Faces and Facets: Variability of Emotion Recognition in Psychopathy Reflect its Affective and Antisocial Features

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Abstract

Psychopathy consists of a constellation of affective-interpersonal features including lack of empathy, callousness, manipulativeness and interpersonal charm, impulsiveness and irresponsibility. Despite its theoretical and predictive value in forensic contexts, the relationships between the psychometric dimensions of psychopathy, including its antisocial features, and the construct's neuropsychological characteristics remain uncertain. In this study, 685 personality-disordered prisoners with histories of serious violent or sexual offences were assessed for psychopathy before completing a computerised and well-validated assessment of the ability to recognise emotional expressions in the face. Prisoners with more of the affective features of psychopathy, and prisoners with more of its anti-social manifestations, showed relatively poor recognition accuracy of fearfulness and disgust. These relationships were independent, modest but were still evident following correction for demographic features (e.g. ethnicity and socioeconomic status), mental illness (e.g. substance and alcohol misuse), personality disorders (other than antisocial personality disorder) and treatment status. By contrast, the associations between these dimensions of psychopathy and emotion recognition were diminished by controlling for cognitive ability. These findings demonstrate that variability in the ability of high-risk personality-disordered prisoners to recognise emotional expressions in the face − in particular, fear and disgust − reflect both the affective and antisocial aspects of psychopathy, and is moderated by cognitive ability.

Keywords: psychopathy, fear, affective deficits, antisocial behaviour

General Scientific Summary

Psychopathy is characterised by affective-interpersonal features and patterns of impulsive and antisocial behaviour. These data indicate that variability in the ability of high-risk prisoners to recognise emotional expressions is linked to psychopathy's affective and antisocial features, is unrelated to demographic and clinical factors, but is also moderated by cognitive ability.

Faces and Facets: Affective Deficits and Antisocial Behaviour in Psychopathy

Have a Common Neuropsychological Substrate

Psychopathy consists of a combination of interpersonal-affective features including

diminished emotional experience, callousness, manipulativeness and interpersonal charm,

irresponsibility, and established patterns of impulsive behaviour (Cleckley, 1976; Hare &

Neumann, 2008). In a forensic context, such traits are strongly associated with criminality,

instrumental and reactive violence, and recidivism (Hare, Clark, Grann, & Thornton, 2000).

Clusters of these specific and comparable traits can be identified in the general, and broadly

non-offending, population (Coid, Freestone, & Ullrich, 2012; Lilienfeld, Watts, Francis

Smith, Berg, & Latzman, 2015; Malterer, Lilienfeld, Neumann, & Newman, 2010) while

recent theoretical development has reconceptualised psychopathy in terms of structural

models of general personality dimensions (Lynam & Miller, 2015; Patrick & Drislane, 2015).

The latter models – emphasising low agreeableness (antagonism) and low conscientiousness

(disinhibition) from the Five Factor Model (FFM) (Gaughan, Miller, Pryor, & Lynam, 2009;

Lynam & Widiger, 2001; Lynam & Widiger, 2007; Miller & Lynam, 2003; Miller et al.,

2016; Miller, Lynam, Widiger, & Leukefeld, 2001) – specify psychopathy as constellations

of features on a continuum across the population rather than a discrete disorder. They also

offer efficient explanations for epidemiological observations such as gender and

comorbidities (Lynam & Miller, 2015; Lynam & Widiger, 2001; Lynam & Widiger, 2007).

Despite these theoretical and empirical advances, there remains significant uncertainty

about the connection between the psychometric components of psychopathy and its

neuropsychological characteristics. Accumulating evidence suggests that psychopathy,

arising out of a neurodevelopmental course (Blair, Peschardt, Budhani, Mitchell, & Pine,

2006; Gao, Glenn, Schug, Yang, & Raine, 2009; Jones, Laurens, Herba, Barker, & Viding,

2009; Viding, Blair, Moffitt, & Plomin, 2005), is associated with pathophysiological function within and, possibly structure of, corticolimbic circuits that mediate impaired performance on a variety of neuropsychological assessments (Carre, Hyde, Neumann, Viding, & Hariri, 2013; Ly et al., 2012; Seara-Cardoso & Viding, 2015; Yang et al., 2010). Investigating connections between the psychometric components of psychopathy and their neuropsychological expression could give us important clues about the contribution of altered cognition and emotion, and their putative neurological bases, to its behavioural and clinical presentation.

In forensic contexts, the most widely used assessment of psychopathy is the Revised Psychopathy Checklist (PCL-R) (Hare, 1991). Initial psychometric analyses of its 20 items identified two underlying factors: one to capture interpersonal and affective deficits (Factor 1) and the other to capture lifestyle choices and anti-social behaviours (Factor 2) (Harpur, Hakstian, & Hare, 1988). Subsequent work refined this structure. First, a 3-factor model isolated the interpersonal, affective and lifestyle items as the measurement with (arguably) the best construct validity (Cooke & Michie, 1999). However, a subsequent 4-facet model restored the antisocial items (e.g. early juvenility) as a central feature of psychopathy (Cleckley, 1976), to enhance the PCL-R's predictive validity in forensic and clinical populations (Hare & Neumann, 2005; Neumann & Hare, 2008).

