychopathy to better characterize any differences in regard to physiological responsiveness. It also will be useful to include a broader range of personality characteristics and physiological measures, such as skin conductance and measures of functional brain activity. The latter will be especially useful in further characterizing gender differences in emotional responding, in both psychopathic and non-psychopathic individuals, as recent studies have reported gender differences in brain activation to emotional stimuli in the absence of differences in the startle response (Lang et al., 1998; Wrase et al., 2003).

In summary, gender, startle probe timing, psychopathy, and personality characteristics associated with emotional detachment, differentiated responsiveness to aversive stimuli in a community sample. Specifically, only males reporting high levels of psychopathy showed a significant deficit in affective modulation of the startle response, and then only when startle occurred early in processing. Conversely, both males and females reporting decreased levels

of anxiety or harm avoidance showed a significant deficit at the earlier probe time. Results suggest that emotional processing difficulties observed in psychopathic individuals may be less extensive than previously believed, instead being mediated by the interplay of a number of factors, including levels of trait anxiety and harm avoidance. Future research should focus on further elucidating the factors that mediate the relationship between psychopathy and emotional modulation of the startle response, including gender, and type and severity of psychopathic characteristics, and examining how deficits in emotional processing may translate into deviant behavior.

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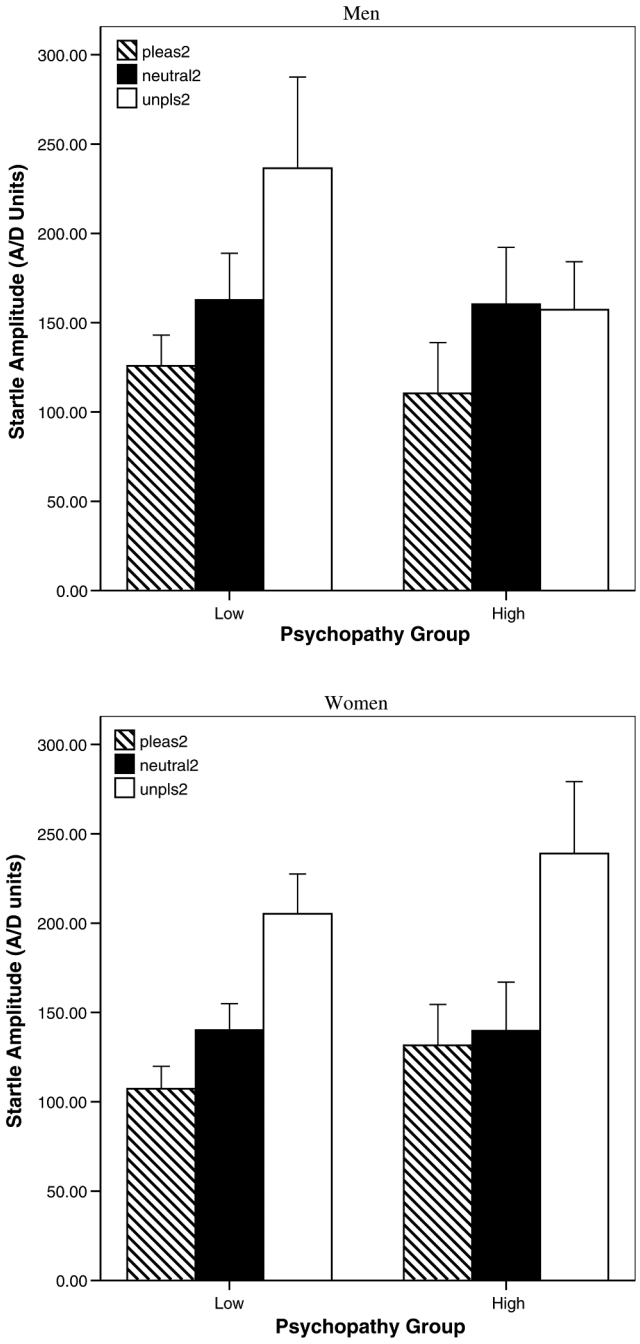

Fig. 1.
Affective startle modulation as a function of gender and total psychopathy score; startle elicited 2.0 s post stimulus onset.

