Do Individuals Calibrate their Personalities to their Physical Characteristics? The Relation of Physical Strength and Attractiveness to Extraversion, Aggression, Dominance and Sense of Power

Exam no. 8478884

MSc in Psychology of Individual Differences

The University of Edinburgh

2012

Acknowledgements

I would like to thank Dr. Lars Penke for helping with this project and for offering invaluable advice throughout, including helpful comments on an earlier draft. His time and patience is much appreciated. Thanks are also due Carmen Ponce for her time and effort in collaboration on this project.

TABLE OF CONTENTS

Page

Abstract

The predictions of several conceptually related evolutionary theories were tested in a sample of 147 men and women. These theories pertain to the evolved functions of psychological traits including extraversion, anger and aggression, entitlement, dominance, and a sense of power. It is proposed that strength in men and attractiveness in women predicts higher expressions on these traits because of the associated cost-benefit trade-offs (Lukaszewski & Roney, 2011; Sell, Tooby, & Cosmides, 2009). In order to assess the link between an individual's physical condition and psychological traits, numerous anthropometric variables were extracted with medical equipment, 3D cameras, and a white-light 3D body scanner. From these measures composite scores of physical strength, facial and bodily masculinity and femininity, and upper body size were calculated serving as proxies of body strength and attractiveness. The findings partly supported the hypotheses. Several of the psychological traits, such as sociality and a sense of power, were significantly associated with muscularity in men. For men, all psychological traits were associated with self-rated attractiveness. Contrary to previous research, none of the anthropometric predictors correlated with traits that assessed verbal and physical aggression for either sex. Similarly, most of the theoretical predictions regarding the association between attractiveness and psychological traits in women were not supported in this sample. The significant associations for men were interpreted as being driven by behavioural strategies related to attaining social status and were pro-social in nature. Results are discussed in terms of their implications for evolutionary theories of the calibration of personality traits to physical characteristics.

List of Tables

Page

Do Individuals Calibrate their Personalities to their Physical Characteristics? The Relation of Physical Strength and Attractiveness to Extraversion, Aggression, Dominance and Sense of Power

In order to understand individual differences in personality, some evolutionary psychologists have conceptualised them as behavioural strategies to meet adaptive challenges posed by the social environment (Buss, 2009; Denissen & Penke, 2008; Nettle, 2006). Our species evolved to be highly social, meaning that many of these adaptive challenges come from the social world. For example, the challenge of maintaining a position in a social hierarchies, of forming alliances, of conducting oneself in conflict and of eliciting help and resources of others (Buss, 2009). It has been hypothesised that a number of psychological traits that are universal to human behaviour are employed to these ends. These include extraversion (Wilt & Revelle, 2008; Nettle, 2005), aggression (Brown, 1991; Ekman, 1973), and dominance (Price, Kang, Dunn, & Hopkins, 2011). If, however, extraversion, aggression, and dominance are adaptive behavioural strategies then natural selection should act to reduce their variability across individuals, yet these traits exhibit extensive individual differences, presenting somewhat of a paradox.

This paradox is addressed in some evolutionary theories which can explain the persistence of individual differences; including life-history theory (Kaplan & Gangestad, 2005), mutation load (Keller & Miller, 2006), and frequency-dependent selection (Penke, Denissen, & Miller, 2007). The focus of the present study is specifically on two recent theories that attempt to explain this paradox by proposing that psychological traits are calibrated to an individual's physical condition. Although this idea was conceived some time ago, as reactive heritability (Tooby & Cosmides, 1990), the theory of facultative calibration of extraversion (Lukaszewski & Roney, 2011) and the recalibrational theory of anger (Sell, 2006; Sell, Tooby, & Cosmides, 2009), both neatly describe how an individual's physical condition or phenotype can predict personality (Nettle, 2005). Specifically, they proposed a link between variations in physical fitness, attractiveness, and strength, which can all be considered proxies for underlying biological quality (Scheyd, Garver-Apgar, & Gangestad, 2008), to the cost-benefit trade-offs associated with certain behavioural strategies. For example, the utility of aggression to inflict physical harm on others, or the threat of doing so, to render them unable to compete for resources, would be one way of using aggression for personal gain (Sell, Hone, & Pound, 2012). Men who are stronger and more formidable are thought more likely to engage in aggressive behaviour simply because they are more likely to succeed and out-compete rivals successfully (Sell, Tooby, et al., 2009).

Similar principles may apply to extraversion and dominance. People who are highly extraverted can increase their access to resources and mates (Nettle, 2005) or attain higher social

status (Anderson, John, Keltner, & Kring, 2001; Lund, Tamnes, Mouestue, Buss, & Vollrath, 2007). Due to the fact that they are also more likely to get hurt, for example, through conflict or infectious diseases (Schaller & Murray, 2008), only those individuals most able to deflect the incurring costs can use extraversion cost-effectively (Lukaszewski & Roney, 2011). Likewise, dominance, a strong sense of entitlement, and a lack of an egalitarian attitude means that individuals who are able to out-compete others successfully would profit from social unfairness (Price et al., 2011).

Physical Attractiveness and Strength as Signals of Inherent Quality

It has been proposed that an individual's physical condition serves as a signal of inherent quality (Rhodes, Simmons, & Peters, 2005), and individuals' condition may reflect a higher or lower degree of the expression of sex-typical characteristics which are captured on the masculinity-femininity continuum. While masculinity in men is associated with attractiveness, specific aspects of masculinity, for example, muscularity, is also a important indicator of competitive ability or aggressive formidability, and consequently access to resources (Grammer, Fink, Møller, & Thornhill, 2003; Sell, Tooby, et al., 2009). Femininity, on the other hand, signals youth and fertility (Grammar et al., 2003). There is a high consensus regarding what is considered attractive (Langlois et al., 2000) and attractiveness is associated with physical health (Gangestad & Scheyd, 2005). Behaviourally, masculinity and femininity have been shown to influence partner selection, especially in short term mating (Burriss, Welling, & Puts, 2011; Gangestad & Simpson, 2000; Penton-Voak et al., 2003). Biologically, the degree of sexual dimorphism expressed depends on levels of sex hormones, such as testosterone and oestrogens in males and females respectively.

Masculinity in Males.

High levels of testosterone are responsible for masculine traits but according to the handicap theory testosterone also suppresses immunocompetence (Moore et al., 2011; Pound, Penton-Voak, & Surrigde, 2009). Therefore, masculine traits can be considered "honest" signals of health because their successful development is associated with high physiological costs (Fink, Täschner, Neave, Hugill, & Dane, 2010; Zahavi, 1975). Masculine traits signal developmental stability and underlying genetic quality and are, therefore, desirable (Moore et al., 2011; Pound et al., 2009). Evidence for this includes negative associations between masculinity and fluctuating asymmetry (FA) (Gangestad & Thornhill, 2003; Little et al., 2008). FA is a putative indicator of developmental stability and pathogen resistance during growth (Gangestad & Thornhill, 2003; Van Dongen & Gangestad, 2011).

Further aspects of masculinity include muscularity, height, leg length and a more V-shaped upper body, while facial masculinity is partly reflected in marked jaw lines and wider faces (Penton-Voak & Chen, 2004). Muscularity is an important determinant of masculinity and is considered attractive (Frederick & Haselton, 2007). Importantly, muscularity or strength increases aggressive formidability and can be used to confer the benefits of physical protection from outside aggressors (Price, Dunn, Hopkins, & Kang, 2012; Snyder et al., 2011). The evolutionary importance of muscularity is highlighted by the fact that is possible to accurately assess an individual's strength from visual cues (Sell, Cosmides, et al., 2009) or their voice (Sell et al., 2010). Thus men are aware of their own strength and that of others, and are therefore able to assess fighting ability (Sell, Cosmides, et al., 2009). Muscularity can be assessed relatively simply by attaining a few selected measures that act as good indicators of overall muscularity. Hand grip strength (HGS) is one commonly used measure, and is closely related to a number of health measures, linked to higher levels of testosterone (Page et al., 2005), and a good proxy of total muscle mass (Kallman, Plato, & Tobin 1990).

Femininity in Females.