While the last 15 years has seen an accumulation of evidence that antisocial behaviour is an 'intertwined' correlate of psychopathy (Lynam & Miller, 2015), formal investigations of the relationships between the 2 factor or the 4 facet scores of the PCL-R (Hare, 1991, 2003) and laboratory measures of cognitive performance and/or emotional experience have produced mixed, sometimes complex, results. For example, DSM-IV antisocial personality disorder (First, Spitzer, Gibbon, & Williams, 1997) has been consistently associated with impairments in executive function (EF)(capturing cognitive organisation, attentional control, decision-making and inhibitory control)(Morgan & Lilienfeld, 2000). However, review of

early studies provides some weak evidence for correlations between interpersonal-affective features of psychopathy (as Factor 1 scores) and EF impairments (Maes & Brazil, 2013) while Factor 2 scores have been linked to impaired behavioural inhibition under conditions of heavier rather than lighter working memory loads (Baskin-Sommers, Wallace, MacCoon, Curtin, & Newman, 2010). Most recently, Baskin-Sommers et al have reported reliable associations between the affective features of psychopathy (reflected in Facet 2 scores of the PCL-R) and EF impairments in 377 male prisoners (Baskin-Sommers et al., 2015). By contrast Hughes et al (2015) reported that extensive antisocial histories (as Facet 4 scores) in a small sample of 49 male prisoners went along with *improved* decision-making, as tested with the Iowa Gambling Task (Hughes, Dolan, Trueblood, & Stout, 2015).

The situation is not substantially clearer for measures of emotional reactivity and/or experience. Diminished fear reactivity (as indexed by enhanced startle reflex following presentation of emotional material)(Davis, 1998) showed selective and positive associations with Factor 1 scores in 54 (sexual offending) criminal psychopaths (Patrick, Benning, & Bradley, 2004; Patrick, Bradley, & Lang, 1993); but only additive or interactive scores of Factors 1 and 2 in samples of female prisoners (N=172)(Sutton, Vitale, & Newman, 2002), community participants (N=90)(Vanman, Mejia, Dawson, Schell, & Raine, 2003) and male prisoner samples (N=108)(Vaidyanathan, Hall, Patrick, & Bernat, 2011). Newman and colleague have provided evidence that Factor 1 scores are associated with altered attention towards threat-related or peripheral stimuli during goal-directed behaviour (and altered early event-related scalp potentials) in samples of male prisoners (Baskin-Sommers, Curtin, Li, & Newman, 2012; Baskin-Sommers, Curtin, & Newman, 2011; Hamilton, Baskin-Sommers, & Newman, 2014). However, Lake et al (2011) reported that both Factor 1 *and* Factor 2 scores are associated with diminished fear-potentiated startle following the presentation of goal-directed cues (Lake, Baskin-Sommers, Li, Curtin, & Newman, 2011). In a smaller study of

43 adult male prisoners, Hansen et al found no association between any of the 4 PCL-R facets and recognition of facial expressions of fear (Hansen, Johnsen, Hart, Waage, & Thayer, 2008). Overall, these mixed results likely reflect the recruitment of mixed samples from divergent prisoner populations, small sample sizes and, occasionally, the use of neuropsychological assessments that are unreliable in non-neurological patient populations.

In the present study, we addressed these issues by (simply) testing whether the 4 facets of the PCL-R (Hare, 2003) are linked to one common measure of neuropsychological impairment in a specific population of prisoners at heightened risk of reoffending: the ability to recognise facial expressions of emotion (Dawel, O'Kearney, McKone, & Palermo, 2012a; Marsh & Blair, 2008). Impaired recognition of facial and vocal emotions are a well-established characteristic of psychopathy (Blair et al., 2004; Brook, Brieman, & Kosson, 2013; Dawel, et al., 2012a; Dolan & Fullam, 2006; Kosson, Suchy, Mayer, & Libby, 2002; Pham & Philippot, 2010). Observations of comparable impairments in children with psychopathic features (Blair, Colledge, Murray, & Mitchell, 2001; Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009; Stevens, Charman, & Blair, 2001) and their association with callous/unemotional traits (for fearful expressions) (White et al., 2016) and diminished activity within amygdala (Jones, et al., 2009; White et al., 2012) suggest an aetiological mechanism in psychopathy (Blair, Peschardt, et al., 2006; Viding, et al., 2005).

Six hundred and eighty five male prisoners were assessed with the PCL-R before completing an assessment of emotional recognition involving the 6 emotional states (fear, sadness, happiness, surprise, anger and disgust; see below)(Ekman & Friesen, 1976). Initially, we focused upon recognition of fear because, arguably, deficits in fear experience and recognition are the largest and most consistent impairments reported in psychopathy (Dawel, et al., 2012a; Lopez, Poy, Patrick, & Molto, 2013; Lykken, 1995; Marsh & Blair, 2008) and those most likely linked to its interpersonal-affective features (Dawel, et al.,

2012a; Dolan & Fullam, 2006). Impaired fear recognition has also been consistently linked to changes in amygdala activity in psychopathic (Carre, et al., 2013; Sebastian et al., 2014; White, et al., 2012) and other clinical populations (Norbury, Selvaraj, Taylor, Harmer, & Cowen, 2010). We hypothesised that (i) affective aspects of psychopathy (reflected in Facet 2 scores) would be linked to variation in the accuracy of fear recognition (and, possibly, other emotions); and that (ii) antisocial features, as an intertwined feature of psychopathy (as Facet 4 scores) would be linked to variability in recognition accuracy of multiple emotions.

