Personality and Individual Differences 50 (2011) 712–716

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Psychopathic traits predict startle habituation but not modulation in an emotional faces task

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ARTICLE INFO

Article history:
Received 16 August 2010
Received in revised form 14 December 2010
Accepted 15 December 2010
Available online 13 January 2011

Keywords:
Psychopathy
Antisocial traits
Affective deficits
Startle
Habituation
Fearless dominance
Self centered impulsivity

ABSTRACT

The psychophysiological correlates of psychopathic traits in normal-range samples have been a topic of recent interest in studies of the biological basis of personality. It is well established that psychopaths demonstrate abnormal patterns of startle potentiation while viewing emotionally evocative pictures, but this effect has not been demonstrated using pictures of facial affect. Recent research has also indicated that an individual's rate of habituation to an acoustic startle probe may be a reliable correlate of certain personality traits; however, this has not been investigated with psychopathic personality traits. We measured psychopathic personality traits in non-incarcerated young adults and investigated startle physiology while participants viewed pictures of facial affect. We found that psychopathic personality traits had no effect on startle modulation by emotional face category; however, the antisocial dimension of psychopathic traits was strongly associated with slower rates of habituation to the startle probe. This finding highlights the relevance of psychopathy's underlying constructs of emotional functionality and behavioral inhibition, and suggests a relationship between basic sensory habituation and the broader concept of inhibition as it relates to personality and behavior.

1. Introduction

A great deal of effort has been devoted to accounting for the pathological extremes of personality traits using the dimensional perspectives of existing models of personality (e.g. Lynam & Widiger, 2001). Psychopathy is a disorder which has often been assessed with these dimensional perspectives in mind (Fowles, 1980; Hare, 1982; Miller, Lynam, Widiger, & Leukefeld, 2001), particularly because of the heterogeneous assortment of personality traits that help define this construct.

Our modern concept of the psychopathic personality is largely derived from Cleckley (1941), who described 16 traits fundamental to the disorder including egocentrism, remorselessness, antisocial behavior, low anxiety, and a general poverty of emotion. These traits fall into at least two distinct categories represented by discrete developmental pathways (Fowles & Dindo, 2009; Skeem, Poythress, Edens, Lilienfeld, & Cale, 2003). One category accounts for a deficit in emotional processing and a manipulative interpersonal style; the other encompasses tendencies toward social deviance and behavioral disinhibition (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003; Harpur, Hakstian, & Hare, 1988). Mounting evidence suggests that each of these symptom clusters is modulated by dysfunction in distinct but related neurophysiological systems including the amygdala and prefrontal cortex (Blair, 2001).

Investigations into the biological basis of personality have advanced a body of literature related to psychophysiological correlates of psychopathic traits, the most commonly reported feature being a deficit in emotion-modulated potentiation of the startle reflex. Most healthy individuals exhibit a potentiated blink reflex to an acoustic startle probe while viewing pictures with strong negative emotional content (Cuthbert, Bradley, & Lang, 1996). In contrast, psychopaths exhibit deficits in blink modulation, an effect that has been demonstrated most often using incarcerated males (e.g. Patrick, Bradley, & Lang, 1993), but has also been replicated in non-incarcerated males (Benning, Patrick, & Iacono, 2005), incarcerated females (Sutton, Vitale, & Newman, 2002), and undergraduates (Vaidyanathan, Patrick, & Bernat, 2009). Furthermore, these reports consistently demonstrate that this deficit is uniquely related to the disorder's core affective deficits. Antisociality, on the

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doi:10.1016/j.paid.2010.12.023

other hand, has been linked to its own set of psychophysiological correlates such as reduced amplitude of the P3 event-related potential (Gao & Raine, 2009), and elevated levels of anxiety (Hare, 1968; Lykken, 1957).

Many biologically based models of personality have attempted to account for the affective deficits and antisocial tendencies of psychopaths, describing relationships with other personality constructs. It has been suggested that psychopaths and extraverts may be characterized by a common factor related to behavioral inhibition (Fowles, 1980; Gorenstein & Newman, 1980; Newman, Widom, & Nathan, 1985). Eysenck (1967) also maintained that there exists a fundamental relationship between psychopathy and extraversion. According to Gray's (1981) systems of motivation, psychopaths have deficits in their behavioral inhibition system and a behavioral activation system hyper-responsive to reward. Some more contemporary models of personality rely almost exclusively on the interaction between emotion and behavioral inhibition in determining these individual differences (Davidson, 2001, 2002).

One physiological feature that has received longstanding attention in personality research is the rate of habituation for various physiological responses. As a fundamental property of our nervous system, habituation may be an important marker for variation in more complex systems related to personality and inhibition. For example, Eysenck's (1967) theory of personality posited that extraversion was related to low cortical arousal, and from this he hypothesized that extraverts would demonstrate faster rates of habituation. Existing reports, however, have made conclusions regarding this relationship tentative. For instance, in an extensive early review (O'Gorman, 1977) only five of 17 studies reported a significant relationship between extraversion and rates of habituation, without consistency in the direction of the relationship. Furthermore, substantial variation in methodology and interpretive issues were prominent points of contention (Mangan & O'Gorman, 1969). Despite some theoretical ties between personality constructs such as extraversion and psychopathy, habituation rates in psychopaths have gone largely unstudied.