High expressions of oestrogens during development lead to feminine physical characteristics (Gangestad & Scheyd, 2005; Law Smith et al., 2006). Feminine traits are judged attractive and similarly signal developmental stability and underlying genetic quality (Moore et al., 2011; Pound et al., 2009). Body femininity includes sex typical body-fat distribution and facial characteristics such as a small nose, full lip, and high cheek bones (Rhodes et al., 2007; Singh & Singh, 2011). Numerous objective measures are used to capture the degree of femininity in women. These measures signal health and fertility and are reliable indicators of reproductive fitness (Scheyd et al., 2008). For example, a lower waist-to-hip ratio (WHR) of 0.7, which reflects and increased lower-body fat distribution, is linked to high levels of oestradiol and progesterone (Dixson, Grimshaw, Linklater, & Dixson, 2011). Each of these hormones is associated with the reproductive cycle (Jasienska, Ziomkiewicz, Ellison, Lipson, & Thune, 2004), successful development of offspring during pregnancy (Lassek & Gaulin, 2006), and later cognitive performance of offspring (Lassek & Gaulin, 2008).

The Calibration of Personality to Physical Characteristics

Extraversion.

The theory of facultative calibration of extraversion (Lukaszewski & Roney, 2011) describes the process of personality development of extraversion as a general disposition, which may be partly mediated by an individual's physical condition. Extraversion is thought more beneficial to individuals who are inherently fitter because they can effectively avoid the

associated costs of the trait, for example, risk of conflict with competing mates (Lund et al., 2007). Therefore, stronger and more masculine males and more attractive and feminine females should score higher on extraversion because of the physiological implications discussed above.

These predictions have been put to the test. Lukaszewski and Roney (2011) tested a sample of 85 men and 89 women with mean ages of 19.7 and 18.7, respectively. For both sexes, self-rated attractiveness predicted extraversion for males (r=.45) and for females (r=.35), as did physical strength in men (r=.42) but not women (r=.17). Regressing extraversion on self-rated attractiveness and strength clarified that each explained unique variance. In a second study, Lukaszewski and Roney (2011), with a sample of 146 men and 52 women of a similar age range, again found a positive association for strength and self-rated attractiveness with extraversion. In the second study other-rated attractiveness (8 independent judges of facial and bodily attractiveness) also correlated positively with extraversion and strength.

Further evidence showed that other-rated attractiveness was again positively associated with extraversion (Meier, Robinson, Carter, & Hinsz, 2010). In two studies extraversion correlated with other-rated attractiveness (10 and 18 unacquainted judges, in studies 1 and 2, respectively). In the first sample of 84 students with a mean age of 19.6 years, extraversion was predicted by attractiveness (r=.20), and in the second sample of 133 students with a mean age of 18.9 years, attractiveness again predicted extraversion (r=.31). Interestingly, both these correlations were partly mediated by how well groomed an individual looked in the photograph. Nonetheless, this shows that people can use physical characteristics to judge other personalities simply from visual cues.

Anger and Aggression.

The second theory which deals with the relation between personality traits and physical characteristics is the recalibrational theory of anger (Sell, Tooby, et al., 2009). Its basic function is to resolve conflict in favour of the aggressor and to attain the highest possible welfare from other individuals by coercing them with displays of aggression. A formidable reputation leads to better treatment from others who thus avoid physical conflict. In order for this to work practically, the threat must be real and the costs of refusing the aggressor must be greater than paying the expected tribute. In the recalibrational theory this is known as the welfare-trade-off ratio (WTR) (Sell, 2006). Because strength is highly sexually dimorphic, with 99% of the average men being stronger than the average women (Lassek & Gaulin, 2009), bargaining positions of males and females depend on different factors (Sell, Tooby, et al., 2009). For males their formidability is determined by physical strength. While females are less likely to employ physical aggression, the important predictor is attractiveness, which may itself ensure access to resources and higher social status (Scheyd et al., 2008). Highly attractive and feminine females

may confer benefits to other individuals and expected compliance with demands in return but withdraw benefits upon non-compliance (Sell, 2006). According to the WTR, individuals should only refuse benefits from attractive females when compliance with demands is costlier than what is gained. In other words, the WTR poses as a function of how much welfare an individual expects from other members of a social group, depending on aggressive formidability for males and physical attractiveness for females. Inappropriate welfare can be recalibrated through aggression but the cost-effectiveness of recalibrating welfare diminishes as the individual's ability to retaliate increases, i.e. when they are able to respond aggressively themselves or withdraw benefits they posses. While the WTR also depends on numerous environmental factors and kinship, physical strength and attractiveness can be assessed objectively. The prediction here is that physical formidability depending on strength in males, and attractiveness in females, should both correlate with anger (Price et al., 2012).

Sell, Tooby, et al. (2009) found their results to be consistent with this theory. Physical strength in males and attractiveness in females positively correlated with aggression in two samples with mean ages of 21.1 years and 19.5 years. Additionally, strength or aggressive formidability predicted a higher sense of entitlement. In both studies all strength measures correlated positively with aggression. The sample of study 1 consisted of 62 men and included no women. Lifting strength correlated positively with proneness to anger (r=.38), history of fighting (r=.47), and utility of personal aggression (r=.34). Similarly, flexed biceps circumference correlated with the same scales with correlation coefficients of r=.35, r=.47, and r=.47, for each scale respectively. In the second study, 125 males and 156 females strength was measured with a dynamometer, and for males the correlations were positive for all psychological measures with the coefficients of r=.23 to r=.37. In addition, two added scales measuring entitlement (r=.31) and success in conflict (r=.23) were completed. None of the correlations between aggression and strength were significant for females; however, self-rated attractiveness in females correlated positively with proneness to anger (r=.23), utility of personal aggression (r=.18), and entitlement (r=.31). Men's self-rated attractiveness also correlated positively with proneness to anger, history of fighting, and utility of personal aggression.

Partly replicating the findings by Sell, Tooby, et al. (2009) but using more objective measures of attractiveness, Price et al. (2012) tested the same predictions. Anger was assessed with the same scales, namely proneness to anger and fighting history. The additional anthropometric measures were attained by acquisition of 3D body scans for all participants. This permitted construction of composite scores for bodily masculinity and femininity, including volume-to-height index (VHI), and leg-to-body ratio (LBR), as well as further body part specific circumferences. Price et al. (2012) note that the associations could be age sensitive and aggressive formidability may change with age and show a temporal decline (Daly & Wilson,

1988). Thus it is possible that the association between formidability and aggression decreases as formidability shifts with increasing social influence, providing other means of coercion. Therefore, Price et al. (2012) excluded 27 participants from their initial sample of 118, with mean ages of 22.0 years, leaving a remaining sample of 91 with a mean age of 19.93. Overall, the findings were less clear that those of Sell, Tooby, et al. (2009). Upper body size (r=.43), biceps circumference (r=.39), and chest circumference (r=.42) correlated positively with proneness to anger in males. Body masculinity also correlated positively with proneness to anger (r=.33). One possible caveat with the measures of male muscularity is that these measures relied on anatomical size, as opposed to actual strength measures. No significant correlations were observed for history of fighting and none of the anthropometric measures predicted anger in females, the exception being LBR and proneness to anger (r=.31). Only one of the three self-rated attractiveness measures in females correlated with proneness to anger (r=.31).

When measuring strength directly, using a dynamometer, the associations with aggression were however, significant (Gallup, White, & Gallup, 2007). Two subscales of the social experience survey, assessing how much each participant believed themselves to a victim or perpetrator of physical or psychological aggression were used (Newman et al., 2005). Males had a mean age of 18.9 years, females 19.1 years and the total sample consisted of 143 participants. For males left HGS, but not right HGS, correlated significantly with being an aggressor in the high school environment (r=.30).

Additionally, Carré and McCormick (2008) analysed participant's facial width-to-height ratio (facial WHR), a physical characteristic independent of body size (Weston, Friday, & Liò, 2007). It is thought to be related to testosterone level during development (Verdonck, Gaethofs, Carels, & de Zegher, 1999) while possibly acting as another physical cue that allows others to detect aggressive tendencies and aggressive formidability. First, in a sample of 37 men and 51 women, aged 19.0 years, facial WHR was related to behavioural aggression as assessed in an experimental task (Point Subtraction Aggression Paradigm (Cherek, 1981) and trait dominance (Goldberg et al., 2006). The facial WHR was calculated from frontal photographs. Overall men had a greater facial WHR and scored higher on dominance and aggression. For men, facial WHR explained 15% of unique variance in a regression analysis of aggressive behaviour in the behavioural task, but it did not predict trait dominance. For women, facial WHR did not predict any of the aggression or dominance measures. In addition to the sample invited for research participation, Carré and McCormick (2008) also calculated the facial WHR for male varsity hockey players of the University hockey league and those of professional hockey players from the National Hockey League. Aggression was assessed by penalty points received by each player, which are awarded for aggravated physical contact. For varsity hockey players (n=21),

facial WHR's correlated positively with penalty points awarded (r=.54) as well as for aggressive behaviour in professional hockey players (n=121, r=.30).