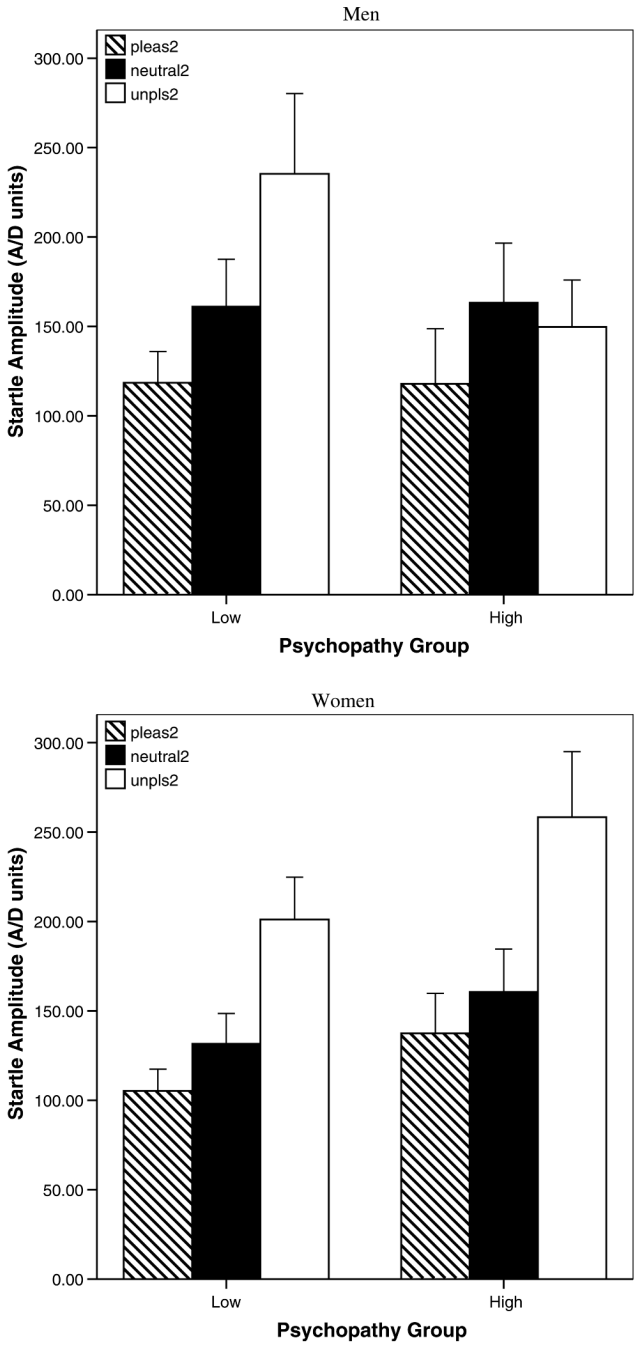

Fig. 2.
Affective startle modulation as a function of gender and Factor-1 psychopathy score; startle elicited 2.0 s post stimulus onset.

