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Fearless dominance mediates the relationship between the facial width-to-height ratio and willingness to cheat

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ABSTRACT

The facial width-to-height ratio (fWHR) is associated with a range of behaviours in men, but little is known about the underlying psychological mechanisms. We tested whether psychopathic personality traits were related to fWHR and mediated the link between this metric and cheating behaviour. Participants (146 men, 76 women) completed the Psychopathic Personality Inventory-Revised and rolled dice to determine the number of ballots allowed for entry into a lottery for a cash prize. Men's willingness to cheat (entering more ballots than permitted) and their extent of cheating (number of additional ballots) was associated positively with fearless dominance and fWHR. Further, in men, fearless dominance was correlated with fWHR and mediated the relationship between fWHR and willingness to cheat, but not the extent of cheating. In women, there were no differences in fWHR or in personality traits between cheaters and non-cheaters. Psychopathic personality traits may thus underlie some fWHR-behaviour relationships in men.

1. Introduction

The facial width-to-height ratio (fWHR; bizygomatic width divided by upper-face height), first described by Weston, Friday, and Liò (2007), has garnered much attention because of its association with a cluster of behavioural tendencies in men, but not in women. For example, men with larger face ratios were more aggressive on a laboratory aggression measure than were men with smaller face ratios (Carré & McCormick, 2008) and violent !Kung San men of Namibia had wider faces than those who were non-violent (Christiansen & Winkler, 1992). Amygdala activation, which predicts aggression in clinical populations (reviewed in Coccaro, Sripada, Yanowitch, & Phan, 2011), shared stronger associations with self-reported aggression in men with larger than with smaller face ratios (Carré, Murphy, & Hariri, 2013). Men with larger face ratios were also more likely to exploit the trust of others for personal gain (Stirrat & Perrett, 2010, 2012), endorse prejudicial beliefs (Hehman, Leitner, Deegan, & Gaertner, 2013), use explicit deception, and cheat in a lottery for a cash prize (Haselhuhn & Wong, 2012) than were men with smaller face ratios; these relationships were absent for women. Further, elite hockey players with larger face ratios had more penalty minutes per game (e.g., slashing, elbowing) than those with smaller ratios (Carré & McCormick, 2008). Although this association was only marginally significant in a larger sample of players ($p = 0.057$; Deaner, Goetz, Shattuck, & Schnotala, 2012), it appears to be moderated such that it is stronger among men who are lower in social status (Goetz et al., in press).

Any relationship between fWHR and such antisocial behaviour likely involves psychological mechanisms. Nevertheless, we have not found relationships between fWHR and broad domains of personality (e.g., such as the "big five" personality traits) (unpublished observations). Targeting specific personality traits rather than broad dimensions may be more fruitful. One study reported a correlation between fWHR and self-ratings of psychological "sense of power" in men, and that sense of power mediated the relationship between fWHR and cheating (Haselhuhn & Wong, 2012). The "sense of power" scale (Anderson & Galinsky, 2006), however, has not received the extensive psychometric analyses conducted for other questionnaires. Further, rather than directly measure cheating, Haselhuhn and Wong (2012) asked participants (50 men, 53 women) to report dice roll values (which were exchangeable for lottery ballots). Men, but not women, with high fWHRs reported higher dice rolls than those with low fWHRs, which the researchers concluded indicated cheating. Thus, cheaters and

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non-cheaters could not be directly compared to determine the true effect size. To address this limitation, we measured cheating directly in a larger sample (146 men and 76 women). We also used a measure of targeted personality traits that may better account for variability in fWHR and in cheating behaviour (and in antisocial behaviour, more generally). We measured psychopathic personality traits because of their robust association with antisocial behaviour in clinical and community samples (reviewed in Leistico, Salekin, DeCoster, & Rogers, 2008; Reidy, Shelley-Tremblay, & Lilienfeld, 2011).