Contrary to these findings, a recent study did support facial WHR as a significant predictor for aggression (Özener, 2012). It was highlighted that the facial WHR was not sexually dimorphic in a large Turkish sample of 230 men and 240 women, who were on average 20.8 years old. Furthermore, a second study of 108 men (20.1 years) and 104 women (20.7 years) showed facial WHR was not significantly associated with physical or verbal aggression, anger, hostility, or indirect aggression for either sex (Özener, 2012).

Dominance.

The predictions of the recalibrational theory of anger, according to which more formidable men and more attractive females should be more anger prone and aggressive, may also lend itself to predict higher scores on trait dominance. Having a higher welfare trade-off ratio should coincide with being more dominant, as this should sustain and provide greater access to resources. While testing whether individuals who are inherently fitter have a stronger sense of social dominance, Price et al. (2011) found that individual's (n=56) dominance scores, as measured on the Social Dominance Orientation scale (Pratto, Sidanius, & Levin, 2006), were positively associated with upper body size (r=.29) and self-rated attractiveness in males (r=.28). Upper body size of was calculated as an aggregate of the z-scores for biceps, horizontal shoulder, and chest circumference. Furthermore, a scale assessing competitiveness (Houston, Harris, McIntire, & Francis, 2002) also correlated with strength in males (r=.24). Lastly, entitlement (labelled worthiness), using the same scale as developed by Sell, Tooby, et al. (2009), was positively correlated with muscularity for males (r=.31) and self-rated attractiveness for both males (r=.37) and females (r=.30).

Sense of Power.

The same mechanisms as described in the theory of facultative calibration of extraversion and the recalibrational theory of anger may apply to and calibrate an individual's sense of power. Being able to out-compete others and a higher WTR should also be associated with a higher sense of power. This is an additional psychological construct that is conceptually linked to extraversion, aggression, entitlement and dominance and may also be related to an individual's physical condition. Power has many philosophical and psychological definitions and is functionally related to the control over resources and social influence (Emerson, 1962; Galinsky, Gruenfeld, & Magee, 2003). Individuals with a higher sense of power also employ behaviours that gain resources, food, and increase access to mates (Anderson, John, & Keltner, 2012; Fiske, 1993) while such behaviours are inhibited by a lack of power (Carver & White,

1994; Anderson & Galinsky, 2006). Psychologically, a high sense of power is linked to a higher self-esteem (r=.45), authority (r=.47), and extraversion (r=.43, r=.49) (Anderson et al., 2012). Furthermore, a higher sense of power has been linked to a lower- risk perception and increased risk taking. Anderson & Galinsky (2006) showed that people who had a higher sense of power were more likely to engage in risky behaviour (study 1), had a more optimistic perception toward various risks and real life dangers (study 2), performed better in a word completion task after being primed for a higher sense of power (study 3), disregarded risks of unprotected sex (study 4), and were more blunt in dealing with problems in personal negotiation (study 5). Consequently, people who are highly extraverted, dominant, or more anger prone and who feel a higher sense of entitlement, should also have a higher sense of power because of the social influence the other psychological traits predict. Possibly reflecting an association with an individual's physical condition is the finding that a higher sense of power has, for example, been linked to better health and longevity (Adler, Epel, Castellazzo, & Ickovics, 2000). While this may not necessarily coincide with aggressive formidability, it should theoretically be linked to attractiveness given that this is proxy for underlying quality (Scheyd et al., 2008). Interestingly, in social cognition studies which assigned individuals to either high or low power conditions, through experimental design showed that people in the high-power condition focused more on rewarding information, were more action-orientated regarding the environment and social aspects within it, and were behaviourally less inhibited (Anderson & Berdahl, 2002; Galinsky et al., 2003; Smith & Bargh, 2008). People who display physical characteristics that signal underlying biological quality may have a lower perception of risk and a higher sense of power because they are able to employ risky behaviours to attain power and are able to combat the costs of such a strategy by being inherently fitter.

The Present Study

The present study tested the theoretical predictions that there are associations between an individual's physical condition and their personality traits.

Consistent with the theory of facultative calibration of extraversion (Lukaszewski & Roney, 2011), it was hypothesised that anatomical and physiological masculinity, muscularity, upper body size, and self-rated attractiveness correlate positively with extraversion and negatively with shyness for males. For females, extraversion should correlate negatively with anatomical and physiological masculinity (reflecting femininity) but should correlate positively with self-rated attractiveness and the opposite should be true for shyness. Muscularity and upper body size should make no significant contributions for females to any of the psychological traits.

In line with the theoretical predictions of the recalibrational theory of anger (Sell, Tooby, et al., 2009) and the predictions made by Price et al., (2011), men with higher anatomical

and physiological masculinity, muscularity, upper body size, and self-rated attractiveness should show more anger proneness, feel more successful in conflict, have a more extensive fighting history, be more dominant, and feel more entitled. For females, in contrast, none of the muscularity and upper body size should make significant contributions to personality. Instead, more feminine women, with a lower WHR, and higher self-rated attractiveness should be more anger prone, feel more successful in conflict (non-physical), be more dominant, and feel more entitled.

Finally, it was hypothesised that all the anthropometric factors for masculinity in males and femininity in females should correlate positively with sense of power and that sense of power itself correlates positively with all the above mentioned personality variables. The association of the sense of power with extraversion should specifically be with facets associated with increased social influence including sociability, assertiveness, activity, and positive emotionality (Anderson et al., 2001; Anderson, Sparato, & Flynn, 2008). In this study, the hypothesis is that a sense of power would mediate the association between these anthropomorphic measures and social influence traits.

Methods

Participants

147 participants (82 males, 65 females), mostly students, took part in the study. The mean age for males was 21.74 years (SD=2.4) and 21.4 years (SD=1.9) for females. The total number of completed years of education was 16.35 years (SD=2.3) for males and 16.31 years (SD=2.0) for females. A monetary reward of £10 or course credit was received by participants for their participation.

Procedure

The procedure described has been approved by the Psychology Research Ethics Committee of the University of Edinburgh (Ref No: 299-1112). After signing for consent each participant had his or her face image taken with a 3D camera (3dMD, 2012) and then their body imaged with a 3D NX12 body scanner ([TC]², 2010). For the facial photograph, participants were asked to sit in front of the cameras and to stay motionless with a neutral facial expression. The 3D scans of the body were taken in sports underwear. Clean underwear was provided in a separated changing area, connected to the fully enclosed camera booth. Prior to the scan the participants were instructed to stand upright, with their shoulder back and arms straight. Then height, with a wall mounted tape measure, and weight, with digital scales, were recorded. Afterwards, flexed biceps circumference was measured with an anatomical tape measure and both the participants' hands were scanned with a flatbed scanner (Epson GT1500). Next participants were asked to press a hydraulic hand dynamometer (SH500, SAEHAN Corp.) as hard as possible to assess handgrip strength for each hand. The best of three trials was taken for each hand. Once one side of the dynamometer's grip was reversed, the participants were asked to press in on it while holding it in front of their chest to provide an additional upper body/chest strength measure. This procedure was reported in detail by Sell, Tooby, et al. (2009) (Appendix). Following this, the participants' lung functions were measured with a spirometer (MicroPlus, CareFusion). For most of the anthropometric measurements three readings were taken; however, only one reading was taken for participants' height, weight, and flexed biceps circumference. Furthermore, a single hand scan and two face scans were acquired. The readings acquired with the scales and tape measures were averaged and the maximum from the three strength and lung function measures were used for later analysis. To ensure the integrity of the measures, the participants were asked about possible respiratory infections as well as any possible injuries to the imaged body parts that. For the last part of the experiment the participants filled out a questionnaire on a desktop computer, which established handedness and assessed personality. Not all items in the questionnaire were pertinent to the current study. This included questions

about sociosexuality and items assessing personality traits of narcissism, psychopathy, and machiavellianism.