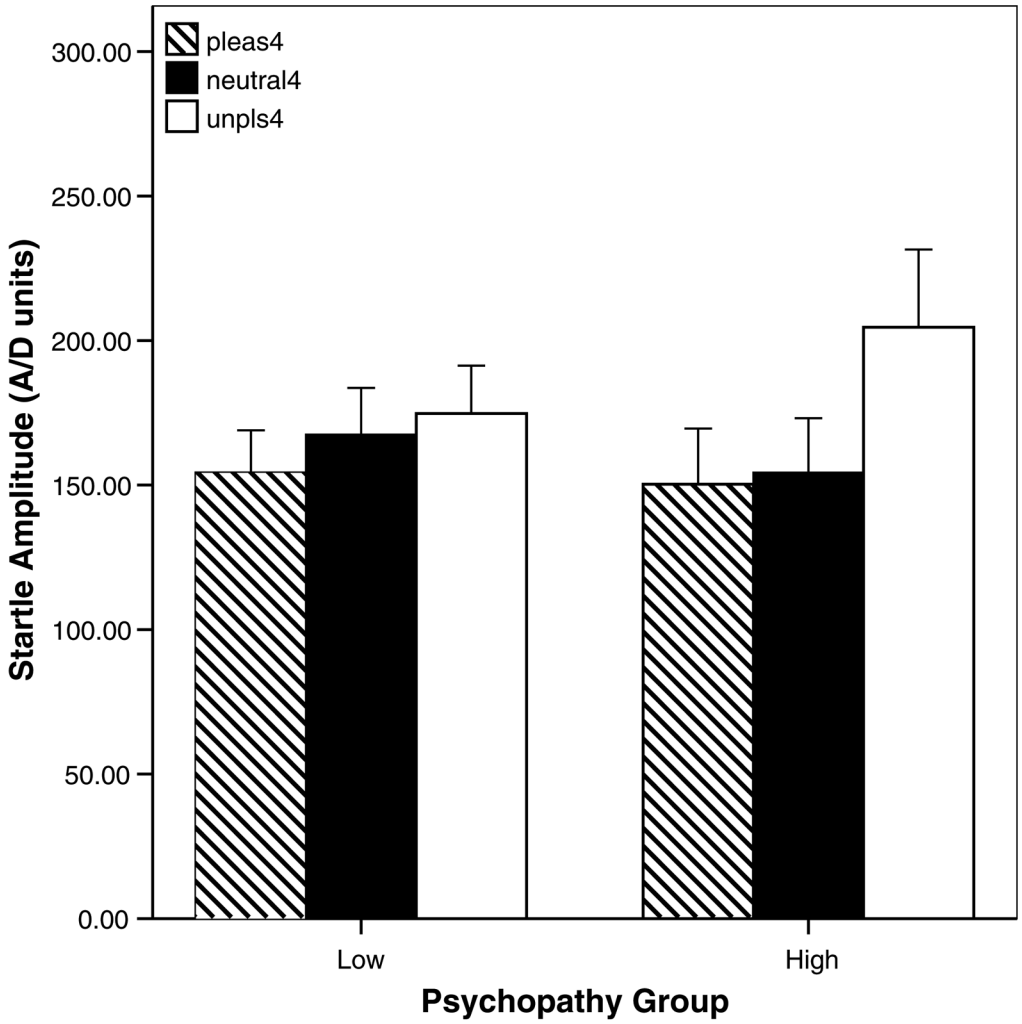

Fig. 3.
Affective startle modulation as a function of total psychopathy score; startle elicited 4.5 s post stimulus onset.

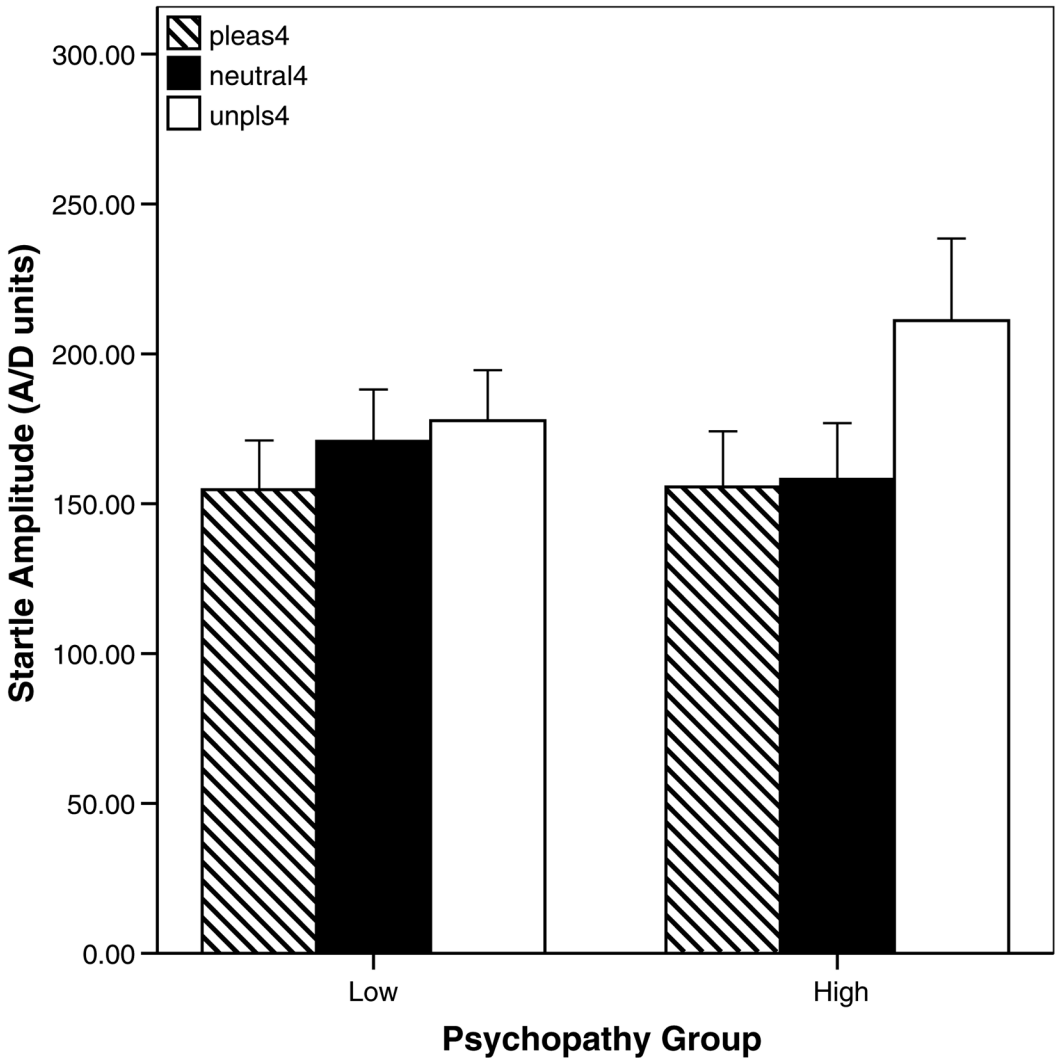

Fig. 4.
Affective startle modulation as a function of Factor-1 psychopathy score; startle elicited 4.5 s post stimulus onset.