Method

The experiment was approved by a National Health Services research ethics committee. Participants provided informed consent, having read an information sheet.

Sample

These data were collected as part of the Prisoner Cohort Study, commissioned by the Home Office of England and Wales (Coid et al., 2009; Coid et al., 2011). This was a prospective study of a cohort of 1353 male prisoners released from United Kingdom prisons between 14 November 2002 and7 October 2005, with the aim of assessing the predictive value of clinical and risk assessment measures for violent and other criminal behaviours in individuals judged to be at elevated risk of serious reoffending behaviour.

The cohort was generated from the Prison Service Inmate Information System if they met the following criteria: (1) serving a prison sentence of 2years or more for a sexual or violent principal offence (but excluding life sentence prisoners), (2) aged 18 years and over, and (3) having 1 year left to serve. Information was provided on previous criminal history using the Home Office Offenders Index on all prisoners in England and Wales satisfying these criteria. On the basis of their current and previous convictions, a stratified sample was identified with over-selection of prisoners from ethnic minority groups, younger prisoners

and potentially high-risk offenders selected using a criterion of the highest scoring 10% on

the Offenders Group Reconviction Scale (OGRS)(Copas & Marshall, 1998).

All participants were seen during the last year before their release from custody and

underwent assessments involving semi-structured interview to assess mental illness,

personality disorders and neuropsychological function. Information including demographics,

offending history and self- reported psychiatric treatments were collected from interview and

file review; drug and alcohol misuse were assessed separately (see below).

Measures of psychopathy

The Psychopathy Checklist Revised (PCL-R)(Hare, 1991, 2003) was used to assess

psychopathy. Twenty items capture the interpersonal (Facet 1), affective (Facet 2), lifestyle

(Facet 3) and antisocial (Facet 4) components of psychopathy; these are scored using a semi-

structured interview and inspection of case records. In brief, Facet 1 items include

grandiosity, superficial charm, pathological lying, and conning/manipulative behaviour.

Facet 2 items capture lack of remorse, failure to accept responsibility, shallow affect, and

callousness/ lack of empathy. Facet 3 includes items need for stimulation, impulsivity,

irresponsibility, parasitic lifestyle, and lack of realistic long-term goals and, finally, Facet 4

includes items to code poor behavioural control, early behavioural problems, juvenile

delinquency, revocation of conditional release, and criminal versatility. Item ratings are

summed to create a total score between 0 and 40 (Hare, 2003). Cronbach's αs for our facet

score ratings were 0.71 for Facet 1, 0.68 for Facet 2, 0.59 for Facet 3 and 0.69 for Facet 4.

Finally, the inter-rater reliability for the 8 researchers who collected the data was tested using

6 reliability cases over 2 days; the intra-class correlation being 0.85 (Coid, et al., 2011) .

Measures of psychological disorder

DSM-IV personality disorders were assessed using the Structured Clinical Interview

for Axis II disorders (SCID-II) (First, et al., 1997).Axis I disorders (current and lifetime

psychosis, depression and drug dependence) were assessed with a structured interview tool

devised by the research team using the respective DSM-IV criteria (First, et al., 1997).

Alcohol misuse was established using the Alcohol Use Disorders Identification Test

(AUDIT) (Bradley et al., 1998). Substance misuse disorders, other than those involving

alcohol, were diagnosed using the structured clinical interview with items covering

compulsive, out-of-control drug use and subjective feeling of dependence, unsuccessful

attempts to quit, tolerance and withdrawal symptoms. Intra-class correlations were 0.98 for

history-taking and 0.80 for clinical assessment (Coid, et al., 2009; Coid, et al., 2011).

Cognitive ability

Participants' cognitive ability was measured using the Wechsler Abbreviated Scale of

Intelligence (WASI)(Wechsler, 1999). It consists of four subtests structured to measure

verbal abilities (vocabulary and similarities) and performance abilities (matrices and block

design).Here, we used the 2 sub-test form to derive an estimate of full-scale IQ only.

Emotion recognition

This computerized test of facial emotion recognition has been used extensively in

pharmacological (Harmer et al., 2009; Harmer, Rogers, Tunbridge, Cowen, & Goodwin,

2003; Harmer, Shelley, Cowen, & Goodwin, 2004) and clinical investigations (Chan,

Goodwin, & Harmer, 2007; Harmer, Grayson, & Goodwin, 2002). Facial expressions

featured the six basic emotions of happiness, surprise, sadness, fear, anger and disgust, taken

from the Pictures of Affect Series (Ekman & Friesen, 1976). Each expression was morphed

across variable percentages of the shape and texture differences between the two standard

images 0% (neutral) and 100% (full emotion) in 10% steps(Young et al., 1997). Four

examples of each emotion, at each intensity, were presented (a total of 10 individuals). Each

face was also given in a neutral expression, making a total of 250 stimuli presentations.

Each face was presented on a computer screen for 500ms and immediately replaced by a blank screen. Participants identified the emotion of each face verbally; the experimenter recording these on the computer keyboard. Following the completion of the task, the data was retrieved as proportions of accurate responses for each emotion, pooling over intensity.

