Journal of Abnormal Psychology
2018, Vol. 127, No. 1, 43–50

0021-843X/18/$12.00 http://dx.doi.org/10.1037/abn0000322

Psychopathic Traits Are Associated With Reduced Fixations to the Eye Region of Fearful Faces

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Impairments in processing fearful faces have been documented in both children and adults with psychopathic traits, suggesting a potential mechanism by which psychopathic individuals develop callous and manipulative interpersonal and affective traits. Recently, research has demonstrated that psychopathic traits are associated with reduced fixations to the eye regions of faces in samples of children and community-dwelling adults, however this relationship has not yet been established in an offender sample with high levels of psychopathy. In the current study, we employed eye-tracking with paradigms involving the identification and passive viewing of facial expressions of emotion, respectively, in a sample of adult male criminal offenders ($n = 108$) to elucidate the relationship between visual processing of fearful facial expressions and interpersonal and affective psychopathic traits. We found that the interpersonal-affective traits of psychopathy were significantly related to fewer fixations to the eyes of fear faces during the emotion recognition task. This association was driven particularly by the interpersonal psychopathic traits (e.g., egocentricity, deceitfulness), whereas fear recognition accuracy was inversely related to the affective psychopathic traits (e.g., callousness, lack of empathy). These findings highlight potential mechanisms for the subset of the interpersonal-affective traits exhibited by psychopathic individuals.

General Scientific Summary
This study demonstrates that psychopathic traits are associated with reduced visual fixations to the eyes of fearful faces in a sample of incarcerated adult male criminal offenders. These findings suggest that reduced attention to fearful faces may be one mechanism contributing to the interpersonal-affective traits of psychopathy.

Keywords: psychopathy, PCL–R, eye-tracking, fear

Supplemental materials: http://dx.doi.org/10.1037/abn0000322.supp

Psychopathy is characterized by malignant interpersonal and affective traits, including manipulation of others, pathological lying, callousness, and lack of empathy (Hare, 1996). Elucidation of the neuropsychological mechanisms underlying these traits could lead to more effective treatment strategies. One prominent line of research in this area has focused on how psychopathic individuals perceive and process emotion, particularly fear, in the facial expressions of others. Impairments in processing fearful faces have been documented in both children and adults with psychopathic traits (R. Blair et al., 2004; R. J. R. Blair, Budhani, Colledge, & Scott, 2005; R. J. R. Blair, Colledge, Murray, & Mitchell, 2001; Boll & Gamer, 2016; Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009; Herpertz et al., 2001; Iria & Barbosa, 2009; A. P. Jones, Laurens, Herba, Barker, & Viding, 2009; Leist & Dadds, 2009; Marsh et al., 2008; Montagne et al., 2005; Muñoz, 2009; Stevens, Charman, & Blair, 2001; Sylvers, Brennan, & Lilienfeld, 2011; Viding et al., 2012). For example, psychopathic traits have been associated with selective deficits in the recognition of fearful facial expressions (R. Blair et al., 2004), and children with callous/unemotional (CU) traits (believed to parallel the empathy deficit seen in adult psychopathic individuals) have demonstrated abnormal neural processing of fearful faces (Jones et al., 2009). The fear recognition deficit associated with psychopathy has lead researchers to examine the potential underlying mechanisms, although it is worth noting that there is evidence of a more global emotional impairment in psychopathy and some have failed to show a spe-

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The hypotheses and data included in this article have been shared in poster format at a conference. These data have not been disseminated in any other fashion.

This work was supported by the National Institute of Mental Health Grant T32MH018931-27.

We thank the many individuals at the Wisconsin Department of Corrections who made this research possible, and we are especially indebted to Warden Judy Smith, Warden Randy Hepp, and Kevin Kallas.

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cific fear deficit (see Decety, Skelly, Yoder, & Kiehl, 2014; Dawel, O'Kearney, McKone, & Palermo, 2012 for evidence of more global emotional impairment; see Glass & Newman, 2006 for evidence of no impairment; and see Sylvers et al., 2011 for evidence of preattentive impairment).