Predictor Variables: Anthropometrics and Fitness Measures

Body shape.

From the body scans, facial images, and recorded variables, a number of measures related to strength and attractiveness were calculated. The data points from the body scanner were extracted using the [TC]² MEP editor ([TC]², 2010) which allowed for all the raw measures to be extracted. The scanner extracted each measure three times and the mean value was calculated across the raw measurements. Reliability was checked using the intra class correlations (ICC) for these three measurements and their reliabilities were high (rs>=.97). The average of the three measurements was then used to construct various ratios that capture body shape. These include waist-to-hip ratio (WHR), waist-to-chest ratio (WCR), bust-underbust ratio (BUR), leg-to-body ratio (LBR), and volume-to-height index (VHI). Additionally, weight and height were used to calculate body mass index (BMI). A description of these measures is provided in Table 1.

Table 1

Body Shape Ratios and Indices

Measure	Description
Waist-to-hip ratio (WHR)	The ratio of waist circumference to that of the hips
Waist-to-chest ratio (WCR)	The ratio of waist circumference to that of the chest
Bust-underbust ratio (BUR)	The ratio of bust circumference to that of the underbust
Leg-to-body ratio (LBR)	The ratio of the distance above the floor to the waist back point, at the height of the biggest waist circumference, to total body height
Volume-to-height index (VHI)	The bulk volume of the body divided by the height measured to the back of neck
Body mass index (BMI)	The person's weight (kg) divided by the square of his or her height

Facial Masculinity.

Facial masculinity was an additional physical measure and calculated from one single face scan (3D). Face scans were analysed using Morphanalyser (Tiddeman, Duffy, & Rabey, 2000). In this process, landmarks were placed on the face, allowing for calculations of specific measures including eye-size, face height and length, and cheekbone prominence, which were then subtracted from one another (see Penton-Voak et al., 2001).

Facial Width-to-Height Ratio (facial WHR).

Extracted with the same means was facial WHR, which was again calculated from the facial 3D images using Morphanalyser (Tiddeman et al., 2000).This ratio depends on width as measured in the distance between the left and the right zygion (bizygomatic width) divided by the height of the upper face as determined by the distance from the upper lip to the brow (see Carré & McCormick, 2008).

Lung Functions.

Lung functions were assessed and calculated with the help of the spirometer. The measures used included forced expiratory volume (FEV1), which is the volume that has been exhaled during the first second of forced expiration, and the forced vital capacity from maximally forced expiratory effort (FVC). Both FEV1 and FVC are, as mentioned, good indicators of physical fitness and the maximum value was used in the construction of the physical masculinity factor, see below.

Anthropometric Composite Scores.

While a large number of individual variables have been associated with health and attractiveness, alone they only provide a limited scope of the overall physical characteristics. Therefore, composite scores for traits that are sexually dimorphic are used to capture bodily masculinity and femininity. These anthropometric factors were extracted using factor analysis. The composite scores act as proxies of body shape masculinity and strength, both important in determining attractiveness and physical fitness .The masculinity-femininity factors were extracted using the whole sample, thus creating a score ranging from the most feminine female to the most masculine male. Upper body size and muscularity were calculated for both sexes but only used as predictors for men. The four factors were anatomical masculinity (A-M), and physical masculinity (P-M), upper body size (UBS), and muscularity (Musc.). A description of the four anthropometric factors and results of the principal components analyses (PCA) are provided in Table 2. Uni-dimensionality was assessed by dividing the value of the first Eigenvalue by that of the second (Reise, Scheines, Widaman & Haviland, in press). Anatomical masculinity captures an individual's physical appearance while physical masculinity is determined by strength and fitness. While these correlate highly, anatomical masculinity is of greater importance when considering actual fitness. Upper body size is an important predictor of formidability specifically in males. When including bicep circumference and maximum hand grip strength, usually measures for the participant's dominant arm were used. Handedness was assessed with the ten item Edinburgh Handedness Inventory (EHI) (Oldfield, 1971). In rare cases the non-dominant arms scores were used when they exceeded the dominants arms ones.

Table 2

Anthropometric Factors with Individual Measures used and PCA Results

Factor	Measures used (components)	1st/2nd Eigenvalue	Total variance explained
Anatomical-masculinity	Shoulder-to-shoulder horizontal width, WHR, BUR, and LBR	2.97	57.9%
Physical-masculinity	Hand-grip strength, upper body strength, FEV1, and FVC	5.47	79.3%
Upper body size	Biceps circumference, shoulder-to-shoulder horizontal width, and full chest circumference	8.93	86.0%
Muscularity	Hand-grip strength and upper body strength	3.79	79.3%

Note. Abbreviations: WHR=Waist-to-hip ratio, BUR=Bust-underbust ratio, LBR=Leg-to-body ratio, FEV1= First second of forced expiration, FVC=Forced vital capacity.

Self-rated Attractiveness.

In addition to the objective measures, participants were also asked about their self-rated attractiveness. This was measured with the three item short version of the Self-rated Mate Value Scale (Lukaszewski & Roney, 2011). The first item was answered from strongly disagree to strongly agree ("Compared to others I'm a very attractive person"). Item two had to be given as a percentage ("I am more attractive than __% of others of my gender"). Finally, item three was given on a one-to-ten likert scale ("On a scale from 1 to 10, how physically attractive are you?"). Similarly to the anthropometric factors, PCA was used to extract a single component with an Eigenvalue of 2.22 (second highest Eigenvalue was 0.44) explaining 74.1% of the total variance.

Outcome variables: Personality Questionnaire

The questionnaire part of the experiment was made up of a large number of items from several scales and took around 30 minutes to complete. Responses for each item were scored by indications of agreement or disagreement from strongly disagree (SD), to disagree (D), neutral (N), agree (A), and strongly agree (SA). Some of the scales were well established and well validated. The total number of items and the Cronbach's alpha for each scale are presented in Table 3. Participants were assessed for extraversion with the NEO-PI-R (Costa & McCrae, 1985, 1992). Tapping a very similar dimension was the shyness scale (Asendorpf & Wilpers, 1998). The shyness scale contains items like "I feel shy in the presence of others" and "I easily approach others" (reverse keyed). Dominance was assessed with items from the International Personality Item Pool (IPIP) (Goldberg et al., 2006). The IPIP dominance scale contains items like "I impose my will on others", "I try to outdo others", and "I demand explanations from others." It focuses closely on self-aggrandising aspects of dominance. To assess entitlement

the entitlement scale developed by Sell, Tooby, et al. (2009) was used. A few items were omitted in the questionnaire (items 1, 4, 7, and 11). Example items included "I deserve more than the average person" and "I sometimes feel uncomfortable when I'm given praise" (reverse keyed). Four further scales constructed by Sell, Tooby, et al. (2009) were also used. These were proneness to anger, fighting history, utility of aggression, and success in conflict. The proneness to anger scale (originally 21 items) included items such as "I have a short fuse" and "People often irritate me" measuring how easily one becomes angry, not however rumination (Sell, Tooby, et al., 2009). Fighting history assessed the degree to which a person had escalated conflict, and two of the five items were "I have physically intimidated someone who had it coming" and "I have stared people down" (Sell, Tooby, et al., 2009). All the original items were retained. Utility of aggression measures agreement to the use of both confrontational verbal and physical aggression and includes items like "Violence can solve problems for me" and "Confronting people scares me". Again, all the original items were retained. The last scale developed by Sell, Tooby, et al. (2009) was success in conflict which asked participants about success in arguments. Items included "When there's a dispute, I usually get my way" and "Other people know not to get in my way". The reduction of scale length did not lead to noteworthy changes in their reliabilities. Lastly, the sense of power scale (Anderson & Galinsky, 2006) assessed a feeling of control over ones social surrounding with items like "I think I have a great deal of power" and "If I want to I can make the decisions". This personality aspect as described in the literature may act as a mediator between masculinity and muscularity and extraversion.