Most early studies examined habituation of electrodermal responses, but more recent reports have focused on habituation of the startle eyeblink reflex. LaRowe, Patrick, Curtin, and Kline (2006) reported findings from two samples, demonstrating faster habituation of the acoustic eyeblink reflex in those with higher extraversion scores. Blumenthal (2001), however, reported slower rates of startle eyeblink habituation in extraverts. So far, the limited number of published reports on this topic restricts any conclusive power on the matter, and there are still no available reports examining relationships between psychopathy and startle eyeblink habituation despite the abundance of investigations into startle physiology and psychopathic traits.

The current study was designed to investigate relationships between psychopathic personality traits and differences in startle eyeblink physiology while subjects viewed pictures of facial affect. Investigations of this effect have almost invariably utilized pictures from *The International Affective Picture System* (Lang, Bradley, & Cuthbert, 2005). Despite prominent use of pictures of facial affect in other emotion-related research, we are not aware of any existing reports using these stimuli which demonstrate aberrant patterns of startle modulation in those with psychopathic traits. After initial analyses revealed no relationships between psychopathic traits and eyeblink magnitude between categories of facial affect, it was determined that an appropriate alternative analysis may reveal differences in rates of habituation to the startle probe as predicted by psychopathic personality traits. This is the first report of a relationship between psychopathic traits and habituation rates. It is our hope that this report will facilitate future investigations devoted specifically to elucidating this relationship.

2. Method

2.1. Participants

A total of 97 (19 male) undergraduate students volunteered and were compensated with partial course credit. Ages ranged from 18 to 22 years with an average of 19.6 years. Volunteers were excluded from recruitment if self-reporting auditory deficits, uncorrected visual deficits, head injury, or major neurological disorder. Prior to the laboratory session, participants were instructed to refrain from caffeine and nicotine for at least 2 h.

2.2. Psychophysiological assessment

Participants completed a picture-viewing eye-blink startle paradigm. Skin was prepared by swabbing with isopropyl alcohol solution and an abrasive surface cleanser (*NuPrep*) to improve surface conduction. Two Ag–AgCl electrodes were affixed 1 cm below the lower lid of the right eye, one directly below the pupil and a second 1 cm to the right of that electrode. A third electrode was placed in the center of the forehead as a ground. Saline gel (*Signa gel*) was used as a conducting medium, and impedances were kept below 5 kΩ. The presentation took place in a noise and radio-frequency attenuated anechoic chamber where participants were seated in a padded chair directly in front of a computer monitor, and fitted with a pair of noise-cancelling headphones through which the startle probes were delivered.

The startle paradigm consisted of 40 images from the Montreal Set of Facial Displays of Emotion (Beaupré & Hess, 2005) presented in a single block in a fixed, pseudo-random order; that is, all participants witnessed an identical order of presentation. An equal number of pictures in the presentation consisted of faces displaying neutral, happy, fearful, angry, or sad expressions. Pictures remained on the screen for 6 s, followed by a two-second interstimulus interval, during which a white plus sign was displayed in the center of the monitor as a point of focus. Startle probes consisted of 50 ms, 100 dB white noise bursts with immediate rise, delivered between 3.5 and 5 s after the picture onset. The probes were paired with half of the pictures in a manner such that each facial expression category was paired with an equal number of startle probes. Additionally, to reduce predictability, three of the interstimulus intervals contained a startle probe, however, the interstimulus probes were ignored in the analysis.

Magnitude of the startle response was measured by electromyogram recordings from the orbicularis oculi muscle of the subject's right eye. Raw EMG signals were collected using BioPac MP150 data acquisition hardware amplified to 5000 Hz. EMG data was filtered with a bandpass at 10–500 Hz, rectified and integrated with a time constant of 10 ms. Blink magnitudes were defined as a smoothed EMG signal, recorded as baseline to peak differences for each startle probe. The baseline was defined as the mean orbicularis oculi EMG reading during the 25 ms prior to onset of the noise; the peak was defined as the maximum EMG amplitude between 40 and 120 ms after the onset of the noise.

2.3. Self-report measures

Psychopathic traits were assessed using the Psychopathic Personality Inventory-Revised (PPI-R; Lilienfeld & Widows, 2005). The PPI-R is designed to identify psychopathic traits by self-report in a non-forensic setting, but has been validated in both institutionalized and community samples (Patrick, Edens, Poythress, Lilienfeld, & Benning, 2006). Responses are required on 154 items using a four point Likert scale. A total score for global psychopathy and two main factor scores are computed. The factor labeled *Fear-*