A groundbreaking study of a rare neurological lesion patient with bilateral amygdala damage demonstrates the critical importance of attending to the eye region of faces for correctly identifying fear (Adolphs et al., 2005). Adolphs et al. used eye-tracking to show that the patient's profound deficit in identifying fear was accompanied by failure to visually fixate to the eyes of faces, and moreover, that instruction to attend to the eye region completely rescued her performance to normal levels. This finding suggests that the fear recognition deficit in psychopathy may similarly result from reduced attention to the eye regions of faces, thus representing a mechanism by which psychopathic individuals develop callous and manipulative interpersonal and affective traits.

In support of this hypothesis, Dadds and colleagues (Dadds, El Masry, Wimalaweera, & Guastella, 2008; Dadds et al., 2006) showed that children with CU traits make fewer visual fixations to the eye regions of fearful faces. Notably, when directed to fixate on the eyes of fearful faces, children with CU traits show improved fear recognition. The authors suggested that a failure to direct attention to the eye regions of fearful faces contributed, in part, to the emotion-recognition problems evidenced by individuals with psychopathic tendencies. Furthermore, children with CU traits show amygdala hypo-reactivity to fearful faces, again highlighting the connection between amygdala functionality, processing of fearful stimuli, and psychopathy (e.g., Jones et al., 2009). Although reduced fixations to the eye region of faces has been demonstrated in children and adolescents with CU traits, and has been linked to self-reported psychopathic traits in nonincarcerated adult men (Boll & Gamer, 2016; Gillespie, Rotshtein, Wells, Beech, & Mitchell, 2015), this critical aspect of social-affective processing has not yet been investigated in adult criminal offenders with high levels of psychopathy. This is important to discern, as it is currently unknown whether inattention to the eye regions of faces is associated with the most severe manifestations of psychopathic traits in adulthood (i.e., in a criminal offender sample).

In addition to considering how psychopathic individuals process specific facial features related to emotional expression, it may be informative to consider if psychopathy is characterized by attentional biases toward, or away from, emotional expressions. Various forms of psychopathology are associated with attentional biases toward certain facial emotions, which has provided meaningful information on potential mechanisms underlying the etiology of disorders and persistence of symptoms. For example, individuals with anxiety and posttraumatic stress disorders tend to overallocate attention to threatening stimuli (e.g., angry faces; Beevers, Lee, Wells, Ellis, & Telch, 2011; Kimble, Fleming, Bandy, Kim, & Zambetti, 2010; Schofield, Johnson, Inhoff, & Coles, 2012; Shechner et al., 2013). This attentional bias toward threat has been proposed as a cognitive mechanism underlying symptoms such as hyperarousal, hypervigilance, and avoidance. Similarly, depression has been linked to overallocation of attention to negatively valenced facial expressions, and underallocation of attention to positive facial expressions (Duque & Vázquez, 2015; Kellough, Beevers, Ellis, & Wells, 2008; Leyman, De Raedt, Vaeyens, & Philippaerts, 2011). Given the stark emotional deficits that characterize psychopathy, it is possible that attentional biases away from emotional stimuli (e.g., fear faces) may contribute to the development and/or maintenance of interpersonal and affective psychopathic traits. Specifically, it is possible that psychopathic individuals tend to ignore fearful stimuli if given the opportunity to attend to other stimuli.

In this study, we employed eye-tracking with paradigms involving the identification and passive viewing of facial expressions of emotion, respectively, in a sample of adult male criminal offenders to elucidate the relationship between visual processing of fearful facial expressions and interpersonal and affective psychopathic traits. In line with previous studies of psychopathy, we also employed a behavioral rating task of emotional valence and emotional identification to assess the accuracy of facial identification (e.g., Eisenbarth, Alpers, Segrè, Calogero, & Angrilli, 2008). It may be important to not only assess visual processing of fearful faces, but also consider behavioral accuracy and valence rating inconsistencies that contribute to poorer accuracy (e.g., rating a positive face more negatively). Specifically, we hypothesized that the severity of interpersonal and affective psychopathic traits would be associated with: a) fewer visual fixations to the eye region of fear faces (relative to other facial features), b) fewer visual fixations to fear faces (relative to faces expressing other emotions), c) lower recognition accuracy of fear faces, and d) lower negative valence rating of fear faces.