Results

Sample characteristics

Demographic and criminological characteristics of the sample are shown in Table 1. The mean (standard error) age of our sample was 29.9(0.41) years (range: 18 to 72 years), with the majority of our being right handed by self-report (n=573, 84.9%). More than a quarter of our prisoners (27.6%, n=189) were taking medication for a mental illness, and more than half reported consultations with a psychiatrist or psychologist (54.3%, n= 371). We found that 21.4% had received treatment for drug (n=146) and 10.2% for alcohol problems (n=70). Our sample scored a mean estimated FSIQ of 90 (0.60), with a range of 4 to 133. Nearly half (45.7%, n=302) scored an FSIQ in the average range between 90 and 119. However, as expected, nearly an equal proportion (44.2%, n=292) scored in the low average and borderline range (between 70 and 89), and 6.9% (n=46) had FSIQ in the low range (less than 69). 3.2% of the prisoners (n=21) had IQ above average (above 120).

Table 1 about here

With regards to the clinical characteristics of our sample (see Table 2), 9.1% (n=62) fulfilled the criteria for lifetime diagnosis of a DSM-IV psychotic illness, 32.4% (n=222) for a depressive illness and 74% (n=504) for at least one DSM-IV personality disorder. The most prevalent personality disorder was antisocial (66.2%, n=450), followed by paranoid (23.7%, n=161) and borderline (20%, n=136). 38.6% of our sample satisfied criteria for a drug dependence disorder (n=262), while 22.4% for alcohol dependence (n=153).

Table 2 about here

Overall, 297 (43.4%) participants were imprisoned for a violent offence and 125

(18.3%) for a sexual offence. PCL-R scores showed a mean score of 17.6(0.29), with a

minimum score of 0 and a maximum score of 36. The mean scores for Facets 1 through 4

were 2.4(0.07), 3.4(0.08), 4.9(0.09) and 5.6(0.11) respectively. Correlations between the 4

facet scores ranged between 0.25 (Facet 1:Facet 4) and 0.60 (Facet3:Facet4) (see Table S1 of

the Supplementary Material). Note: investigation of interactive relationships between fear

recognition and the 4 facets did not produce statistically robust results (see Table S2).

Recognition of facial emotions

Table 3 shows the bivariate correlations between each of 4 PCL-R facet scores and

recognition accuracy of the 6 emotions: fear, anger, disgust, surprise, happiness and sadness.

Individuals with more of the affective features that characterise psychopathy − i.e. Facet 2;

lack of remorse, failure to accept responsibility, shallow affect, and callousness/ lack of

empathy − tended to be less accurate at recognising both fear (r=-0.13, p<0.001) and disgust

(r=-0.08, p=0.036) compared to those with fewer of these features. Individuals with more

extensive anti-social histories − i.e. Facet 4; poor behavioural control, early behavioural

problems, juvenile delinquency, revocation of conditional release, and criminal versatility −

showed similar reductions in fear (r=-0.10, p=0.012) and disgust recognition accuracy (r=-

0.12, p=0.001) and, additionally, were less accurate with surprise (r=-0.12, p=0.002).

Table 3 about here

Individuals with more of the interpersonal features of psychopathy − i.e. Facet 1;

grandiosity, superficial charm, pathological lying, and conning/manipulative behaviour −

demonstrated enhanced recognition of anger (r=0.08, p=0.049) compared to individuals with

fewer of the interpersonal features. By contrast, individuals with more of the lifestyle

features of psychopathy − i.e. Facet 3; need for stimulation, impulsivity, irresponsibility,

parasitic lifestyle, and lack of realistic long-term goals − demonstrated reductions in

recognition accuracy for surprise (r=-0.08, p=0.032). Recognition of facial expressions of happiness and sadness were not clearly associated with any of PCL-R facet (see Table 3).

Table 4 shows the univariate regressions of the recognition accuracy scores for the 6 individual emotions (dependent variables) against the 4 facets of the PCL-R (independent variables). These were separate 'base' models for each emotion against the facets (all 4 included in each model), picking out unique variance. Next, we adjusted these models for the effects of other variables that might, in this sample, have confounded the relationships between recognition accuracy and the four PCL-R facets (Table S3). Specifically, we added age as a continuous variable, ethnicity and marital status as categorical variables, and socioeconomic status (social class I & II versus III-V) as binary variables. We also added mental illness (e.g. AUDIT scores) and personality disorders as ordinal (dimensional) variables since they are prevalent in forensic populations and are associated with impaired emotion recognition .We excluded antisocial personality disorder because of its overlap with items from the anti-social facet (Facet 4) of the PCL-R. We also included current treatment status (psychotropic medication, consultations with mental health professionals, and treatments for drug and alcohol dependence coded separately) as binary variables.

Finally, in a third model (Table S4), we included estimated participants' full-scale IQ, as a single continuous variable, since cognitive ability can be related to both psychopathy and recognition of facial emotions. We provide the β-coefficients arising out of these two extra models in two additional tables in the Supplemental Material (see Tables S3 and S4).

We present the findings for each emotion separately.