We used the well-validated Psychopathic Personality Inventory-Revised (PPI-R; Lilienfeld & Widows, 2005), which assesses multiple personality traits relevant to psychopathy that load onto three factors: fearless dominance (low anxiety/stress, fearlessness, and high social dominance and influence), self-centred impulsivity (tendency to exploit others and to blame others for personal failures, and impulsivity), and coldheartedness (tendency to be apathetic, guiltless, and callous). We hypothesized that fearless dominance would be most relevant to cheating on the basis that it predicted antisocial behaviour (self-benefiting/other-costing behaviour) in versions of a Dictator game (Geniole, Busseri, & McCormick, in press) and because this factor contains items similar to the "sense of power" scale (e.g., fearless dominance: I am good at getting people to do favors for me, I often end up being the leader of a group, I have an easy time standing up for my rights; sense of power: I can get others to do what I want; If I want to, I get to make the decisions; My ideas and opinions are rarely ignored). Nevertheless, fearless dominance is distinct from sense of power in that it includes items that assess fearlessness and stress immunity. These characteristics may increase cheating by reducing the fears associated with being identified as a cheater. Furthermore, fearless dominance was related positively to achievement drive (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003) and sensation seeking (reviewed in Poythress & Hall, 2011), traits that promote cheating (e.g., DeAndrea, Carpenter, Shulman, & Levine, 2009; Williams, Nathanson, & Paulhus, 2010). Therefore, we predicted that fWHR in men would be associated with cheating and psychopathic personality traits (specifically fearless dominance), that cheaters would be higher in fearless dominance than non-cheaters, and that the relationship between fWHR and cheating would be mediated by fearless dominance. We examined relationships among women, but predicted that the associations between fWHR, cheating, and personality would be specific to men.

2. Methods

2.1. Participants

Procedures were approved by (the Brock University and Wayne State University) Research Ethics Boards. Two-hundred twenty-three undergraduates were recruited through online research pools at both institutions (146 men and 77 women, M_{age} = 20.28, SD_{age} = 2.79, 67% White, 5% Asian, 11% Black, 17% other) and consented to the procedures of the study. One participant was removed because her hijab limited facial measurements.

2.2. Measure of psychopathic personality traits

The 154 item Psychopathic Personality Inventory – Revised (PPI-R; Lilienfeld & Widows, 2005) includes eight content scales subsumed by three factors: Fearless Dominance, Self-Centred Impulsivity, and Coldheartedness (described in Section 1). The factors are internally consistent (Cronbach's $\alpha \geqslant .78$ for each factor scale), possess high test–retest reliability ($rs \geqslant .82$; Lilienfeld & Widows, 2005), and are correlated with other self-report measures of psychopathic personality traits (Marcus, Fulton, & Edens, 2012). In the current sample, Fearless Dominance (α = .91), Self-Centred Impulsivity (α = .89), and Coldheartedness (α = .80) were also internally consistent. The PPI-R questionnaire was embedded into a set of unrelated tasks administered for a different study.

2.3. Measure of cheating

To measure cheating, we modified the dice rolling/lottery procedure of Haselhuhn and Wong (2012) in which the number of ballots a participant could enter into a lottery was determined by a dice roll. After completing the test battery, participants were given blank ballots, the lottery-box (into which ballots would be entered), a pen, and a printout of instructions: "(1) Go to www.random.org/dice; (2) Click 'roll dice' once. This will roll a pair of dice; (3) Add the numbers on each die together. This will equal the number of ballots you can enter into the raffle."

Participants were told that because several participants were in different rooms, the researcher had to remain available in the hallway. This procedure provided the participant the opportunity to cheat (entering more ballots into the lottery-box than the value of the dice roll) "undetected". Hidden software recorded participants' computer activity during the dice rolling procedure.

2.4. Facial width-to-height ratio (FWHR)

After the lottery, participants went to the hallway to be photographed posed in a neutral facial expression for measurement of fWHR according to landmarks described in Weston and colleagues (2007) as in our previous studies (e.g., Carré & McCormick, 2008). Research assistants (blind to the hypotheses) measured the height (distance between lip and brow) and width (distance between left and right zygion) using ImageJ (NIH software). Inter-rater reliability was high for width, height, and the ratio of the face measures ($rs > .87$).