Method

Participants included $n = 108$ adult male inmates incarcerated at a medium security prison in Wisconsin ($n = 68$ for the facial emotion recognition task; $n = 62$ for the facial emotion free view task). $n = 22$ participants completed both tasks (approximately 12 months apart). Participants were selected from a larger pool of participants who completed a standard battery of personality assessments, including the Psychopathy Checklist—Revised (PCL–R, Hare, 2003). From this larger sample, we selected a subsample of offenders based on PCL–R score to adequately represent low (PCL–R $<$21), intermediate (PCL–R $\geq$21 and $\leq$29), and high (PCL–R $\geq$30) psychopathy participants to complete the two eye tracking tasks.

Inmates were eligible for participation if they were between the ages of 18 and 55, had no documented diagnosis of a psychotic disorder or posttraumatic stress disorder, and were not currently taking psychotropic medications. Additionally, participants were eligible if they had a 4th grade reading level or above and scored 70 or above on a standardized measure of intelligence (Wechsler, 1981). All participants provided informed consent prior to any data collection. Inmates were notified that participation was completely voluntary and would have no impact on their incarceration status. All procedures were approved by the university institutional review board (Protocol No. 2014–1106). Three participants were excluded because of outlier data with undue influence on the regression models (Cook, 1977; two for eye tracking data and one for recognition accuracy data). An additional 10 subjects were excluded for eye tracking errors (i.e., eye tracker malfunctioned and did not record eye fixations) or missing data. Accordingly, the final sample size included $n = 98$ participants (with $n = 22$ completing both tasks). The final sample size for the facial emotion recognition task was $n = 58$ ($n = 17$ low PCL–R, $n = 19$ intermediate PCL–R, $n =$

22 high PCL–R). The final sample size for the facial emotion free view task was $n = 62$ ($n = 19$ low PCL–R, $n = 21$ intermediate PCL–R, $n = 22$ high PCL–R). Participant characteristics for both tasks are included in Table 1.

Assessments

Psychopathy. The Psychopathy Checklist-Revised (PCL–R) was used to assess psychopathy (Hare, 2003). The PCL–R is a scale of 20 items rated 0–2 based on the degree to which the trait is present. The PCL–R can be further broken into a two-factor and a four-facet model. Factor 1 comprises the interpersonal-affective features of psychopathy (Facet 1: interpersonal; Facet 2: affective) whereas Factor 2 comprises the lifestyle-antisocial features of psychopathy (Facet 3: lifestyle; Facet 4: antisocial). We computed factor and facet scores based on published guidelines (Hare, 2003). Trained research staff performed all clinical assessments based on information obtained during interviews and reviews of institutional files. Interrater reliability ratings were available for $n = 9$ participants, yielding a high intraclass correlation for PCL–R total scores ($r = .98$), Factor 1 scores ($r = .96$), and Factor 2 scores ($r = .98$). These intraclass correlation values are consistent with previous studies from our lab (Dargis, Newman, & Koenigs, 2016; Philippi et al., 2015; Wolf et al., 2015). PCL–R scores ranged from 8–39 in the facial emotion free view task, and from 8–37 in the facial emotion recognition task.

Intelligence. Intelligence was assessed using the Wechsler Adult Intelligence Scale—Revised (Wechsler, 1981).

Negative Affect. Negative affect was assessed using the Negative Affectivity (NA) scale of the Multidimensional Personality Questionnaire–Brief Form (MPQ-BF; Patrick, Curtin, & Tellegen, 2002). The MPQ-BF is a 155-question, self-report measure of personality traits. The MPQ-BF trait scales are highly correlated with the full MPQ and are consistent with its higher order factors (Patrick et al., 2002). The NA scale is comprised of three subscales, including Stress Reaction (i.e., individual describe themselves as tense, vulnerable, anxious, irritable); Aggression (i.e., individual describe themselves as physically aggressive, enjoy violence and enjoy upsetting others); and Alienation (i.e., individuals feel used and betrayed by others, feel pushed around and that others will harm them).