<div align="center">Table 4 about here</div>

Fear

Table 4 shows the β coefficients for the base model for fear recognition against the 4 facets scores of the PCL-R. Consistent with the bivariate correlations, individuals with more

of the affective features (reflected in higher Facet 2 scores) were less accurate in the recognition of fear compared to those with fewer of these features (β= -0.12 (SE: 0.04); 95% CI= -0.19, -0.06, p<0.001). Individuals with more extensive antisocial histories (reflected in higher Facet 4 scores) showed similar reductions (β= -0.06 (0.03); 95% CI= -0.12, -0.01, p=0.017). By contrast, individuals with more of the interpersonal or lifestyle features (Facet 1 and Facet 3) showed only marginally positive associations with fear recognition (β= 0.04 (0.04), 95% CI= -0.04, 0.11 and β= 0.07 (0.04); 95% CI= 0.00, 0.14, respectively).

Subsequent adjustments for demographics, diagnoses of mental disorders, alcohol and/or substance misuse disorders, and current treatment status did not substantially alter the above pattern of relationships (Table S3). However, adjustment for cognitive ability further attenuated the strength of the relationship between both the affective and antisocial facets and fear recognition (Table S4); becoming marginally non-significant (β= -0.07 (0.04); 95% CI= -0.15, 0.00, p=0.054 and β= -0.05 (0.03); 95% CI= -0.11, 0.00, p=0.067 respectively).

Anger

Individuals with more of the interpersonal features of psychopathy (reflected in Facet 1 scores) demonstrated enhanced recognition of anger (β= 0.12 (SE: 0.06); 95% CI= 0.01, 0.23, p=0.031) compared to those without these features. This association survived subsequent analyses adjusting for demography, diagnoses of mental disorders, and current treatment status (see Table S3) but did not survive correction for cognitive ability (Table S4).

Disgust

Individuals with more of the interpersonal features of psychopathy (reflected in the Facet 1 scores) demonstrated enhanced recognition of disgust (β= 0.12 (SE: 0.04); 95% CI= 0.04, 0.20, p=0.004), whereas those with more affective and antisocial features (reflected in higher Facet 2 and Facet 4 scores) showed relatively poor accuracy in recognising this emotion (β= -0.10 (SE: 0.04); 95% CI= -0.17, -0.02, p=0.009 and β= -0.08 (SE: 0.03); 95%

CI= -0.13, -0.02, p=0.007 respectively). Adjusting for demographic variables, diagnoses of

mental disorders and current treatment status did not alter the results (see Table S3);

however, adjustment for FSIQ rendered them non-significant (see Tables S4).

Surprise

In the base model, individuals with more of the interpersonal features of psychopathy

(reflected in Facet 1 scores) were more accurate at recognising surprise than individuals with

less of these features (β= 0.09 (SE: 0.04); 95% CI= 0.01, 0.17, p=0.036); individuals with

more antisocial features (with Facet 4 scores) were less accurate (β= -0.06 (SE: 0.03); 95%

CI= -0.12, -0.00, p=0.037). Adjustments for demographics, clinical factors and cognitive

ability rendered the relationships between the interpersonal facet and surprise recognition

non-significant; however, the negative association involving antisocial features remained

significant (β= -0.07 (SE: 0.03); 95% CI= -0.13, -0.00, p=0.049) (see Tables S3 and S4).

Happiness and sadness

We found no significant associations between the 4 facets of the PCL-R and the

recognition accuracy of happiness or sadness in the base model (see Tables 4, S3 and S4).

Discussion

These data demonstrate that both the affective deficits of psychopathy (captured by

Facet 2 of the PCL-R)(Hare, 2003) and the antisocial behaviour (captured by Facet 4) are

associated with diminished recognition of facial expressions of fear and disgust; while the

interpersonal features (captured by Facet 1) showed weak associations with *improved*

recognition of facial expressions of anger and surprise. These relationships were evident in a

large cohort of 685 prisoners at heightened risk of serious reoffending (Coid, et al., 2009;

Coid, et al., 2011) and remained statistically significant following control for the effects of

demographic (i.e. marital status, SES and ethnicity) and clinical variables (i.e. mental illness,

personality disorders other than antisocial, treatment status for alcohol and substance misuse).

However, these associations were rendered marginally non-significant following control for (general) cognitive ability (as indicated by WASI scores (Wechsler, 1999)). Collectively, the data presented here represent a comprehensive examination of facial emotion recognition in psychopathy, as measured with the PCL-R, in a high-risk (and inmate) forensic sample. Before considering their implications, we consider two statistical features of these findings: their robustness in the face of confounding clinical and psychometric factors, and effect sizes.

First, these findings tell us something about the stability of associations between the PCL-R's psychometric features and emotion recognition accuracy against common confounds in high-risk forensic populations. First, the strongest associations observed here, between, on the one hand, Facet 2 and Facet 4 of the PCL-R and, on the other hand, accuracy of both fear and disgust recognition, were robust when we controlled for demographic factors (i.e. marital status, ethnicity and SES) and clinical factors elevated in high-risk forensic populations (i.e. mental illness, personality disorders other than antisocial, treatment status for alcohol and substance misuse). However, they were substantially weakened, though not abolished, following control for participants' WASI scores. A substantial proportion of our sample (44.2%) scored estimated (by 2 subtest) FSIQ in the low average to borderline range. Therefore, our results demonstrate that, while the links between the affective and antisocial components of psychopathy (on the one hand) and fear and disgust recognition (on the other hand) do not reflect unspecified demographic characteristics or complicating clinical aspects, they can reflect relatively low (and co-varying) cognitive ability, at least in high-risk samples.