2.5. Statistical analysis

To simplify interpretation of results, we conducted 2 × 2 analyses of variance to determine if fWHR or the three factors of psychopathy differed for men versus women and cheaters versus non-cheaters (point-biserial correlations among variables produce the same results). To determine whether fWHR was related to the psychopathic personality factors, we entered the three factors as simultaneous predictors of fWHR. Bootstrapped mediation analysis (Preacher & Hayes, 2008) also was conducted to determine if the relationship between fWHR and cheating was mediated by psychopathic personality factors. Although three cases were identified as influential on specific regression coefficients and as multivariate outliers, removal of these cases did not alter the results significantly. Thus, all cases were included in the analyses reported.

3. Results

3.1. fWHR and psychopathic personality traits as a function of sex and cheating

Men (13%) and women (20%) did not differ in the percent that cheated in the lottery, $\chi^2 = 1.74$, $p = 0.13$. A two-factor (Sex = men vs. women; Cheating = cheaters vs. non-cheaters) ANOVA on fearless dominance scores indicated a main effect of Sex (men > women: $F_{1,218} = 38.06$, $p < 0.001$) that was obviated by a significant interaction between Sex and Cheating ($F_{1,218} = 8.80$, $p < 0.01$; see Fig. 1a). Follow-up t-tests indicated that for men ($t_{144} = -2.55$,

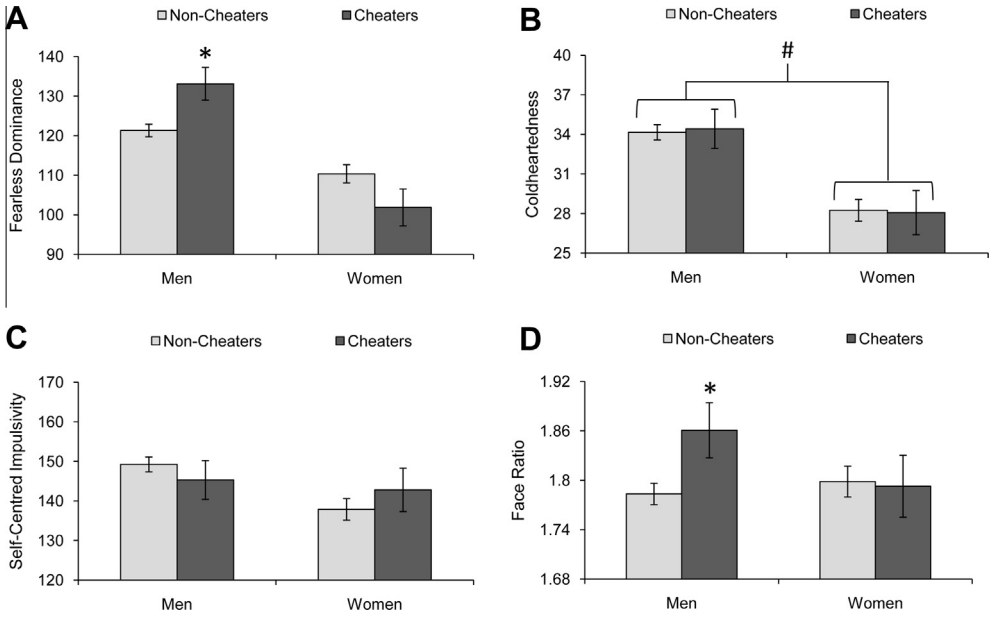

Fig. 1. Mean (SEM) fearless dominance (Panel A), coldheartedness (Panel B), self-centred impulsivity (Panel C), and fWHRs (Panel D) of participants who cheated (19 men, 15 women) or not (127 men, 61 women). *higher in cheaters, $p < 0.05$; #higher in men, $p < 0.05$.

$p = 0.01$, Cohen's $d = .64$), but not for women ($t_{74} = 1.78$, $p = 0.08$, Cohen's $d = .48$), cheaters had higher fearless dominance scores than did non-cheaters (see Table 1). Men had higher coldheartedness ($F_{1,218} = 24.88$, $p < 0.001$, Cohen's $d = .92$; see Fig. 1b) and higher, but not statistically significant, self-centred impulsivity scores than did women ($F_{1,218} = 2.96$, $p = 0.09$; see Fig. 1c), but there was no main effect of Cheating or interaction of Sex and Cheating for either coldheartedness or self-centred impulsivity ($ps > 0.25$).