Table 1
Participant Information

Task	*M* (*SD*)
Facial emotion recognition task ($n = 58$)	
PCL–R	23.97 (7.72)
Factor 1	9.32 (3.20)
Factor 2	12.99 (4.57)
Age	32.33 (8.26)
IQ	100.98 (11.29)
Negative Affect	46.81 (19.49)
Race %	31% AA/ 69% CA
Facial emotion free view task ($n = 62$)	
PCL–R	24.71 (7.98)
Factor 1	10.06 (3.19)
Factor 2	12.81 (5.04)
Age	32.45 (7.95)
IQ	99.27 (12.29)
Negative Affect	44.76 (16.17)
Race %	45% AA/ 55% CA

Note. CA = Caucasian; AA = African American; PCL–R = Psychopathy Checklist—Revised.

Facial emotion recognition task. Stimuli were chosen from the Karolinska Directed Emotional Faces set (Lundqvist, Flykt, & Öhman, 1998). Ten male and 10 female actors, each depicting two emotions out of happiness, sadness, anger, fear, disgust, and neutral, comprised the stimuli. Face stimuli were converted to gray scale, cropped to remove hair and ears, and matched for size and luminance. Before beginning the task, participants were instructed that on each trial a face would appear onscreen for several seconds, during which time they should try to identify the emotion of the face. Trials began with presentation of a fixation cross for 4 ± 1 seconds, followed by a 3-s face presentation. Faces were presented such that the tip of the nose appeared at the same point on the screen as the fixation cross. After viewing the face, participants had unlimited time to use a computer mouse to identify the emotion from the six possibilities presented and rate the expression's valence ("How positive or negative was that facial expression?") on a nine-point scale. Higher scores indicate less negative and/or more positive ratings. Faces were not presented onscreen during the response screens.

Facial emotion free view task. Stimuli were chosen from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015). Sixteen Caucasian male actors and 16 African American male actors, each depicting happy, anger, fear, and neutral facial expressions, comprised the stimuli. All actors appeared before a black background. Each trial consisted of one actor's happy, anger, fear, and neutral images located in the four quadrants of the computer screen. Location of expressions was counterbalanced across trials, so that each emotion category appeared equally across all four locations. Trials began with a presentation of a fixation cross for 1 second, followed by a 10-s presentation of the four faces. Participants were not given explicit directions for how to complete the task, but rather, told to view the images in whatever way they wanted. Therefore, this task did not involve a behavioral response.

Eye Tracking

Participants' eye movements were tracked at 60 Hz with an ASL D6 desk-mounted eye tracker (Applied Science Laboratories, Bedford, MA). Participants were seated approximately 64 cm away from the monitor. All participants underwent a nine-point calibration prior to beginning the experimental task. Head tracking software was used to account for head movements in real time. Fixations were defined as gaze coordinates remaining inside 1° visual angle for 100ms or greater (Karsh & Breitenbach, 1983; Lambert, Monty, & Hall, 1974), and identified offline using automated software.

For the facial emotion recognition task, each face stimulus was divided into two areas of interest (AOIs) for analysis. The vertical bounds of the "eye" AOI were just superior of the corrugator muscle and the inferior orbit, and the horizontal bounds were the lateral corners of each eye. The "face" AOI was a rectangle the maximum height and width of the face stimulus.

For the facial emotion free view task, each of the four face images in a trial (happy, anger, fear, and neutral) was identified as a separate AOI. The vertical and horizontal bounds of the AOI included the entire image.

For all analyses performed on eye tracking data, individual trials were excluded if eye tracking failed for greater than 25% of samples during the face presentation. This threshold was set to reduce the impact of eye tracking artifacts introduced by excessive blinking and head movement.

Data Analyses

Multiple regression analyses were used to examine the proportion of fixations made to the eye region of faces in the facial emotion recognition task. Proportion of eye fixations was calculated by dividing the total number of fixations to the eyes by the number of fixations made to the face (including the eyes). Multiple regression analyses were also used to examine the relationship between psychopathy, emotional accuracy, and emotional valence ratings. For the facial emotion free view task, multiple regression analyses were conducted to examine the proportion of fixations made to each facial expression. Proportion of fixations was calculated by dividing the total number of fixations made to one facial expression by the total number of fixations made to all four facial expressions. All variables included in the models were mean-centered.