Second, the strength of the associations involving the individual facet scores and emotion recognition accuracy reported here were, even in the best cases, modest. Indeed, while base models that included all four facets together but not the demographic, clinical and psychometric factors produced R^2 values between 0.0022 (sadness) and 0.0267 (fear) (see Table 4), fully corrected models with the inclusion of these latter variables, produced much

larger R^2 values between 0.0657 (surprise) and 0.1738 (disgust) (see Table S4); these improvements being statistically significant. These limited associations might raise some doubt about the importance of the altered emotion recognition in explaining the behavioural correlates of psychopathy. Broadly speaking, there are two ways to consider this challenge.

On the one hand, to the extent that problems in emotion recognition are seen as being functionally deleterious in social interactions – such that, for example, individuals with high Facet 2 scores fail to see distress signals in others, facilitating reactive aggression (Blair, 1995, 2003, 2013; Blair, Jones, Clark, & Smith, 1997) – their modest associations with PCL-R facets suggest that these impairments have only limited consequences for the aggressive behaviour seen in psychopathic populations. (Though this leaves open the possibility that it is the missing emotional correlates of distress identification that actually modulates aggressive behaviour (Blair, 2005, 2013; Rhee et al., 2013)). On the other hand, the relationships between the capacity of individuals to recognise emotions and actual social behaviour may be highly non-linear. So, changes in emotional recognition of the kind observed here may be more appropriately interpreted as relatively weak indicators of changes in the emotional function and experience of psychopathic individuals (Blair et al., 2006; Burley, Gray, & Snowden, 2017; Kiehl et al., 2004; Newman, Curtin, Bertsch, & Baskin-Sommers, 2010; Patrick, et al., 1993; Williamson, Harpur, & Hare, 1991). From this standpoint, relatively poor recognition of fearful expressions – to take just one example – in individuals with high Facet 2 scores (compared to individuals with low Facet 2 scores) is only a weak expression of the broader affective deficits of psychopathy. These emotional deficits – often measured, as they were here, using forced choice tests – might be masked, at least partially, by various non-specific (e.g. motivational) and situational factors.

Our findings broadly support the proposal that psychopathy is associated with problems in the recognition of fearful facial expressions (Dawel, et al., 2012a; Marsh & Blair,

2008) but, in contrast to a smaller scale study (Hansen et al, 2008), demonstrate that this

feature of the disorder is linked to two of its four psychometric facets (Hare, 2003): both its

affective (Facet 1) and its antisocial characteristics (Facet 4). Other investigations have

reported relationships between fear reactivity and interactive effects of Factor 1 and Factor 2

of the PCL-R (Sutton, et al., 2002; Vaidyanathan, et al., 2011; Vanman, et al., 2003).

However, we found no evidence that the negative association between, for example, Facet 4

scores and accuracy of fear recognition was moderated by Facet 2 scores. This suggests that,

their shared variance aside, the connections between the affective and antisocial features of

the PCL-R and the ability to recognise facial expression of fear are unique and independent.

Previously, Cooke and colleagues argued that the items of Facets 1, 2 and 3 of the

PCL-R provide a specification of psychopathy with the greatest construct validity; and that

the antisocial behaviour captured by remaining items, as Facet 4, represents the contingent

expression of these central features (Cooke & Michie, 1999; Cooke, Michie, & Skeem, 2007;

Skeem & Cooke, 2010a, 2010b). However, the inclusion of Facet 4 substantially improves

the predictive validity of the PCL-R (Hare & Neumann, 2008) and evidence has continued to

accumulate that anti-sociality, as distinct from criminality (Neumann, Hare, & Pardini, 2014),

is intimately related to, or 'intertwined with' (Lynam & Miller, 2015), psychopathy in both

forensic and general community populations (Camp, Skeem, Barchard, Lilienfeld, &

Poythress, 2013; Hecht, Berg, Lilienfeld, & Latzman, 2016). Our findings contribute to this

debate by suggesting that problems in fear recognition may be linked to both the affective

aspects of the construct (e.g. lack of remorse, shallow affect, and callous/ lack of empathy)

and the heightened propensity for antisocial behaviour (e.g. poor behavioural control, early

behavioural problems, juvenile delinquency and criminal versatility). Put the other way

around, our data suggest that the affective and antisocial features of psychopathy find

expression in poor fear recognition in, at least in high-risk forensic populations.

Our data may also have implications for our understanding of psychopathy in terms of structural models of personality. FFM conceptions construe the construct in terms of (i) low scores on all facets of the agreeableness factor (i.e. trust, straightforwardness, altruism, compliance, modesty, tender-mindedness); (ii) low scores on the facets of the conscientiousness factor (i.e. competence, order, dutifulness, achievement striving, self-discipline and deliberation); plus (iii) low anxiety and high anger from the neuroticism factor; and (iv) low warmth and high assertiveness from the extraversion factor; see (Lynam & Miller, 2015; Lynam & Widiger, 2001; Miller & Lynam, 2015). Antagonism, with disinhibition traits, collects together both diminished affect and liability for anti-sociality, and appears to be the most distinctive correlate of psychopathy (Gaughan, et al., 2009; Lilienfeld, et al., 2015; Miller, et al., 2016; O'Boyle, Forsyth, Banks, Story, & White, 2015; Seibert, Miller, Few, Zeichner, & Lynam, 2011). Therefore, our findings can be re-presented to indicate that trait antagonism – as expressed in high-risk prisoners – is associated with both diminished ability to recognise facial expressions of fear and disgust.