A two-factor ANOVA on fWHR indicated that there were no main effects ($Fs < 1.67$, $ps > 0.19$) or interaction ($F_{1,218} = 2.25$, $p = 0.14$). Nevertheless, we conducted follow-up t-tests for the sexes separately based on our prediction that the relationship between fWHR and cheating would be specific to, or driven by, men. Results indicated that within men ($t_{144} = -1.97$, $p = 0.05$, Cohen's $d = .49$), but not within women ($t_{74} = 0.17$, $p = 0.86$, Cohen's $d = .08$), cheaters had larger fWHRs than did non-cheaters (see Fig. 1d).

3.2. Is fWHR related to psychopathic personality traits?

In men, the linear regression predicting fWHR was significant ($F_{3,142} = 2.76$, $p = 0.05$, $R^2 = .06$); fearless dominance was the only significant predictor ($t = 2.05$, $\beta = .17$, $p = 0.04$; other $ps > 0.05$) (see Fig. 2a). In women, the model was significant ($F_{3,72} = 3.60$, $p = 0.02$, $R^2 = .13$) and self-centred impulsivity ($t = -2.02$, $\beta = -.23$, $p = 0.05$; see Fig. 2b) and coldheartedness ($t = 2.72$, $\beta = .31$, $p < 0.01$; see Fig. 2c) were significant predictors but fearless dominance was not ($t = 0.62$, $\beta = .07$, $p = .54$).

3.3. Does fearless dominance mediate the relationship between fWHR and cheating in men?

We used binary logistic regression to test whether the relationship between fWHR and cheating was mediated by fearless dominance in men. fWHR was entered as the independent variable (Step 1), fearless dominance as the mediator (Step 2), and cheating as the dependent variable. Consistent with our prediction, the association between fWHR and cheating ($B = 3.13$, $Wald = 3.71$, $p = 0.05$) became non-significant ($B = 2.63$, $Wald = 2.57$, $p = 0.11$) when fearless dominance ($B = 0.03$, $Wald = 4.92$, $p = 0.02$) was added to the model as an additional predictor (Overall Model: $\chi^2 = 9.09$, $p = 0.01$, *Nagelkerke* $R^2 = .11$).

We also tested the prediction using bootstrapped mediation analysis with 5000 random samplings of the data with replacement. The mediation analysis indicated that the association between fWHR and cheating was indirect ($B = 0.58$; 95% confidence interval lower = 0.02, upper = 1.75) and mediated by fearless dominance (confidence intervals that do not overlap with a value of zero are indicative of mediation, Preacher & Hayes, 2008).

In men, extent of cheating (number of extra ballots entered into lottery) was associated positively with fWHR ($r = .23$, $p < 0.01$) and fearless dominance ($r = .21$, $p = 0.01$), but not with the other personality factors ($ps > 0.66$). Further, fearless dominance ($\beta = .16$, $t = 1.98$, $p = 0.05$) and fWHR ($\beta = .18$, $t = 2.24$, $p = 0.03$) were independent predictors of extent of cheating in a linear regression analysis and in a bootstrapped analysis ($B = 0.19$; 95% confidence interval lower = −0.001, upper = .73). In women, extent of cheating was associated negatively with fearless dominance ($r = -.26$, $p = 0.03$) but not with fWHR or the other personality factors ($ps > .21$).

Table 1
Descriptive statistics [mean (SD)] for cheaters (19 men, 15 women) and non-cheaters (127 men, 61 women) split by sex.