For all models examining the relationships with factor scores, both factors were included in the models, and for models examining the relationships with facet scores, all four facets were included in the models. This was done to examine the unique variance associated with each component of the PCL–R, as there is evidence that the interpersonal-affective traits of psychopathy (e.g., selfishness and callousness) show divergent relationships to external correlates when included in the same models as the lifestyle-antisocial features (e.g., criminality, impulsivity; Hicks & Patrick, 2006). Race was included as a covariate in all models as there is evidence that fixations to faces vary depending on the race of the participant and the race of the stimulus face image (Hills & Pake, 2013). Age, IQ, and negative affect were included as covariates as each of these variables has been associated with facial emotion processing (Ball et al., 2012; Buitelaar, van der Wees, Swaab-Barneveld, & Gaag, 1999; Charles, Mather, & Carstensen, 2003; Kret, Denollet, Grèzes, & de Gelder, 2011; Mather & Carstensen, 2003; Short, Sonuga-Barke, Adams, & Fairchild, 2016; Vizueta, Patrick, Jiang, Thomas, & He, 2012). Additionally, negative affect is an important factor regarding heterogeneity in psychopathy. Studies have shown significant behavioral and personality differences in psychopathic individuals based on level of negative affectivity (e.g., Hicks & Patrick, 2006), and there is evidence that these differences include processing of emotional stimuli (e.g., Kimonis, Frick, Cauffman, Goldweber, & Skeem, 2012). Finally, number of eye fixations made outside of the AOI's was also included as a covariate to control for the variability in eye tracking fixations tracked across participants. Bivariate correlations between these variables are included in Table 2. Descriptive statistics regarding task performance for the sample are included in Table 3. Our study was designed to test the a priori hypotheses regarding Factor 1 scores and the measures of fear processing; all other reported results are at an uncorrected threshold ($p < .05$) and should therefore be interpreted as preliminary.

Table 2
Bivariate Correlations Between Study Variables

Variable	Fear face eye fixations	Fear face fixations	Fear face recognition accuracy	Negative face valence rating
PCL–R total	−.02*	−.18*	.001*	.19
Factor 1	−.14*	−.09*	−.06*	.31*
Factor 2	.08*	−.21*	.01*	.07
Facet 1	−.20*	−.12*	.04*	.24
Facet 2	−.01*	−.01*	−.18*	.31*
Facet 3	−.02*	−.14*	.10*	.07
Facet 4	.12*	−.22*	−.05*	.06
Age	−.10*	.11*	−.12*	.06
Race	−.21*	−.004*	−.07*	.15
IQ	.17*	.24*	.09*	−.14
Negative Affect	.16*	.19*	−.05*	.07

Note. Fear face eye fixations pertain to the facial emotion recognition task; fear face fixations pertain to the facial emotion free view task.
* $p < .05$.

Analyses presented below are organized first by task (i.e., facial emotion recognition or facial emotion free view) and then by specific task performance variable (i.e., eye tracking fixations, emotional accuracy, emotional valence rating). For each task performance variable, results begin with the a priori hypothesis regarding the relationship between task performance and the interpersonal-affective features of psychopathy (Factor 1). Secondary (nonhypothesized) relationships are then presented for Factor 2 scores, PCL–R total scores, facet scores.

Facial emotion recognition—Fixations. As hypothesized, Factor 1 scores were negatively associated with the proportion of fixations to the eye region of fearful faces, $B = -.02$, $SE\ B = .01$, $t(43) = -2.05$, $p = .04$, $\Delta R^2 = .07$, 95% confidence interval (CI) [−.05, −.0004]. By contrast, Factor 2 scores were positively associated with the proportion of fixations to the eye region of fearful faces, $B = .02$, $SE\ B = .008$, $t(43) = 2.03$, $p = .04$, $\Delta R^2 = .06$, 95% CI [.0007, .03] (Figure 1). PCL–R total scores did not significantly relate to the proportion of fixations to the eye region for any emotion category ($ps > .2$). When controlling for all other facets, Facet 1 scores were negatively associated with the proportion of fixations to the eye region of fearful faces, $B = -.03$, $SE\ B = .01$, $t(40) = -2.28$, $p = .03$, $\Delta R^2 = .08$, 95% CI [−.06, −.004], whereas Facet 4 scores were positively associated with the proportion of fixations to the eye region of fearful faces, $B = .03$, $SE\ B = .01$, $t(40) = 2.45$, $p = .02$, $\Delta R^2 = .12$, 95% CI [.005, .06]. No other factor or facet scores were associated with the proportion of fixations to the eye region for any other emotion category ($ps > .3$).