Table 3

Personality Scales and Measures of Reliability

Scale	Number of Items	Cronbach's alpha
Extraversion (NEO-PI-R)	48	.92
Dominance (IPIP do)	15	.78
Shyness	5	.84
Entitlement	11	.66
Fighting history	5	.69
Proneness to anger	11	.66
Utility of aggression	16	.72
Success in conflict	7	.78
Sense of power	8	.80

Statistical Analysis

First, descriptive statistics were reported for all the anthropometric factors and individual variables, as well as for the psychological traits. For variables attained for both sexes, t-tests were conducted to examine sex differences. The effect sizes for the sex differences were also calculated. Second, bivariate correlations were computed to examine the inter-correlations for the anthropometric and self-rated attractiveness variables and the inter-correlations for the psychological traits. Thereafter, the associations between anthropometric and the psychological traits were calculated. Partial correlations were also calculated in order to control for age. All analyses were conducted separately for males and females.

Once the preliminary analysis was completed the male sample became the main target of analysis because most of the theoretical predictions were not supported by the female sample. First, multiple linear regression analysis was used to examine the unique contributions of anthropometric predictors to psychological traits. Additionally, bivariate correlations were also computed to examine the link between the anthropometric factors and the facets of extraversion. Subsequent to this, multiple regression analysis helped examine the relationship between the anthropometric factors and the extraversion facets.

Finally, in order to unpack the causal pathways underpinning the significant bivariate associations between muscularity with sense of power and the extraversion/shyness composite sociality, a mediation analysis was conducted. It was hypothesised that sense of power mediated the relation between muscularity and sociality. This was tested using a path mediation model implemented in Mplus 6.11 (Muthén & Muthén, 1998-2011) using maximum likelihood estimation and bootstrapped confidence intervals. The direct and indirect effects of sociality on muscularity were computed. Significant mediation was indicated by statistically significant indirect effects.

Results

Descriptive Statistics and Data Cleaning

A small number of outliers were removed prior to statistical analysis. These were identified by visual inspection and by checking z-scores above and below 3.28. Normality was checked by examination of skewness, kurtosis, and conducting Kolmogorov-Smirnov tests of normality (Stephens, 1979).

Descriptive statistics and sex differences are reported in Table 4 for all variables split by gender. The variables include composite scores but a number of measures are also reported separately to allow for comparison with previous findings from the reviewed literature. No descriptive statistics are reported for upper body size and muscularity for females as this was only calculated for males.

One extra composite score was created from the extraversion and the shyness scale and named sociality. This was justified by the fact that shyness and extraversion conceptually measure the same construct and correlated highly (r=-.77). From the two scales, one component was extracted with an Eigenvalue of 1.79; explaining 89% of the variance (see Lukaszewski & Roney, 2011).

As expected, all of the anthropometric variables are highly sexually dimorphic, the only exception was facial masculinity. Surprisingly, women had higher facial WHR. On the personality scales that contain items related to physical aggression (utility of aggression and fighting history), men scored significantly higher. For the other personality variables, results were more mixed and only some were subject to statistically significant sex differences. Interestingly, women had significantly higher scores on extraversion (sociality), sense of power, and proneness to anger, while men had significantly higher scores for success in conflict and entitlement.

Table 4

Descriptive Statistics of all Variables with Sex Differences and t-test Results

Variable	Male			Female			Sex difference		
	n	Mean	SD	n	Mean	SD	t	p	Cohen's d
Height (cm)	82	180.98	6.11	65	166.75	5.42	14.74	<.001	2.46
Weight (kg)	82	75.36	9.67	65	61.35	8.26	9.30	<.001	1.56
FBR (cm)	81	33.23	3.19	65	28.07	3.07	9.88	<.001	1.65
FBL (cm)	82	32.71	3.49	65	27.44	2.82	9.89	<.001	1.66
HGS (kg)	82	46.34	9.05	65	28.35	5.64	14.75	<.001	2.39
UBstrength (kg)	81	39.19	11.63	65	18.32	5.41	14.33	<.001	2.30
WHR	82	.85	.04	65	0.79	.04	8.49	<.001	1.50
BUR	82	1.09	.03	65	1.19	.05	-15.86	<.001	-2.43
LBR	82	.59	.02	65	.61	.02	-5.92	<.001	-1.00
BMI	82	23.0	2.67	65	22.07	2.84	2.04	<.05	.34
VHI	82	20.92	2.61	65	19.63	3.74	2.46	<.05	.40
WCR	82	.83	.04	65	0.86	.04	-4.31	<.001	-0.75
A-M	82	.74	.54	65	-0.94	.57	18.29	<.001	2.95
P-M	80	.75	.61	65	-0.92	.47	18.12	<.001	3.10
F-M	81	.15	2.21	61	-0.21	1.84	1.03	.31	.18
UBS	80	.05	.91	65	-	-	-	-	-
Musc.	80	.00	1.00	65	-	-	-	-	-
fWHR	81	2.01	.13	60	2.11	.17	-3.90	<.001	-.66
UofA	81	2.88	.44	65	2.59	.37	4.13	<.001	.71
PtoA	81	2.95	.49	65	3.09	.52	-1.68	.10	-.28
SinC	81	3.15	.54	65	2.99	.56	1.78	.08	.29
FH	81	2.64	.78	65	2.03	.63	5.17	<.001	.86
Ent.	81	2.93	.54	65	2.78	.46	1.78	.08	.30
Do.	81	3.07	.51	65	2.93	.51	1.70	.09	.28
Ex.	81	3.47	.49	65	3.58	.44	-1.34	.18	-.24
SofP	81	3.48	.53	65	3.50	.53	-.21	.84	-.04
Shy.	81	2.49	.80	65	2.42	.86	.47	.64	.09
Soc.	81	-.07	1.01	65	.09	.99	-.96	.34	-.16
SRA	81	.29	.86	65	-0.36	1.06	4.06	<.001	.67

Note. Abbreviations: FBR/L=Flexed biceps right/left, HGS=Hand grip strength, UBstrength=Upper body strength, WHR=Waist-to-hip ratio, BUR=Bust-underbust ratio, LBR=Leg-to-body ratio, BMI=Body mass index, VHI=Volume-height index, WCR= Waist-to-chest ratio, A-M=Anatomical masculinity, P-M=Physical masculinity, UBS=Upper body size, Musc.=Muscularity, fWHR=Facial width-to-height ratio, UofA=Utility of aggression, PtoA=Proneness to anger, SinC=Success in conflict, FH=Fighting history, Ent.=Entitlement, Do.=Dominance, Ex.=Extraversion, SoP=Sense of power, Shy.=Shyness, Soc.=Sociality, SRA=Self-rated attractiveness

Inter-correlations between Anthropometric Measures and Self-rated Attractiveness

For males (see Table 5), anatomical and physical masculinity, upper body size and muscularity all correlated positively with self-rated attractiveness. Interestingly, muscularity did not correlate significantly with anatomical masculinity. This shows that anatomical masculinity is in fact not a good predictor of strength in this sample. Facial masculinity only correlated positively with physical masculinity and negatively with facial WHR, which itself did not correlate significantly with any of the other anthropometric measures. Self-rated attractiveness did not correlate significantly with WHR, LBR, facial masculinity, or facial WHR.

Table 5

Inter-correlations between Anthropometric Variables for Males

Variable	A-M	P-M	UBS	Musc.	WHR	LBR	F-M	fWHR	SRA
A-M	-								
P-M	.30**	-							
UBS	.63**	.48**	-						
Musc.	.11	.79**	.37**	-					
WHR	.71**	-.06	.30**	-.18	-				
LBR	-.42**	-.15	-.07	-.17	-.06	-			
F-M	-.05	.31**	.10	.12	-.21	.07	-		
fWHR	-.17	-.12	-.18	.00	-.10	.08	-.45**	-	
SRA	.23*	.41**	.36**	.38**	-.07	-.14	.17	-.06	-

Note. Abbreviations: A-M=Anatomical masculinity, P-M=Physical masculinity, UBS=Upper body size, Musc.=Muscularity, WHR=Waist-to-hip ratio, LBR=Leg-to-body ratio, F-M=Facial masculinity, facial WHR= Facial width-to-height ratio, SRA=Self-rated attractiveness. *p<.05, **p<.01

For females, self-rated attractiveness did not correlate with any of the two anthropometric measures, i.e. anatomical and physical femininity (see Table 6). Overall only a few significant correlations were observed. These were between the composite scores for masculinity/femininity, strength, and UBS, which measures associated physical characteristics. Facial masculinity correlated negatively with facial WHR.

