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Psychopathic traits affect the visual exploration of facial expressions

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ABSTRACT

Deficits in emotional reactivity and recognition have been reported in psychopathy. Impaired attention to the eyes along with amygdala malfunctions may underlie these problems. Here, we investigated how different facets of psychopathy modulate the visual exploration of facial expressions by assessing personality traits in a sample of healthy young adults using an eye-tracking based face perception task. Fearless Dominance (the interpersonal-emotional facet of psychopathy) and Coldheartedness scores predicted reduced face exploration consistent with findings on lowered emotional reactivity in psychopathy. Moreover, participants high on the social deviance facet of psychopathy ('Self-Centered Impulsivity') showed a reduced bias to shift attention towards the eyes. Our data suggest that facets of psychopathy modulate face processing in healthy individuals and reveal possible attentional mechanisms which might be responsible for the severe impairments of social perception and behavior observed in psychopathy.

1. Introduction

Psychopathy is a personality disorder characterized by callous-unemotional traits and antisocial behavioral tendencies. Although primarily investigated in criminal offenders, psychopathy represents a continuous rather than a discrete attribute. Accordingly, a growing number of studies has started to examine facets of psychopathy on the basis of normal-range personality traits in community samples. In the current study, psychopathic traits were assessed in healthy participants with the Psychopathic Personality Inventory-Revised (PPI-R, Lilienfeld & Widows, 2005), a well-validated trait measure of psychopathy. The total psychopathy score in the PPI-R is composed of two latent factors: Fearless Dominance represents the interpersonal-emotional facet of psychopathy and is characterized by low anticipatory anxiety, high stress immunity and social dominance, whereas Self-Centered Impulsivity is linked to antisocial deviance aspects such as aggressive personality features, alienation and impulsive behavior (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003; Ross, Benning, Patrick, Thompson, & Thurston, 2009). The subscale Coldheartedness does not load on any factor, but reflects the callous-unemotional features of psychopathy, such as low empathy and indifference towards others' feelings. Each of these three high-level factors relates differentially to neural and behavioral differences seen in psychopathy. For instance, Fearless Dominance was associated with deficient fear-potentiated startle reactions (Benning, Patrick, & Iacono, 2005) and reduced amplitudes in the feedback-related negativity (Schulreich, Pfabigan, Derntl, & Sailer, 2013). Self-Centered Impulsivity scores in contrast, were unrelated to feedback processing, but frontal amplitude reductions of the P300 have been reported (Carlson, Thái, & McLarnon, 2009). Moreover, a recent study reported an association of Fearless Dominance with a reduced N170 component during face processing, whereas Coldheartedness scores predicted enhanced N170 amplitudes in this study (Almeida, Ferreira-Santos, Vieira, Barbosa, & Marques-Teixeira, 2014).

Impaired emotion recognition has been reported as a core deficit in psychopathy in two meta-analyses (Dawel, O'Kearney, McKone, & Palermo, 2012; Marsh & Blair, 2008), although several individual studies have failed to find evidence for such difficulties in incarcerated and community samples (Glass & Newman, 2006; Gordon, Baird, & End, 2004; Han, Alders, Greening, Neufeld, & Mitchell, 2012). Moreover, participants with high psychopathic traits showed reduced somatic responding to emotional and in particular threatening cues (Benning, Patrick, Salekin, & Leistico, 2005; Rothemund et al., 2012; Verschuere, Crombez, De Clercq, & Koster, 2005). Malfunctions in amygdala circuits have been suggested to underlie these deficits (Moul, Killcross, & Dadds, 2012). Several studies reported structural amygdala abnormalities in individuals with psychopathy (Boccardi et al., 2011; Yang, Raine, Colletti,

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Toga, & Narr, 2010; Yang, Raine, Narr, Colletti, & Toga, 2009) as well as reduced amygdala activation during the presentation of fearful faces, fear conditioning and other tasks involving emotional processing (see Moul et al. (2012) for review). Interestingly, recent studies demonstrated impaired fear recognition in children and adolescents with callous-unemotional traits along with a failure to direct attention to the eyes, the facial feature that best characterizes fear (Dadds et al., 2006; Dadds, El Masry, Wimalaweera, & Guastella, 2008; Dadds, Jambrak, Pasalich, Hawes, & Brennan, 2011), paralleling problems shown by patients with amygdala damage (Adolphs, Tranel, Damasio, & Damasio, 1994; Gamer, Schmitz, Tittgemeyer, & Schilbach, 2013). When explicitly instructed to look at the eyes, the fear-recognition deficit is alleviated in children with high callous-unemotional traits (Dadds et al., 2006) as well as in patients with bilateral amygdala lesions (Adolphs et al., 2005). However, it should be noted that psychopathy has also been shown to impair the recognition of fear in vocal and postural cues (Dawel et al., 2012), suggesting that other attentional mechanisms apart from a lowered attention to the eye region may underlie such general deficits in emotion recognition.