Psychopathic individuals sometimes exhibit broader impairments in emotional recognition rather than just fear (Brook, et al., 2013; Dawel, et al., 2012a; Kosson, et al., 2002; Marsh & Blair, 2008; Pham & Philippot, 2010). However, the consistency of such deficits is relatively low and probably confounded by cross-study differences in populations sampled and dependent measures (Dawel, O'Kearney, McKone, & Palermo, 2012b). Contrary to previous reports (Blair, et al., 2001; Blair, et al., 2004; Dolan & Fullam, 2006), we found little evidence that PCL-R facet scores were associated with the recognition accuracy for sadness or happiness. However, consistent with at least two other studies (Dawel, et al., 2012a; Kosson, et al., 2002; Suchy, Whittaker, Strassberg, & Eastvold, 2009), we did find that higher Facet 2 and Facet 4 score went along with diminished recognition of disgust. Facial expressions of fear and disgust can be amongst the hardest to identify of the

basic emotions but diverge in their recognition accuracy across the lifespan (Calder et al.,

2003). They can also have opposite impacts upon psychological functions such as attention

(Vermeulen, Godefroid, & Mermillod, 2009) and their recognition is supported by partially

dissociable neural circuits (see below) (Calder, Lawrence, & Young, 2001). Disgust, as an

experienced emotional state, may also contribute to the capacity to sense moral transgressions

(Schaich Borg, Lieberman, & Kiehl, 2008; Schnall, Haidt, Clore, & Jordan, 2008) but see

(Pizarro, Inbar, & Helion, 2011). Therefore, the present data suggest that both the affective

and antisocial aspects of psychopathy are linked to the suppressed recognition and, perhaps,

the experience of emotional states that help to mediate moral cognition.

Finally, individuals with psychopathic traits can show diminished recognition of

facial expressions of surprise (Blair, et al., 2004; Dawel, et al., 2012a; Dolan & Fullam, 2006;

Fairchild, et al., 2009) and slightly less reliably, anger (Dawel, et al., 2012a). The present

data indicate opposing associations with Facet 1 and Facet 4 PCL-R scores; with the

interpersonal features of psychopathy going along with enhanced recognition of surprise and

anger; but the antisocial features going along with diminished recognition of surprise.

Although only the latter relationship remained statistically significant following control for

both clinical factors and cognitive ability, the former relationship suggests that the

interpersonal characteristics of psychopathy – most obviously, the ability to con and

manipulate others – is aided by an enhanced sensitivity to signals of threat or signals that

other people are processing unexpected information and events. Equally, extensive antisocial

histories captured by higher Facet 4 scores (e.g. poor behavioural controls) could be stronger

in individuals who fail to recognise the often subtle signs of surprise in others (Reisenzein,

Bordgen, Holtbernd, & Matz, 2006), as one of several facial 'interrupt signals' for aggressive

or challenging behaviour (c.f. Blair et al's Violence Inhibition Mechanism)(Blair, 1995).

Neuroimaging evidence indicates that psychopathy, as a neurodevelopmental disorder (Blair, 1995; Blair, Peschardt, et al., 2006; Carre, et al., 2013; Gao, et al., 2009), is associated with pathophysiological function within corticolimbic neural circuits (Carre, et al., 2013; Kiehl, et al., 2004; Seara-Cardoso & Viding, 2015). On the one hand, diminished activity (as weaker blood-oxygenation-level-dependent; BOLD signals) within circuits organized around the amygdala appear to mediate the impoverished emotional reactivity and experience characteristic of individuals with psychopathic characteristics (Jones, et al., 2009). On the other hand, heightened BOLD responses within anterior cortical systems (e.g. orbitofrontal and cingulate cortices) and sub-cortical afferent targets (e.g. the ventral striatum and amygdala) may mediate both the impulsive and poor behavioural control that characterises the disorder. However, these patterns are not consistently observed (Finger et al., 2011) and can be modulated by task demands (e.g. perspective-taking). Surprisingly, the extant data tends to highlight relationships between the interpersonal style and antisocial features of psychopathy (e.g. Facet 1 and Facet 4 of the PCL-R) and BOLD signals (Seara-Cardoso & Viding, 2015). The present data offer two boundary conditions for investigations that seek to relate psychopathic features to disrupted functioning in at least partially overlapping neural circuits: specifically, affective deficits and extensive antisocial histories may be associated with impaired fear recognition mediated by altered signalling within amygdala-based circuits (Adolphs, 2008) while impaired disgust recognition mediated by functional changes in circuitry around the insula and striatum (Calder, et al., 2001).

Our study's main strengths include a large cohort of 685 participants, the use of a well-validated measure of emotional recognition, and the inclusion of a large range of clinical and demography records. However, research is needed to test common relationships between the affective and antisocial dimensions of psychopathy and fear (and disgust recognition)(and antagonism) in the broader population using both facial and vocal expressions of emotion.

However, notwithstanding these possibilities, our findings indicate that, in a sample of high-risk prisoners, the affective and antisocial aspects of psychopathy find expression in relatively poor recognition of fear and disgust in the face.