Table 6

Inter-correlations between Anthropometric Variables for Females

Variable	A-M	P-M	UBS	Musc.	WHR	LBR	F-M	fWHR	SRA
A-M	-								
P-M	.39**	-							
UBS	.38**	.32*	-						
Musc.	.33**	.67**	.33**	-					
WHR	.61**	.21	.20	.10	-				
LBR	-.49**	.-.10	.19	-.11	-.06	-			
F-M	-.02	-.15	.08	-.17	.08	.23	-		
fWHR	.23	.23	.05	.06	.11	-.14	-.49**	-	
SRA	.08	-.06	-.18	.01	.04	-.22	.00	-.10	-

Note. Abbreviations: A-M=Anatomical masculinity, P-M=Physical masculinity, UBS=Upper body size, Musc.=Muscularity, WHR=Waist-to-hip ratio, LBR=Leg-to-body ratio, F-M=Facial masculinity, fWHR= Facial width-to-height ratio, SRA=Self-rated attractiveness. *p<.05, **p<.01.

Inter-correlations between Personality Scales

The inter-correlations for the personality scales are presented in Table 7 for males and Table 8 for females.

Table 7

Inter-correlations between Personality Scales for Males

Scale	1. Ex.	2.Do.	3. Shy.	4. Ent.	5.FH	6.PtoA	7.UofA	8.SinC	9.SofP	10.Soc
1.Ex.	-									
2. Do.	.14	-								
3. Shy.	-.81**	-.05	-							
4. Ent.	.23*	.45**	-.29**	-						
5. FH	.08	.30**	-.17	.28**	-					
6. PtoA	.08	.55**	-.02	.38**	.43**	-				
7. UofA	.26*	.49**	-.24*	.50**	.62**	.57**	-			
8. SinC	.28*	.52**	-.34**	.67**	.36**	.43**	.54**	-		
9. SofP	.53**	.43**	-.60**	.64**	.30**	.31**	.46**	.78**	-	
10. Soc.	.95**	.10	-.95	.27*	.13	.05	.27*	.33**	.59**	-

Note. Abbreviations: Ex.=Extraversion, Do.=Dominance, Shy.=Shyness, Ent.=Entitlement, FH=Fighting history, PtoA=Proneness to anger, UofA=Utility of aggression, SinC=Success in conflict, SoP=Sense of power, Soc.=Sociality. *p<.05, **p<.01.

Table 8

Inter-correlations between Personality Scales for Females

Scale	1.Ex.	2.Do.	3.Shy.	4.Ent.	5.FH	6.PtoA	7.UofA	8.SinC	9.SofP.	10.Soc.
1.Ex.	-									
2.Do.	.24*	-								
3.Shy.	-.77**	-.16	-							
4.Ent.	.30*	.32**	-.33**	-						
5.FH	-.03	.19	-.10	.10	-					
6.PtoA	-.06	.39**	.06	-.04	.35**	-				
7.UofA	.04	.28*	-.15	.04	.55**	.49**	-			
8.SinC	.39**	.50**	-.27**	.34**	.15	.23	.10	-		
9.SofP	.55**	.40**	-.44**	.38**	.09	.04	.01	.78**	-	
10.Soc.	.93**	.21	-.95	.34**	.04	-.06	.10	.35	.52**	-

Note. Abbreviations: Ex.=Extraversion, Do.=Dominance, Shy.=Shyness, Ent.=Entitlement, FH=Fighting history, PtoA=Proneness to anger, UofA=Utility of aggression, SinC=Success in conflict, SoP=Sense of power, Soc.=Sociality. *p<.05, **p<.01.

For males, a number of different patterns emerged. Strong correlations were observed between sense of power with success in conflict and sense of power with sociality as these tap very similar psychological dimension. Dominance and entitlement also have a high correlation with sense of power, sociality and all of the aggression measures. Both the aggression and fighting measures correlated highly with themselves but they did not correlate significantly with extraversion. Fighting history did not correlate significantly with any of the other scales.

For females, a very similar pattern of correlations was observed with a strong correlation between sense of power and success in conflict, dominance, and entitlement. Again, none of correlations with the fighting history were significant.

For both sexes, a high negative correlation was observed between extraversion and shyness. Sociality correlated with the same scales as extraversion and shyness. Proneness to anger and utility of aggression also correlated high for both sexes.

Anthropometric Predictors for Personality

Anthropometric Predictors for Personality for Males.

Table 9 presents the correlations between the anthropometric predictor variables and the personality scores for each of the scales. The associations with age were also reported.

Table 9

Correlations between Anthropometric Predictors and Personality Scales for Males

Personality trait	Anthropometric predictor, SRA, and age							
	A-M	**P-M**	**UBS**	**Musc.**	**F-M**	**fWHR**	**SRA**	**Age**
Utility of aggression	.29**	.10	.20*	.08	-.11	.14	.45**	-.02
Proneness to anger	.08	-.03	.10	-.04	.13	-.01	.37**	.12
Success in conflict	.11	.16	.14	.26**	.11	-.02	.57**	.00
Fighting history	.12	.10	.10	.10	-.03	.07	.32**	-.07
Entitlement	.10	.23*	.24*	.32**	.15	.03	.57**	.10
Dominance	.13	-.10	.70	.03	.06	-.13	.29**	-.06
Extraversion	.13	.21*	.24*	.28**	.06	.00	.45**	-.23*
Sense of power	.16	.21*	.19*	.27**	.16	-.10	.65**	-.10
Shyness	.00	-.22	-.18	-.27*	-.06	-.02	-.46**	.22
Sociality	.07	.23*	.22	.29**	.06	.01	.48**	-.23*

Note. Abbreviations: A-M=Anatomical masculinity, P-M= Physical masculinity, UBS=Upper body size, Muscularity=Musc., F-M=Facial masculinity, fWHR= Facial width-to-height ratio, SRA=Self-rated attractiveness. Significance values are two-tailed. *p<.05, **p<.01

For men, a number of correlations were significant. Both the significant correlations and those that failed to reach significance were in the expected directions. Anatomical masculinity predicted only utility of aggression, while the remaining correlations with the personality scales were just above *r*=.10. Physical masculinity predicted a higher sense of entitlement, extraversion/sociality and sense of power, but was not significantly associated with any of the aggression measures. Upper body size again predicted entitlement, extraversion and sense of power, in addition to the utility of aggression. For males, the strongest correlations were observed between muscularity and the personality scales. Muscularity was positively associated with entitlement, extraversion/sociality, sense of power, and success in conflict. Additionally, extraversion, shyness, and their composite sociality, correlated with muscularity. Interestingly, neither masculinity nor muscularity predicted fighting history, proneness to anger, or dominance. Similarly, facial masculinity and facial WHR yielded no significant correlations with the personality scales. Facial WHR did correlate with utility of aggression but not significantly. On the other hand, self-rated attractiveness correlated highly with all of the personality scales. Lastly, age correlated negatively with extraversion and sociality, but for none of the aggression measures.

Anthropometric Predictors for Personality for Females.

Table 10 present the correlations between the anthropometric predictor variables and the personality scores for each of the scales. Again, the associations with age were reported.

Table 10

Correlations between Anthropometric Predictors and Personality Scales for Females

Personality trait	Anthropometric predictor, SRA, and age							
	A-M	**P-M**	**WHR**	**LBR**	**F-M**	**fWHR**	**SRA**	**Age**
Utility of aggression	-.11	-.24*	-.09	-.05	-.03	.18	-.19	.10
Proneness to anger	-.06	-.08	-.05	.10	-.03	.06	-.27*	.08
Success in conflict	-.08	.17	-.18	-.03	.07	-.21	.29*	.03
Fighting history	.02	-.16	-.06	-.15	-.12	.01	.08	.20
Entitlement	.08	-.10	.14	-.04	-.05	.00	.31**	.05
Dominance	-.02	.19	-.09	-.17	-.15	-.07	.06	-.03
Extraversion	.15	.11	.16	-.04	.15	-.05	.29*	.00
Sense of power	-.19	.03	-.25*	-.03	.06	-.23	.40**	.07
Shyness	-.03	.11	.05	.06	-.21	-.07	-.29	-.09
Sociality	.10	-.01	-.05	.01	.19	.01	.31*	.05

Note. Abbreviations: A-M=Anatomical masculinity, P-M= Physical masculinity, WHR=Waist-to-hip ratio, LBR=Leg-to-body ratio, F-M=Facial masculinity, fWHR= Facial width-to-height ratio, SRA=Self-rated attractiveness. Significance values are two-tailed. *p<.05, **p<.01

For females, only two correlations between the anthropometric predictors and personality scales were significant. These were negative correlations between physical masculinity, utility of aggression and WHR with the sense of power scale, which was the predicted direction of association. However, overall the direction of the correlations, including those that did not reach significance, were less consistent than those for the males. While a number anthropometric measures predicted higher scores on fighting history, all of those correlations failed to reach significance. Although non-significant, unexpected positive correlations were attained for the anthropometric predictors and extraversion. Additionally, self-rated attractiveness did not correlate significantly with utility of aggression, fighting history, and dominance. Self-rated attractiveness still correlated significantly with entitlement, extraversion, and sense of power. Again, none of the correlations between facial masculinity and facial WHR with the personality scales were significant. Although the correlation between facial WHR with utility of aggression was relatively high (r=.22), it again failed to reach significance. A further unexpected finding was that proneness to anger correlated negatively with self-rated attractiveness even though a positive correlation was predicted.