	Men		Women	
	Cheaters	Non-cheaters	Cheaters	Non-cheaters
Face ratio	1.86 (0.17)	1.78 (0.16)	1.79 (0.12)	1.80 (0.12)
Fearless dominance	133.12 (18.24)	121.31 (18.86)	101.87 (19.42)	110.36 (15.79)
Self-centred impulsivity	145.32 (18.68)	149.24 (22.19)	142.80 (13.44)	137.87 (21.61)
Coldheartedness	34.42 (6.23)	34.16 (6.35)	28.07 (5.54)	28.25 (7.04)
Extent of cheating	3.58 (2.06)		2.93 (2.09)	

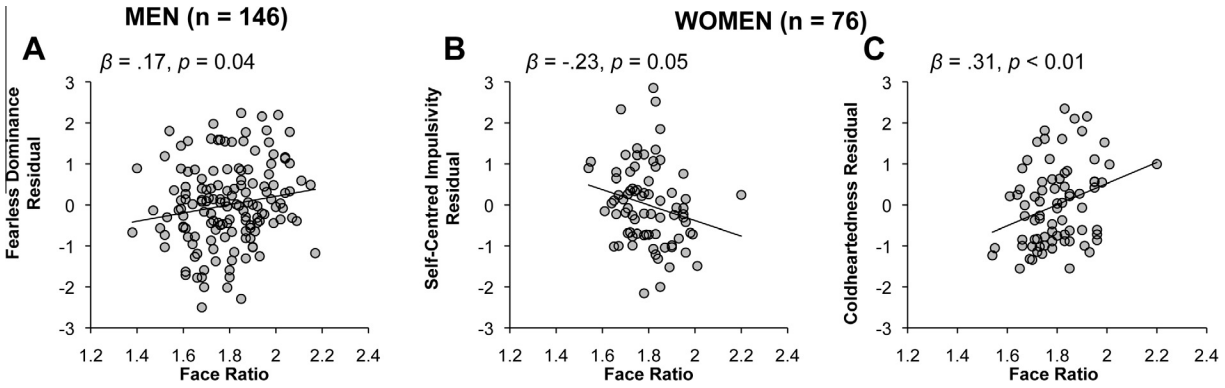

Fig. 2. Scatterplots of the fWHR and fearless dominance residuals in men (Panel A), and of the fWHR and self-centred impulsivity residuals (Panel B) and coldheartedness residuals (Panel C) in women. Residuals were created by regressing each psychopathic personality factor on the other two psychopathic personality factors and saving the standardized residual.

4. Discussion

We investigated the extent to which psychopathic personality traits were related to the facial width-to-height ratio (fWHR) and mediated the link between this metric and antisocial behaviour, specifically cheating in a lottery for a cash prize. Consistent with our predictions, men with larger fWHRs were more willing to cheat, cheated to a greater extent, and had higher scores on the psychopathic personality factor of fearless dominance. In men, fearless dominance mediated the relationship between the fWHR and willingness to cheat, but not extent of cheating. Thus, our results confirm and extend the previous report by Haselhuhn and Wong (2012), who found a relationship between estimated cheating and the fWHR in men to be mediated by psychological sense of power.

The finding that fWHR and fearless dominance were associated with cheating adds to evidence that the fWHR is associated with antisociality (e.g., aggression, Carré & McCormick, 2008; Goetz et al., in press; deception, Haselhuhn & Wong, 2012; prejudice, Hehman et al., 2013; exploiting the trust of others, Stirrat & Perrett, 2012). Such traits, however, may confer success. For example, fWHR was a positive predictor of achievement drive in presidents (Lewis, Lefevre, & Bates, 2012), financial success among chief executive officers (Wong, Ormiston, & Haselhuhn, 2011; see also Alrajih & Ward, in press), homerun frequency in baseball players (Tsujimura & Banissy, 2013), and with reproductive success (Loehr & O'Hara, 2013; near significant effect also reported in Gómez-Valdés et al., 2013, $p = 0.053$). Further, the relationship between fWHR and competitive behaviour may be stronger towards out-group than in-group members; fWHR was associated with prosocial or self-sacrificing behaviour towards in-group members when competition with the out-group was salient (Stirrat & Perrett, 2012). Similarly, although fearless dominance is considered a psychopathic trait and associated with aggression (Birkley, Giancola, & Lance, 2012; Denson, White, & Warburton, 2009), high fearless dominance also predicted greater achievement, well-being, education level, and class rank (Benning et al., 2003). Many researchers have suggested that traits within this factor (i.e., fearlessness, superficial charm) may promote success in business and politics, whereas the maladaptive behaviours stem from other trait factors (reviewed in Hall & Benning, 2006). Thus, despite some correlations with behaviours that seem antisocial, properly channelled aggression and dominance associated with having a larger fWHR may confer benefits and positive outcomes.