Facial emotion recognition—Accuracy. Contrary to our hypothesis, Factor 1 scores were not significantly related to recognition accuracy for fearful faces ($p = .3$). PCL–R total scores, Factor 1 scores, and Factor 2 scores were not significantly related to recognition accuracy any emotion category ($ps > .2$). However, when controlling for other facets, there was a significant relationship between Facet 2 scores and emotional accuracy for fear faces, such that individuals with higher Facet 2 scores were significantly less accurate at identifying fearful facial expressions, $B = -.09$, $SE\ B = .02$, $t(41) = -3.65$, $p < .001$, $\Delta R^2 = .23$, 95% CI [−.14, −.04]. Conversely, Facet 3 scores were associated with greater recognition accuracy for fear faces, $B = .05$, $SE\ B = .02$,

Table 3
Mean Task Performance

Valence	Total sample, *M* (*SD*)	PCL–R ≥ 30, *M* (*SD*)	PCL–R < 21, *M* (*SD*)
Facial emotion recognition—Proportion eye fixations			
Fear	.34 (.19)	.35 (.21)	.34 (.16)
Happy	.30 (.16)	.27 (.16)	.36 (.14)
Neutral	.34 (.19)	.35 (.20)	.39 (.19)
Sad	.34 (.17)	.34 (.19)	.34 (.18)
Disgust	.28 (.17)	.27 (.20)	.32 (.14)
Facial emotion recognition—Accuracy			
Fear	.86 (.16)	.87 (.14)	.86 (.22)
Happy	.99 (.01)	1.00 (0)	1.00 (0)
Neutral	.94 (.13)	.93 (.16)	.95 (.09)
Sad	.93 (.11)	.92 (.11)	.91 (.13)
Disgust	.83 (.20)	.86 (.21)	.85 (.15)
Facial emotion recognition—Valence			
Fear	3.14 (.80)	3.23 (.82)	3.09 (.80)
Happy	7.65 (.86)	7.58 (.86)	7.64 (.95)
Neutral	4.99 (.20)	4.98 (.20)	5.00 (.17)
Sad	3.09 (.85)	3.37 (.73)	3.01 (.79)
Disgust	2.68 (.97)	2.94 (.56)	2.39 (.90)
Facial emotion free view—Proportion fixations			
Fear	.25 (.04)	.24 (.04)	.26 (.05)
Happy	.23 (.14)	.24 (.04)	.22 (.04)
Neutral	.24 (.06)	.26 (.09)	.23 (.04)
Anger	.28 (.08)	.25 (.06)	.29 (.08)

Note. PCL–R = Psychopathy Checklist—Revised.

$t(41) = 3.17$, $p < .01$, $\Delta R^2 = .17$, 95% CI [.02, .08]. Accuracy was not significantly associated with proportion of fixations to the eyes of fear faces ($p = .3$).

Facial emotion recognition—Valence. Contrary to our hypothesis, Factor 1 scores were not significantly related to valence ratings for fearful faces ($p = .1$). PCL–R total scores, factor scores, and facet scores did not relate to valence ratings for fear faces (*ps* > .1). However, PCL–R total scores were significantly related to higher (less negative) valence ratings for disgust faces, $B = .04$, $SE\ B = .01$, $t(51) = 2.65$, $p = .01$, $\Delta R^2 = .11$, 95% CI [.009, .07]. Factor 1 scores, when controlling for Factor 2 scores, were associated with higher (less negative) valence ratings for sad faces, $B = .14$, $SE\ B = .04$, $t(51) = 3.48$, $p = .001$, $\Delta R^2 = .18$, 95% CI [.02, .21], and disgust faces, $B = .12$, $SE\ B = .04$, $t(51) = 3.13$, $p < .01$, $\Delta R^2 = .15$, 95% CI [.04, .2]. Facet 1 scores, when controlling for all other facet scores, were significantly associated with higher valence ratings for both sad, $B = .14$, $SE\ B = .06$, $t(41) = 2.49$, $p < .02$, $\Delta R^2 = .10$, 95% CI [.03, .25], and disgust faces, $B = .12$, $SE\ B = .06$, $t(41) = 2.08$, $p = .04$, $\Delta R^2 = .07$, 95% CI [.004, .23].