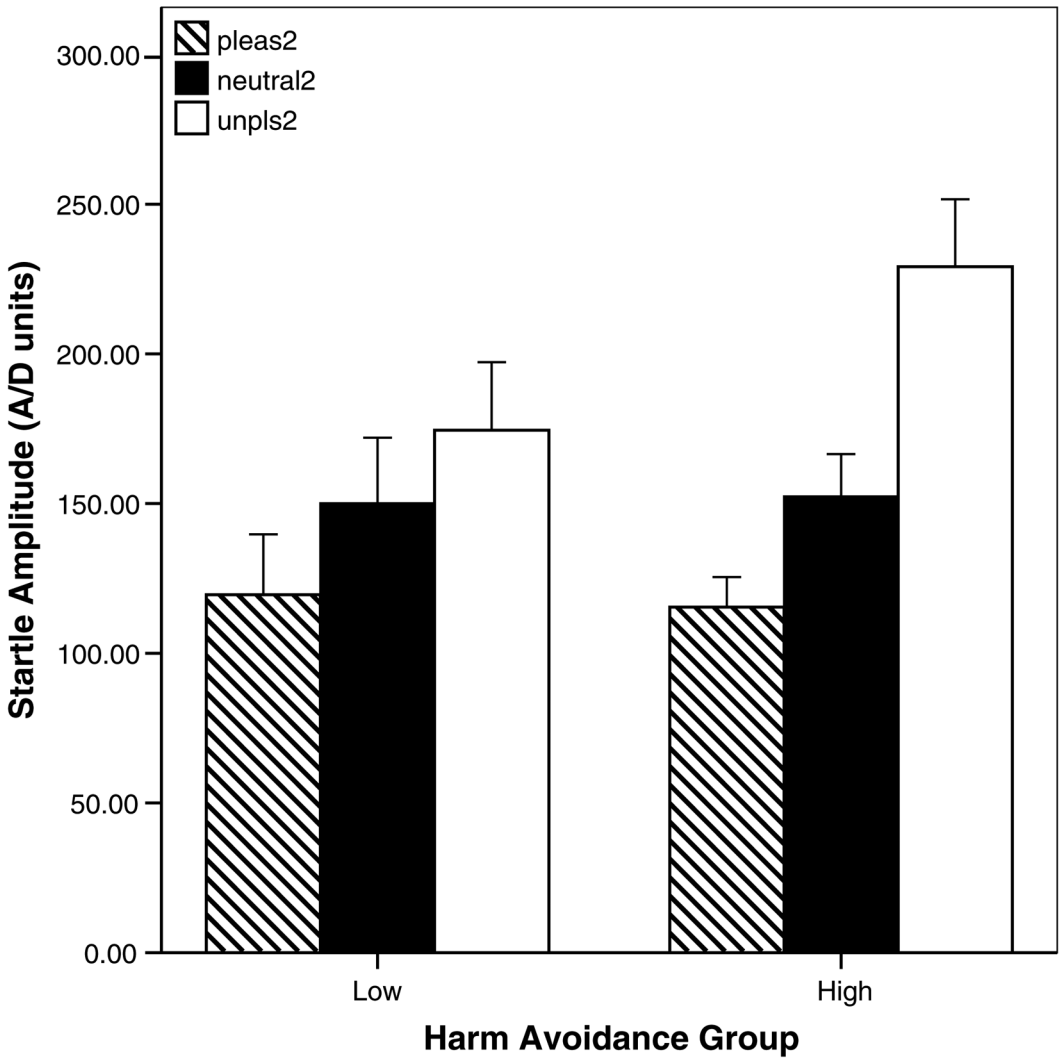

Fig. 5.
Affective startle modulation as a function of self-reported harm avoidance; startle elicited 2.0 s post stimulus onset.