In this study, we investigated whether recognition and visual exploration of facial expressions are related to personality traits of psychopathy in a community sample of young adults. For this purpose, participants performed an emotion recognition task that allowed for the quantification of attentional orienting towards the eyes and towards the mouth during face processing (Gamer & Büchel, 2009). Angry, fearful, happy and neutral faces were presented very briefly (150 ms) or longer (2000 ms) while measuring eye movements. In each trial, faces were unpredictably shifted either upwards or downwards such that either the eyes or the mouth was initially fixated. This design allowed us to quantify the target of the first saccade after stimulus onset as a measure of initial attention shifting towards facial features of differential diagnostic relevance. Previous studies using this paradigm indicate that participants show a preference for attending to the eye region across different emotions and this gaze bias was attenuated for happy as compared to fearful faces as the mouth region possesses a higher diagnostic relevance for recognizing happy faces (Gamer & Büchel, 2009). Moreover, this preferential processing of diagnostic facial features has been shown to be independent from task demands (Scheller, Büchel, & Gamer, 2012) but depended on the structural integrity of the amygdala (Gamer et al., 2013) and was correlated with phasic amygdala activation (Gamer & Büchel, 2009).

We expected that high scores on psychopathic personality features would result in reduced attentional orienting towards the eyes along with impaired emotion recognition in the current study. Additionally, we examined eye-tracking measures reflecting the intensity of face exploration and vigilance towards facial cues (i.e., the number of saccades and the latency of saccadic onsets). Due to the overall reduced emotional reactivity in psychopathy, a reduction in exploration intensity and vigilance for high psychopathic traits was hypothesized. Moreover, we investigated whether different facets of psychopathy (i.e., Fearless Dominance, Self-Centered Impulsivity and Coldheartedness) as assessed with the PPI-R would relate differentially to face scanning parameters.

The current study represents a secondary analysis of data acquired in the context of a previous study, in which we investigated how a functional genetic variation in the serotonin transporter-linked polymorphic region (5-HTTLPR) modulates gaze on facial emotions (Boll & Gamer, 2014). In this study, we found that the 5-HTT gene affected emotion classification accuracy by influencing the general vigilance to facial cues. Specifically, the high 5-HTT expressing l-allele was associated with reduced emotion recognition and less fixation changes in response to facial expressions. In the current study, we focused on modulatory effects of psychopathic traits on eye tracking and behavioral measures. Importantly, the current analyses were performed in a subset of the original sample (Boll & Gamer, 2014) since psychopathy was not assessed in all volunteers. Previous studies have shown associations between the 5-HTTLPR genotype and psychopathic traits (Garcia, Aluja, Fibla, Cuevas, & García, 2010; Glenn, 2011) with the long l allele being linked to affective characteristics of psychopathy in particular (Sadeh, Javdani, & Verona, 2013). We therefore also examined possible interactions of psychopathic traits and 5-HTTLPR on gazing behavior in our current analyses. Using hierarchical linear regression models, we determined whether associations found for psychopathic trait measures relied on variance accounted for by the 5-HTTLPR genotypes or solely on psychopathic traits.

2. Methods

2.1. Participants

Volunteers were recruited from a large pool of genotyped individuals and selected on the basis of their 5-HTTLPR/rs25531 genotypes. The short s-allele of the 5-HTTLPR is associated with reduced 5-HTT expression relative to the long l-allele (Heils et al., 1995) as well as the G-allele of the single-nucleotide polymorphism (SNP), rs25531, that reduces 5-HTT expression levels in 5-HTTLPR l-allele carriers to expression levels nearly equivalent to s-carriers (Hu et al., 2006). On this basis, participants were assigned to either a high or a low 5-HTT expressing group depending on their genetic make-up. Volunteers with a medium 5-HTT expressing variant (L_A/L_G, s/L_A) were not included.

Eighty-three participants with normal or corrected-to-normal visual acuity were initially enrolled in the study that was approved by the Ethics Committee of the Medical Board in Hamburg, Germany (see also Boll & Gamer, 2014). The current analysis involves a subset of 66 volunteers who completed a German version of the PPI-R (Alpers & Eisenbarth, 2008). Four subjects were excluded from data analyses due to poor data quality (less than 65% valid eye tracking trials). As recommended in the manual, another participant was excluded because he scored very high on the deviant responding scale of the PPI-R (T-value > 60, Alpers & Eisenbarth, 2008), that was designed to detect random responses or malingering, which left 61 individuals (31 females) for analyses. Gender and genotype distributions as well as socio-demographic data of the low and the high 5-HTT group are shown in Table 1. Volunteers also completed German versions of the Beck Depression Inventory (BDI, Hautzinger, Bailer, Worall, & Keller, 1994), the State-Trait Anxiety Inventory (STAI, Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), the Positive and Negative Affect Schedule (PANAS, Watson, Clark, & Tellegen, 1988), the Social Desirability Scale (Stöber, 2001), the Social Interaction Anxiety Scale (SIAS, Mattick & Clarke, 1998), two Alexithymia Questionnaires (BVAQ, Vorst & Bermond, 2001; TAS-20, Bagby, Parker, & Taylor, 1994) and the Reading Mind in the Eyes Test (RMET, Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). No group differences with respect to genotypes were observed in these measures (all *p*-values > .05, see also Supplemental Table S1).

2.2. Psychopathic trait measures

The PPI-R was used to assess psychopathic traits (Lilienfeld & Widows, 2005). The PPI-R is a self-report questionnaire to measure psychopathy in which volunteers are asked to indicate how much each of the 154 items applies to them on a 4-point Likert scale ranging from 1 (*false*) to 4 (*true*). It yields a total score as well as scores on eight subscales (Impulsive Nonconformity, Blame Externalization, Machiavellian Egocentricity, Carefree Nonplanfulness, Stress