Facial emotion free view. Contrary to our hypothesis, Factor 1 scores were not significantly related to the proportion of fixations to fearful faces, when compared with other facial expressions ($p = .9$). However, PCL–R total scores were associated with a smaller proportion of fixations to fearful faces when compared with the other facial expressions, $B = -.001$, $SE\ B = .001$, $t(49) = -2.08$, $p = .04$, $\Delta R^2 = .07$, 95% CI [−.003, −2.06]. Factor 2 and facet scores were not related to proportion of fixations to fearful faces (*ps* > .4). PCL–R scores, factor, and facet scores were not related to fixations to happy, neutral or anger faces (*ps* > .09).

Discussion

In this study, we tested the relationship between the interpersonal-affective traits of psychopathy and processing of fearful faces. In support of our main hypothesis, we found that PCL–R Factor 1 scores, which index the interpersonal-affective traits of psychopathy, significantly related to fewer fixations to the eyes of fear faces. This finding reveals a potential mechanism for a subset of the execrable traits exhibited by psychopathic individuals.

Although fewer fixations to the eye regions of faces has been proposed as a mechanism by which individuals high in psychopathy experience blunted affect and impaired empathic processing (e.g., Dadds et al., 2008), this effect in our sample was driven particularly by the interpersonal (Facet 1) features of psychopathy (e.g., charm, grandiosity), rather than the affective (Facet 2) features of psychopathy (e.g., callousness, shallow affect). Interestingly, autism, too, has been linked to impaired empathic processing and fewer fixations to the eyes of faces; a finding that has also been proposed as a mechanism contributing to the empathy deficits demonstrated by children and adults with autism (Dapretto et al., 2006; Spezio, Adolphs, Hurley, & Piven, 2007). Despite these proposals within the autism literature, there is evidence to suggest that deficient eye fixations among autistic children may be more closely related to impaired interpersonal functioning, rather than empathic processing (Klin, Jones, Schultz, Volkmar, & Cohen, 2002; Speer, Cook, McMahon, & Clark, 2007). For instance, Jones, Carr, and Klin (2008) reported that reduced fixations on the eyes by young children with autism was significantly related to level of social impairment. The authors suggested that early deficits in making eye fixations to faces may adversely affect social development. As the current study reported a significant inverse relationship between the interpersonal (Facet 1) features of psychopathy and fixation to the eyes, it is plausible that failure to

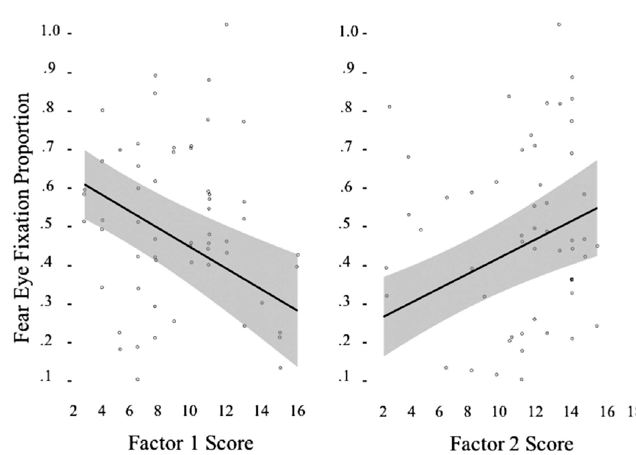

Figure 1. Relationships between Psychopathy Checklist—Revised (PCL–R) factor scores and proportion of fixations to the eye region of fear faces. Left panel: Factor 1 scores are associated with reduced proportion of fixations to the eyes of fear faces. Right panel: Factor 2 scores are associated with increased proportion of fixations to the eyes of fear faces.

attend to the eyes of others engenders the abnormal socialization often displayed by psychopathic individuals (e.g., ability to lie pathologically, with little concern for potential social consequences). This is not to suggest, of course, that psychopathic and autistic individuals show similar interpersonal function, but rather to highlight that the current findings support the connection between attending to the eyes of faces and social functioning.