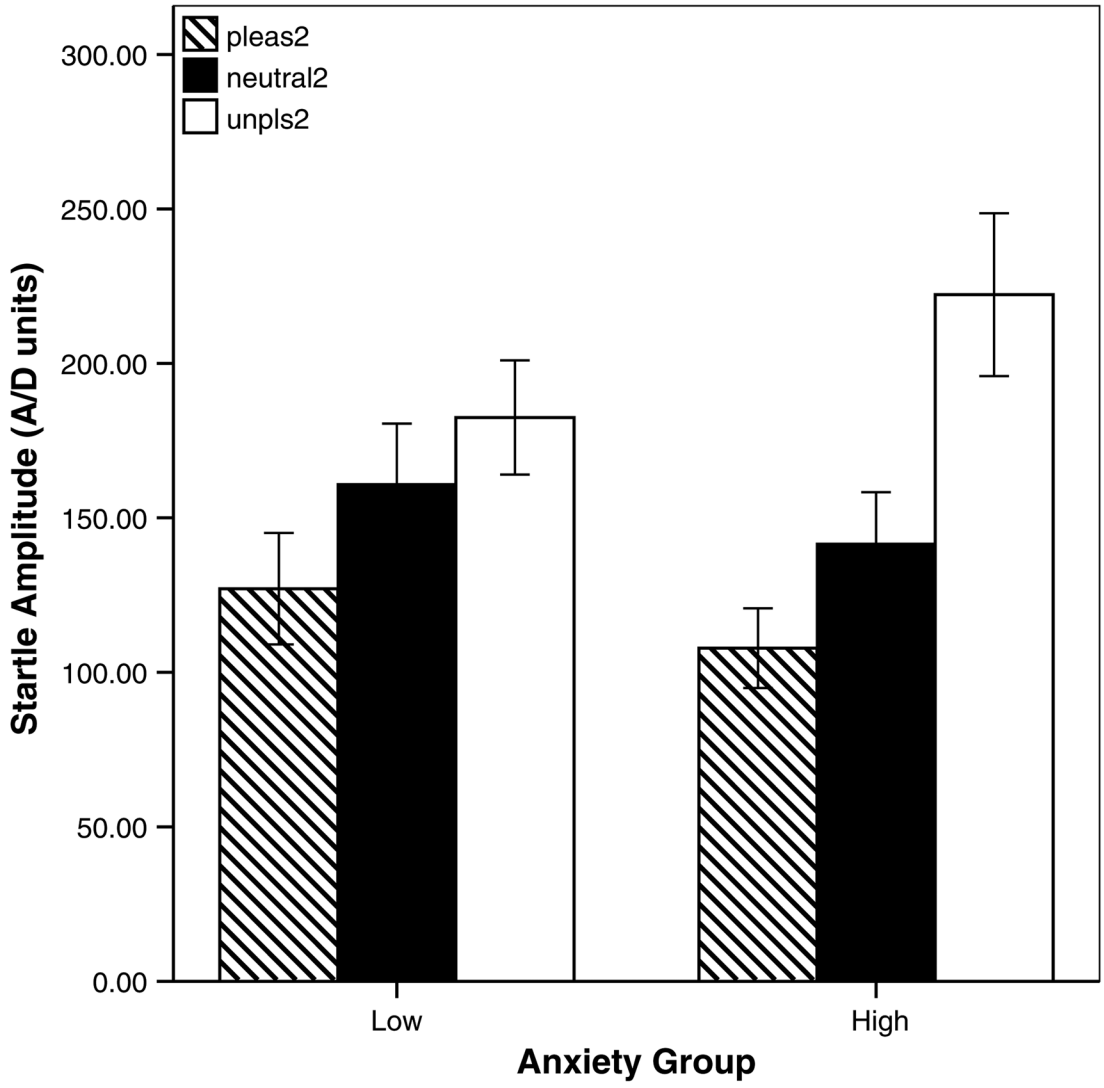

Fig. 6.
Affective startle modulation as a function of self-reported anxiety; startle elicited 2.0 s post stimulus onset.

Table 1

Relationship between self-reported psychopathy and personality

	PPI-total	PPI1	PPI2
Fearfulness	−0.49**	−0.70**	0.15
Anxiety	−0.03	−0.41**	0.59**
Harm avoidance	−0.75**	−0.74**	−0.29*
Excitement seeking			
Disinhibition	0.46**	0.37**	0.32**
Boredom susceptibility	0.70**	0.61**	0.38**
Antisociality			
DSM-IV	0.61**	0.33**	0.65**
MMPI-Pd	0.35**	0.01	0.66**
Impulsivity			
MPQ-control[a]	−0.63**	−0.44**	−0.52**
Eysenck	0.58**	0.30**	0.65**

[a]The control subscale is reverse scored as a measure of impulsivity.

*$p < 0.05$.

**$p < 0.001$.