Controlling Correlations for Age.

In the cited literature that examined correlations between aggressive formidability, e.g. muscularity, and aggression, most of the samples had a relatively young age around, or below,

20 years. Theoretically younger males may be more likely to employ physical aggression in arguments compared to older males, and some research actively excluded older participants to attain a more comparable and viable sample (Price et al, 2011). To test this age effect on physical aggression, age was also controlled. The age-controlled correlation matrix for the anthropometric predictors on personality scales of the male sample is presented in Table 11.

Table 11

Age-controlled Correlations between Anthropometric Predictors and Personality Scales for Males

Personality trait	**Anthropometric predictor and SRA**						
	A-M	**P-M**	**UBS**	**Musc.**	**F-M**	**fWHR**	**SRA**
Utility of aggression	.26*	.06	.21	.06	-.10	.15	.19*
Proneness to anger	-.02	-.08	.07	-.07	.13	.03	-.04
Success in conflict	.10	.16	.11	.26*	.10	.00	.43**
Fighting history	.10	.10	.10	.10	-.04	.08	.33**
Entitlement	.10	.10	.22	.30**	.15	.05	.60**
Dominance	.06	.22	.26	-.01	.07	-.13	.24**
Extraversion	.16	-.06	.30*	.26*	.07	-.04	.44**
Sense of power	.17	.20	.19	.24*	.15	-.11	.67**
Shyness	-.37	-.21	-.23*	-.25*	-.08	.02	-.47**
Sociality	.11	.22	.28*	.27*	.08	-.03	.48**

Note. Abbreviations: A-M=Anatomical masculinity, P-M= Physical masculinity, UBS=Upper body size, Muscularity=Musc., F-M=Facial masculinity, fWHR= Facial width-to-height ratio, SRA=self-rated attractiveness. Significance values are two-tailed. *p<.05, **p<.01

Correlations between physical masculinity and upper body size with personality scales of entitlement, sense of power, and sociality were reduced and marginally failed to reach significance. Interestingly, the association between self-rated attractiveness and proneness to anger was completely attenuated and the correlation of self-rated attractiveness and utility of aggression dropped to half the original size. Nonetheless, the correlations between utility of aggression and muscularity did remain significant. Furthermore, the correlations between muscularity and sociality (extraversion and shyness) also remained significant. With no attenuation of the anthropometric factors, the remaining analysis was carried out on the original associations as presented in Table 9.

Summary of Preliminary Analysis

For men, the results are largely in support of the theoretical predictions: more masculine and stronger men and men with greater upper body size scored higher on extraversion, sense of power, and entitlement. Selectively, these same measures also predicted success in conflict and utility of aggression. One finding that was unexpected however, was that proneness to anger and fighting history were unrelated to all composite scores of masculinity and muscularity. Additionally, controlling for age did not have a large effect on the associations between anthropometric factors and the aggression variables, except for self-rated attractiveness and proneness to anger.

For women, however, only very few correlations were significant. Neither extraversion, nor entitlement were related to female femininity. Some were in fact associated with the anthropometric factors in the opposite direction than expected. Even self-rated attractiveness did not predict personality, with one negative correlation with anger proneness and few positive correlations with success in conflict, extraversion and entitlement. A few correlations supported the theoretical predictions but those failed to reach significance, e.g. for fighting history.

Multiple Regressions and Mediation Model

In the next step of the analysis the causal pathways between selected variables were examined. Due to the fact that females only yielded few significant correlations, the focus in the following analysis will be on males.

Multiple Regressions.

A number of anthropometric variables correlated with entitlement, sense of power, and sociality. In order to establish which of these explained unique variance, the personality traits that showed more than one significant association were regressed onto the four main anthropometric composite scores and results are presented in Table 12. Only muscularity explained unique variance for success in conflict and entitlement.

Table 12

Multiple Regressions for Personality Traits on Anthropometric Predictors for Males

Predictor	Personality traits									
	UofA		SinC		Ent.		SofP		Soc.	
	β (S.E)	P	β (S.E)	P	β (S.E)	p	β (S.E)	p	β (S.E.)	p
Musc.	.07 (.08)	.69	.39 (.10)	.04	.37 (.10)	.04	.30 (.10)	.10	.26 (.19)	.15
UBS	.09 (.08)	.57	-.04 (.10)	.83	.13 (.09)	.40	.02 (.09)	.90	.23 (.18)	.14
P-M	-.95 (.14)	.62	-.15 (.18)	.43	-.12 (.17)	.52	-.07 (.17)	.71	-.09 (.32)	.65
A-M	.20 (.13)	.18	.13 (.16)	.39	.04 (.15)	.15	.11 (.15)	.45	-.12 (.29)	.41

Note. Abbreviations: A-M=Anatomical masculinity, P-M= Physical masculinity, UBS=Upper body size, Muscularity=Musc., UofA=Utility of aggression, SinC=Success in conflict, Ent.=Entitlement, SoP=Sense of power, Soc.=Sociality

Facets of Extraversion.

The NEO-PI-R extraversion scale is composed of 6 different facets that tap different psychological dimensions of extraversion. The individual correlations between anthropometric factors and the extraversion facets were further examined in Table 13. Additional correlations are reported for the extraversion facets with self-rated attractiveness and sense of power.

Table 13

Correlations between Anthropometric Predictors, SRA, Sense of Power and Facets of Extraversion for Males

Anthropometrics	Facets of extraversion					
	E1	E2	E3	E4	E5	E6
A-M	.12	.09	.16	.21	-.12	.09
P-M	.11	.21	.26*	.24*	.04	.14
UBS	.27*	.12	.27*	.27*	.02	.17
Musc.	.17	.15	.35**	.32**	.16	.21
SRA	.19	.37**	.55**	.50**	.28*	.16
SofP	.28**	.42**	.71**	.44**	.29**	.27*

Note. Abbreviations: A-M=Anatomical masculinity, P-M= Physical masculinity, UBS=Upper body size, Muscularity=Musc., SRA=self-rated attractiveness, SofP=Sense of power E1=Warmth, E2=Gregariousness, E3=Assertiveness, E4=Activity, E5=Excitement seeking, E6=Positive emotion. Significance values are two-tailed. *p<.05, **p<.01

From the correlation matrix it is clear that the facets of assertiveness (E3) and activity (E4) carry most of correlation between extraversion and the anthropometric factors. Only one

other objective measure, upper body size, correlates significantly with warmth. Although all facets correlate significantly with sense of power, the association with assertiveness was the strongest at r=.71. Again, specifically muscularity explained unique variance for both of these facets just like the initial regressions reported in Table 12 between the separate traits and anthropometric predictors (see Table 14).

Table 14

Multiple Regressions for Facets of Extraversion on Anthropometric Predictors for Males

Predictors	**Extraversion facets**			
	Assertiveness (E3)		**Activity (E4)**	
	β (S.E.)	**P**	**β (S.E.)**	**P**
Muscularity	.41 (.12)	.03	.37 (.11)	.04
Upper body size	.18 (.11)	.24	.15 (.11)	.35
Physical masculinity	-.17 (.20)	.35	-.17 (.18)	.37
Anatomical masculinity	.00 (.18)	.99	.09 (.17)	.55

Mediation Model.

