Reduced negative affect response in female psychopaths

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ABSTRACT

Studies that investigate the differences between high and low psychopathic persons in brain activity during emotional facial expression processing are rare and commonly focus on males. The current study assessed whether previously reported behavioral differences would be reflected in differential brain activity in a sample of female offenders.

The participants included 23 female forensic inpatients with high and low scores on the Psychopathy Checklist Revised (PCL-R). ERPs were recorded during presentation of emotional facial expressions (i.e., fear, angry, and happy). Results revealed no differences in N170, P3 and late positive potential components between groups, but a significant difference in N2 only for angry and fear facial expressions, with high psychopathic participants showing lower reactivity. This N2 effect was found to be related to Factor 2 but not Factor 1 of the PCL-R. In time frequency analysis, theta activity underlying N2 best reflected these differences.

Findings in this female sample are consistent with a cortical deficit in processing facial expression of negative emotions in psychopathic men. In addition, differences in processing seem to appear relatively early.

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1. Introduction

There is a substantial research tradition focusing on the processing of emotional facial expressions in healthy groups, as they are highly relevant social and emotional cues in personal interactions (Frischen, Eastwood, & Smilek, 2008). Previous research has shown that facial expressions can be detected more quickly and elicit different behavioral and psychophysiological responses depending on the emotional content (e.g., Alpers & Gerdes, 2007; Calvo, Avero, & Lundqvist, 2006; Zebrowitz, 2006). Some key underlying mechanisms of attention modulation and perception of faces have been investigated previously. First, the early event-related potential (ERP) N170 component has been found to be sensitive to a number of early face processing parameters, as well as to personally significant objects (Rossion, Curran, & Gauthier, 2002). In addition, an increased later positivity (P2) in response to emotional facial expressions has been found (Ashley, Vuilleumier, & Swick, 2004; Eimer & Holmes, 2007). For example, in a typical face processing task (i.e., face in the crowd task), where a single different emotional facial expression has to be detected in a field of emotional facial expressions, happy faces have been shown to be more readily detected as compared to other emotional facial expressions (Becker, Anderson, Mortensen, Neufeld, & Neel, 2011). This effect has been interpreted as a fast detection of the less ambiguous emotional facial expression. In other studies, however, a rapid detection of angry facial expressions has been related to a time shift in ERPs, namely an earlier N2 for angry compared to happy targets (Feldmann-Wüstefeld, Schmidt-Daffy, & Schubö, 2011). Furthermore, processing of angry facial expressions has been related to an enhanced early posterior negativity and an enhanced late positive potential (LPP) compared to other emotional expressions (Schupp et al., 2004). Thus, previous research supports the inference that emotional face processing can be readily detected in both early and later neurophysiological processes, and that angry faces are associated with a facilitated processing.

There are several disorders that are partially characterized by symptoms of deficient emotional facial expression decoding, such as schizophrenia or autism (Dalton et al., 2005; Fullam & Dolan, 2006). The psychopathic personality has also been linked to a deficient processing of emotional facial expressions (Blair et al., 2004). The capacity for categorization of facial expressions according to

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their emotional content has been shown to be attenuated in psychopathy for different negative emotional facial expressions such as disgust (Kosson, Suchy, Mayer, & Libby, 2002), sadness (Eisenbarth, Alpers, Segrè, Calogero, & Angrilli, 2008; Hastings, Tangney, & Stuewig, 2008), and fear (Iria & Barbosa, 2009). Similar impairments can also be found in children or juveniles with personality traits related to psychopathy (e.g., so called callous-unemotional traits; Dadds, El Masry, Wimalaweera, & Guastella, 2008; Sylvers, Brennan, & Lilienfeld, 2011). In addition, it has been shown that this impairment can be temporarily reversed by a short training on directing attention to the eyes of the facial expressions (Dadds et al., 2008). At the same time, some studies have found no differences between high and low psychopathic individuals, although different subject selection approaches and methodological aspects, such as presentation durations or number of emotion categories, represent important potential confounds. In an attempt to deal with the multitude of methods used, a recent meta-analysis on emotional categorization capacity in psychopaths showed that there is an impairment for recognition of negative emotions (Wilson, Juodis, & Porter, 2011), with the highest effect sizes found for verbal response tasks.