Table 1. Demographic and criminological characteristics of 685 participants in the Prisoner Cohort Study (Coid, et al., 2009; Coid, et al., 2011) who completed as assessment of emotion recognition.

		N (%)
Age group	- 18-34	- 508 (74.2)
	- 35-54	- 140 (20.4)
	- >55	- 37 (5.4)
Ethnic origin	- White	- 563 (82.2)
	- Black	- 82 (11.9)
	- Asian	- 21 (3.1)
	- Other	- 19 (2.8)
Marital status	- Married/cohabiting	- 270 (39.4)
	- Single	- 364 (53.1)
	- Separated/widowed	- 51 (7.5)
Social class[1]	- I and II	- 31 (4.5)
	- Other (III-V)	- 652 (95.5)
IQ	- <69	- 46 (6.9)
	- 70-79	- 123 (18.6)
	- 80-89	- 169 (25.6)
	- 90-109	- 257 (38.9)
	- 110-119	- 45 (6.8)
	- >120	- 21 (3.2)
Handed	- Right	- 573 (84.9)
	- Left	- 93 (13.8)
Index Offence	- violent	- 297 (43.4)
	- sexual	- 125 (18.3)

Note: [1]Occupational social class was coded into one of seven groups: professional (I), managerial/

technical (II), skilled non-manual (IIINM), skilled manual (IIIM), semiskilled (IV), unskilled (V), and

undetermined.

Table 2. Clinical features of 685 participants in the Prisoner Cohort Study (Coid, et al., 2009; Coid, et al., 2011) who completed an assessment of emotion recognition.

		N (%)
Mental illness	- Psychosis	- 62 (0.1)
	- Depression	- 222 (32.4)
Personality disorder	- Antisocial	- 450 (66.2)
	- Borderline	- 136 (20.0)
	- Paranoid	- 161 (23.7)
	- Narcissistic	- 64 (9.4)
	- Schizoid	- 42 (6.2)
	- Obsessive compulsive	- 41 (6.0)
	- Schizotypal	- 21 (3.1)
	- Other (Dependent, Histrionic)	- 12 (1.7)
Addiction	- alcohol	- 153 (22.4)
	- drugs	- 262 (38.6)

Table 3. Bivariate correlations between four facets of the PCL-R psychopathy and recognition accuracy for the 6 basic emotions (Ekman & Friesen, 1976) in 685 participants from the Prisoner Cohort Study (Coid, et al., 2009; Coid, et al., 2011) .

	Facet 1	*Facet 2*	*Facet 3*	*Facet 4*
Fear	-0.03	**-0.13[#]**	-0.02	**-0.10[†]**
Anger	**0.08[†]**	-0.01	0.01	-0.02
Disgust	0.05	**-0.08[†]**	-0.04	**-0.12[#]**
Surprise	0.03	-0.06	**-0.08[†]**	**-0.12[≠]**
Happiness	0.02	-0.02	-0.05	-0.05
Sadness	0.03	0.03	-0.01	-0.03

Note: # $p<0.001$, ≠ $p<0.01$, † $p<0.05$

Table 4. Associations between 4 facets of the PCL-R (Hare, 2003) and emotion recognition in 685 participants of the Prisoner Cohort Study (Coid et al., 2009; Coid et al., 2011).

	Facet 1	*Facet 2*	*Facet 3*	*Facet 4*	R^2
Fear	0.04 (0.04)	**-0.12 (0.04)**	0.07 (0.04)	**-0.06 (0.03)**	0.0267
	(-0.04, 0.11)	**(-0.19, -0.06)**[#]	(0.00, 0.14)	**(-0.12, -0.01)**[†]	
Anger	**0.08 (0.03)**	- 0.04 (0.03)	0.01 (0.03)	- 0.01 (0.02)	0.0093
	(0.02, 0.14)[†]	(-0.09, 0.02)	(-0.04, 0.07)	(-0.05, 0.03)	
Disgust	**0.12 (0.04)**	**-0.10 (0.04)**	0.03 (0.04)	**- 0.08 (0.03)**	0.0237
	(0.04, 0.20)[≠]	**(-0.17, -0.02)**[≠]	(-0.04, 0.11)	**(-0.13, -0.02)**[≠]	
Surprise	**0.09 (0.04)**	- 0.05 (0.04)	-0.02 (0.04)	**- 0.06 (0.03)**	0.0192
	(0.01, 0.17)[†]	(-0.13, 0.02)	(-0.09, 0.06)	**(-0.12, -0.00)**[†]	
Happiness	0.05 (0.04)	-0.01 (0.04)	-0.03 (0.04)	- 0.02 (0.03)	0.0043
	(-0.04, 0.14)	(-0.09, 0.07)	(-0.11, 0.05)	(-0.08, 0.04)	
Sadness	0.03 (0.04)	0.02 (0.04)	-0.00 (0.04)	- 0.02 (0.03)	0.0022
	(-0.05, 0.11)	(-0.05, 0.10)	(-0.08, 0.07)	(-0.08, 0.04)	

Note 1: # $p<0.001$, ≠ $p<0.01$, † $p<0.05$

Note 2: Proportionate recognition scores for each emotion are entered as outcome variables in separate models, with facets entered simultaneously as predictors. We report *β*-coefficients, standard error (SES), 95% Confidence Intervals (CI) and R^2 for each model.

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