Despite the significant association between eye fixations to fearful faces and interpersonal (Facet 1) psychopathic traits, we found that the affective features of psychopathy (Facet 2) were significantly related to poorer recognition of fear faces. Indeed, this relationship between Facet 2 and fear recognition accuracy was the strongest statistical association in the study. The observed dissociation within Factor 1 traits (i.e., reduced eye fixations to fearful faces associated with Facet 1, but reduced fear recognition accuracy associated with Facet 2) suggests different etiological mechanisms for these subsets of psychopathic traits. Moreover, the lack of a significant relationship between eye fixations and recognition accuracy for fearful faces further supports the dissociability of these functions. It is also worth noting that fear deficits have been documented independently of overt attention to the fearful stimuli (Sylvers et al., 2011; Brislin et al., 2017).

Contrary to our hypothesis, Factor 1 scores were not related to recognition accuracy for fearful faces. Although various studies have shown deficient fear face recognition among psychopathic individuals (e.g., R. Blair et al., 2004; R. J. R. Blair et al., 2005; R. J. R. Blair et al., 2001), there are several examples within the literature in which psychopathy was not associated with reduced recognition accuracy (Gillespie et al., 2015; Glass & Newman, 2006; Pajer, Leininger, & Gardner, 2010). Notably, Gillespie et al. (2015) also found reduced eye fixations to fear faces, but intact fear face recognition, among nonincarcerated men with psychopathic traits. The authors suggested that the subclinical nature of their sample may have explained this discrepancy, though we report similar findings within a sample of incarcerated men with pathologically high levels of psychopathy. It is possible that reduced attention to the eyes of faces results in impaired recognition early in development (e.g., Dadds et al., 2008; Dadds et al., 2006), but by adulthood psychopathic individuals have improved their ability to recognize stereotypical expressions of fear, despite persistent abnormalities in fixation patterns. Relatedly, methodological differences between studies may account for these differences in recognition accuracy findings, as some studies that report impaired facial emotion recognition have utilized more difficult task stimuli (e.g., morphing emotion faces; R. Blair et al., 2004), compared with the high-intensity, stereotyped expressions that we used in this study.

Beyond fear face eye fixations, we also found that PCL–R Total scores were significantly related to fewer fixations to fear faces compared with other faces during the Free View task. In other words, when given no specific direction, individuals high in psychopathy tend to ignore fearful faces. It is plausible that incarcerated psychopathic offenders with particularly extensive criminal records are more likely to encounter fearful expressions throughout their lifetime via the perpetration of violence and other callous acts. Accordingly, it is plausible that a tendency not to attend to fear faces may be one mechanism by which individuals with psychopathic traits are prone to repeatedly commit such offenses. Alternatively, it is possible that individuals with more callous and violent behavior habituate to fearful faces, and thus these stimuli capture less of their attention during laboratory task experiments (Breiter et al., 1996; Lloyd, Medina, Hawk, Fosco, & Richards, 2014). The cross-sectional nature of the current study precludes any direct evidence regarding causality of these relationships.

In addition to the hypothesized results regarding Factor 1 scores and fearful faces, exploratory supplemental analyses associated psychopathic traits with more widespread abnormalities across facial emotions. Specifically, PCL–R Total scores were significantly related to less negative valence ratings of disgust and sad faces, though this was predominately driven by Factor 1 and Facet 1. Impairments in processing a variety of emotions have been previously demonstrated among psychopathic individuals (Dawel et al., 2012; Dolan & Fullam, 2006; Eisenbarth et al., 2008; Hastings, Tangney, & Stuewig, 2008; Pera-Guardiola et al., 2016). Because these findings regarding emotions other than fear from the present study were not hypothesized and uncorrected for multiple comparisons, we believe they would need to be replicated before being interpreted as support for a broader emotion impairment.

In sum, the current study provides novel eye-tracking data from adult offenders linking interpersonal psychopathic traits with reduced fixations to the eye region of fearful faces. Gaining a better understanding of the way in which psychopathic offenders attend to the emotions of others has important treatment implications, as facilitating attention to emotion may be one method for improving deficient social and affective function among high psychopathy individuals (e.g., Baskin-Sommers, Curtin, & Newman, 2015).

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Received April 12, 2017
Revision received September 15, 2017
Accepted September 27, 2017 ■