Fearless dominance and fWHR might share a common biological origin. Male and female face shapes diverge during puberty coincident with rising testosterone concentrations (Marečková et al., 2011; Verdonck, Gaethofs, Carels, & de Zegher, 1999), which also shape neural circuitry (reviewed in Blakemore, 2012). Masculinity and/or dominance in the face is associated positively with testosterone concentrations (e.g., Marečková et al., 2011; Penton-Voak & Chen, 2004; Pound, Penton-Voak, & Surridge, 2009; Swaddle & Reierson, 2002), and a recent study reported positive associations between fWHR and testosterone concentrations (Lefevre, Lewis, Perrett, & Penke, 2013). Testosterone is associated with dominance, personalized power, leadership, and with antisocial behaviour and risk-taking (reviewed in Archer, 2006). Men with higher testosterone concentrations had greater concern about status and greater hormonal reactivity to threats to status (reviewed in Archer, 2006; Mehta & Josephs, 2010). If testosterone at puberty influences both fearless dominance and face structure, then relationships of both to each other and to situation-specific behaviours consistent with fearless dominant behaviour would be expected.

Whereas fearless dominance promoted cheating in men, it marginally protected against willingness to cheat, and significantly reduced the extent of cheating, in women. Further, women with larger fWHRs had higher scores on the factor of coldheartedness and lower scores on the factor of self-centred impulsivity than did women with smaller fWHRs, which was unexpected given the lack of relationships between fWHR and behaviour for women in previous studies (Carré & McCormick, 2008; Haselhuhn & Wong, 2012; Stirrat & Perrett, 2010). One study found that coldheartedness was associated positively with social exclusion behaviours, the use of malicious humour, and verbal aggression in university students (84 women, 19 men) (Warren & Clarbour, 2009). Such indirect, relational aggression may be more relevant for investigations of women than other measures of dominance and aggression, which are typically higher in men than in women (reviewed in Archer, 2009). Further, men typically score higher in psychopathic personality traits than do women (reviewed in Dolan & Völlm, 2009), and other studies have reported that sex moderates the associations between psychopathic personality traits and behaviours such as aggression (e.g., Birkley et al., 2012; Miller & Lynam, 2003) and cooperation in trust games (e.g., Rilling et al., 2007). Similarly, our finding that fearless dominance was associated positively with cheating in men and negatively with cheating in women may reflect that the construct of psychopathy leads to different behavioural manifestations in men and in women and that the construct itself may be qualitatively different between the sexes (e.g., Dolan & Völlm, 2009).

In conclusion, our findings add to evidence that fWHR may signal personality correlates underlying aggressive and untrustworthy behaviour. In keeping with the possibility that fWHR may be an "honest signal" of men's behavioural tendencies, observers'

judgements of men's aggressive potential (Carré, McCormick, & Mondloch, 2009; Carré, Morrissey, Mondloch, & McCormick, 2010; Geniole, Keyes, Mondloch, Carré, & McCormick, 2012), dominance (Alrajih & Ward, in press), intimidation (Hehman, Leitner, & Gaertner, 2013), trustworthiness (Efferson & Vogt, 2013; Kleisner, Priplatova, Frost, & Flegr, 2013; Stirrat & Perrett, 2010), and prejudice (Hehman et al., 2013) were correlated positively with fWHR. Furthermore, correlations between observers' judgements of men's aggressive potential and fWHR were found irrespective of the sex and ethnicity of the observers (Chinese or Caucasian) and of the ethnicity of the men's faces (Short et al., 2012). Moreover, estimates of aggression were correlated with fWHR even when made by observers as young as eight (Short et al., 2012) and as old as 90 years of age (Boshyan, Zebrowitz, Franklin, McCormick, & Carré, in press).

There is evidence that the fWHR influences social interactions, with participants less likely to entrust money to men with larger fWHRs in trust games (Stirrat & Perrett, 2010). If the fWHR is indeed an honest signal of personality and behavioural propensities, a question to be answered is are there advantages to signalling one's aggressive and untrustworthy personality or are the advantages primarily in the perception of the signal?

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None.

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