There are few studies investigating cerebral processes underlying these impairments. Psychophysiological research using different kinds of emotional pictures found a reduced reactivity mainly to negative stimuli using the startle reflex (Justus & Finn, 2007; Patrick, Bradley, & Lang, 1993; Vaidyanathan, Hall, Patrick, & Bernat, 2011) or functional magnetic resonance tomography (for a review, see: Blair, 2006; Yang & Raine, 2009). These effects have been related to Factor 1 (affective and interpersonal aspects; Vaidyanathan et al., 2011) of the Psychopathy Checklist Revised (Hare, 2003), but also to Factor 2 (antisocial and lifestyle aspects; Yang & Raine, 2009). These findings would suggest similar reduced emotion related activity in response to negative facial stimuli, consistent with findings concerning the categorization of negative facial expressions. There are only a few studies targeting this hypothesis. One study, which utilized a visual oddball task with emotional facial expressions, found an earlier P3a component, a later P3b component, and a decreased N300 in highly psychopathic students (Campanella, Vanhoolandt, & Philippot, 2005). Another study investigating startle reactions to facial expressions in high and low psychopathic students found a reduced habituation to startle probes in students high on psychopathic traits (Anderson, Wan, Young, & Stanford, 2011) instead of the expected reduced startle modulation. Functional differences do not have to be linked to reduced categorization capacities; however, although high psychopathic participants showed no behavioral differences compared to low psychopathic ones in response to emotional facial expressions, reduced activity in subregions of the frontal cortex and the amygdala were found (Gordon, Baird, & End, 2004). In a flanker task using facial expressions of fear and anger, highly psychopathic students showed a reduced error related negativity (ERN; Munro et al., 2007). During simple watching of facial expressions of fear, psychopathic forensic inpatients show reduced activation of the fusiform face area compared to a control group. These group differences were not present for happy facial expressions (Deeley et al., 2006). A recent study investigated the interaction of inhibitory control and emotional content (affective words) on P3 amplitudes in male psychopaths as compared to criminals with antisocial personality disorder and to criminal control group. They found a reduced reactivity in the psychopathic group to negative words, independent of inhibitory control condition (Verona, Sprague, & Sadeh, 2012). Only few of the reported findings on emotion processing refer to female samples of psychopaths, which might be due to the smaller prevalence of high psychopathic traits in females compared to males (Verona & Vitale, 2006). Gender differences in the appearance of psychopathic traits have been stated mainly for the antisocial component, i.e., antisocial behavior (see Dolan & Voellm, 2009). Current research on emotion detection in female psychopaths points to deficits similar to those known from male samples, such as in emotion categorization (Eisenbarth et al., 2008), in startle potentiation during negative emotional content presentation (Vaidyanathan, Patrick, & Bernat, 2009) and in non-moral emotion regulation (Harenski, Kim, & Hamann, 2009). However, it is unclear whether gender differences in emotion processing influence the emotional deficit, as there are only a few studies investigating this relationship.

Time–frequency (TF) approaches to ERP analysis have been widely applied in the field, and can provide more selective and sensitive measures by incorporating frequency information simultaneously with more conventional time domain information. TF approaches have been used to assess processes occurring across a broad range of frequencies. The present work is focused on lower frequency delta (e.g., 0–3 Hz) and theta (e.g., 3–7 Hz) activity, which have been widely assessed during conventional time domain components such as P2, N2, and P3. An important research thread in this area has focused on functional inferences about cognitive control related to theta activity, including the error-related negativity (ERN; Cohen, Elger, & Ranganath, 2007; Gehring & Willoughby, 2004; Trujillo & Allen, 2007; Yordanova, Falkenstein, Hohnsbein, & Kolev, 2004), feedback-negativity (FN; Cohen, 2011; Gehring & Willoughby, 2004), and the no-go N2 (Kamarajan et al., 2006). Recent work supports the view that medial-frontal theta observed across such tasks may represent highly related brain activations (Cavanaugh et al., 2011). Additional work has documented a central role for theta in conventional orienting-novelty and oddball tasks (Barry, Heys, & Hasselmo, 2012; Başar, Başar-Eroglu, Karakaş, & Schürmann, 2001; Başar, Başar-Eroğlu, Karakaş, & Schürmann, 1999; Demiralp, Ademoglu, Istefanopulos, Başar-Eroglu, & Başar, 2001; Folstein & Van Petten, 2008). Recent work from our group has focused on separating contributions from activity occurring in the theta and delta frequency ranges during time-domain ERP component measures, including the feedback-negativity (FN) and P3 (Bernat, Nelson, Steele, Gehring, & Patrick, 2011), error-related negativity (ERN; Bernat, Williams, & Gehring, 2005), go/no-go N2 (Harper, Malone, & Bernat, in press), and P3 and slow-wave during affective picture processing (Olson, Bernat, Cole, & Anokhin, 2012). These findings support the view that theta and delta measures generally index separable neurophysiological process that co-occur during conventional component windows, motivating assessment of activity in these bands for the current report.

The present study investigates psychophysiological correlates of face processing in female criminal psychopaths using both time domain and time–frequency domain analytic approaches, in order to assess these processes and their relationship with psychopathic traits in a female offender sample. In line with past behavioral studies on psychopathic traits in both males and females (Blair et al., 2004; Eisenbarth et al., 2008), we hypothesized that there would be a reduction in reactivity to negative facial expressions as compared to positive facial expressions in female criminal psychopaths in the early stages of face processing.

2. Methods

2.1. Sample

Participants in this study were all female inpatients in a psychiatric facility of the Italian prison system. They were recruited as high and low psychopathic patients, excluding those with schizophrenic disorders or with low intelligence (score below 70). This recruitment included 28 participants with a mean age of 37.50 years ($SD = 6.80$, range = 24–52). After artifact tagging, data for only 23 participants were clean and suitable for analysis. This subsample had a mean age of 36.96 years ($SD = 6.81$, range = 24–52), and a mean education was 9.68 years ($SD = 2.93$, range = 5–15). The mean level of current substance abuse (average of present abuse of drugs, tobacco, or alcohol) was .55 ($SD = .38$). The diagnoses from clinical files