The extraversion facets, assertiveness and activity are most highly correlated with muscularity, and both these facets are associated with a sense of power. Therefore the associations between sociality, sense of power, and muscularity were further analysed. This was achieved by testing whether the relation between muscularity and sociality was mediated by sense of power. The indirect effect of muscularity on extraversion (i.e. that mediated by sense of power) was .15 (p= .018). There was no significant direct effect of muscularity on extraversion in the model. This suggests that the effects of muscularity on extraversion were completely mediated by sense of power. This supports the idea that strength predicts extraversion via sense of power, which is closely linked to assertiveness and entitlement (Anderson et al., 2012).

Discussion

Summary of Results and Implications

The current study builds upon previous research that examined the extent to which an individual's physical condition, in particular, anthropometric factors that capture sex typical characteristics, predicts their personality. The study tested theoretical predictions derived from evolutionary theories which propose that an individual's personality can become calibrated to their physical characteristics. These theories were separately conceived, although conceptually linked: the theory of facultative calibration of extraversion (Lukaszewski & Roney, 2011) and the recalibrational theory of anger (Sell, Tooby, et al., 2009). The logic of these theories was extended to test the hypotheses that additional traits, such as dominance (Price et al., 2012) and sense of power (Anderson et al., 2012; Anderson & Galinsky, 2006) are also subject to these calibration processes. More masculine and stronger men and more feminine and attractive women were expected to score higher on psychological traits of extraversion, aggression, dominance, entitlement, and sense of power. This was expected because the costs of the cost-benefit trade-offs associated with the expression of these psychological traits could best be overcome by highly masculine and feminine individuals due to their biological and physiological implications in terms of superior health and social leverage (Lukaszewski & Roney, 2011; Sell, Tooby, et al., 2009; Price et al., 2012, Anderson et al., 2012).

The results supported many of the theoretical predictions, for example, stronger and more masculine men scored higher on traits like extraversion, sense of power, and entitlement. On the other hand, they were not significantly more aggressive than weaker or less masculine men. The most important factor for men was muscularity and this factor explained the unique variance of the personality traits success in conflict, entitlement, sense of power and sociality. Anatomical masculinity also explained unique variance for the utility of aggression in men.

On the contrary, there was no support for the research hypotheses in the female subsample. Some of the results were in fact the opposite of these hypotheses. For example, extraversion correlated negatively with femininity. Overall, only two attractiveness measures predicted psychological traits significantly. The specific findings and the theoretical implications are discussed in turn as well as the limitations and future directions.

Self-rated attractiveness correlated positively with the four main anthropometric factors in men. More masculine and strong men had a more positive body image and perceived themselves as more attractive than less strong and less masculine men. This was is in line with previous findings (Frederick & Haselton, 2007). Self-rated attractiveness, correlated with scores on all the personality traits. Female self-rated attractiveness failed to correlate significantly with

the objective anthropometric measures of femininity and attractiveness but still correlated in the expected directions with a number of the traits.

In support of the theory of facultative calibration of extraversion (Lukaszewski & Roney, 2011), strength and self-rated attractiveness correlated positively with extraversion for men. However, the association with anatomical masculinity was not significant, possibly because this was not a good indicator of muscularity which was the most important predictor for men. More feminine women did not score higher on extraversion. On the contrary, for females, femininity correlated negatively with extraversion, albeit not significantly. This finding is difficult to explain given the fact that extraversion's association with self-rated attractiveness remained positive.

Individuals who scored higher on extraversion also had higher sense of power and both traits are associated with increased access to resources (Anderson et al., 2012; Lukaszewski & Roney, 2011; Nettle, 2005). After examining the association between the individual extraversion facets and the anthropometric factors it became clear that muscularity predicted scores on the facets of assertiveness and activity in particular. When correlating assertiveness with an individual's sense of power the strong correlation obtained suggests that they measure very a similar psychological construct. Interestingly, a sense of power mediated the association between extraversion and muscularity completely.

The predictions of the recalibrational theory of anger (Sell, Tooby, et al., 2009) received only limited support in this sample. For males, strength predicted only success in conflict but none of the other aggression scales. Only two further masculinity measures correlated significantly with the utility of aggression. Proneness to anger and fighting history yielded the weakest associations with muscularity and masculinity. In contrast to the results for extraversion, the utility of aggression correlated only with anatomical masculinity, which is not strength per se, only body shape masculinity. This however still acts as a visual cue of formidability (Fink et al., 2010). Again, for females the results were even more inconsistent compared to previous findings. Only physical femininity predicted higher scores on the utility of aggression but the association with self-rated attractiveness was non-significant. Surprisingly, self-rated attractiveness correlated positively with success in conflict, but negatively with proneness to anger.

One particular measure predicted to correlate with anger and aggression was facial WHR. However in this study, facial WHR was not an important predictor for aggressive behaviour (Carré & McCormick, 2008; Carré, McCormick, & Mondloch, 2009). Rather, in this sample females had wider faces overall and facial WHR's were significantly higher than in previous samples by Carré & McCormick (2008) and Özener (2012). Facial WHR in females

correlated positively with bodily masculinity, albeit not significantly, and facial WHR in males correlated negatively with anthropometric masculinity. Again these associations were small and not significant. For both sexes however, there were significant negative correlations between facial WHR and facial masculinity. Thus current results were more in line with findings by Özener (2012) who found no association between facial WHR and aggression and who noted that biological and cultural differences may account for the lack of findings. It remains uncertain how good a predictor facial WHR is of personality and more research is required as currently no solid conclusions can be drawn.

Similarly, the current study offers only limited support for the hypothesis that stronger men and more attractive women are less egalitarian and more dominant as previously predicted (Price et al., 2012). Muscularity and self-rated attractiveness predicted entitlement in men, whereas femininity for women was not associated with entitlement. An unexpected finding for both sexes was that none of the anthropometric factors significantly predicted scores on dominance despite this trait's association with status seeking (Price et al., 2012). Recently, Price et al. (2012) showed that upper body size predicted less egalitarian and more dominant traits but the associations between upper body size and muscularity with dominance in this sample were practically non-existent. Furthermore, dominance yielded the weakest correlation with self-rated attractiveness for men. Similarly, for women no significant correlations were observed between the anthropometric factors and self-rated attractiveness with dominance. One possible explanation is that the dominance scale captures more coercive and less pro-social aspects of personality, which do not reflect desirable traits, and may thus have lead to socially desirable, or deceptive, responding (Vazire & Mehl, 2008). Furthermore, individuals in this sample may genuinely be inclined to employ pro-social behavioural strategies, i.e. extraversion, for increasing social status and seek to achieve elevation within social hierarchies, rather than coercive behavioural strategies as captured by the dominance scale (Hawley, 1999; Lund et al., 2007).

The variation in age of the participants did offer insights into variation among for psychological traits, including the purported attenuation of physical aggression with age. The predictions that aggression tends to decline after graduate age (Daly & Wilson, 1988) was not fully supported in this sample (Sell, Tooby, et al., 2009). Only the association between self-rated attractiveness and proneness to anger was attenuated. Unrelated to aggression, extraversion did decline slightly with age but only for men. While this was unexpected it is not surprising as extraversion has been shown to decline after the age of 30 (Roberts, Walton, & Viechtbauer, 2006) and the oldest participants in this sample were 28 years old with the youngest being 18. Additionally, Price et al. (2012) suggested that formidability may, in older age, depend on social influence, yet again further psychological traits that are related to social influence, like

dominance only showed a marginal increase with age, entitlement, and sense of power, and correlated negatively with age but not significantly.

Limitations and Future Directions

There were few significant associations in the female sample and further investigation will be required to establish the reason for this. For example, most associations between anthropometric and self-rated attractiveness with the psychological traits were not significant. The only two significant anthropometric predictors, WHR for sense of power and anatomical femininity for utility of aggression, did not themselves correlate with self-rated attractiveness. Possibly women in this sample were modest in judging their own attractiveness (Price et al., 2012) and may have felt intimidated or self-conscious after being "body-scanned". Alternatively, they were less accurate in estimating their attractiveness (Brewer, Archer, & Manning, 2007) or they over-estimated their attractiveness (Trivers, 1999). A valuable addition for future research would be to have a measure of other-rated attractiveness for both participants' faces and bodies (Holtzman & Strube, 2010).

There was a number of surprising findings regarding the anthropometric measures. For example, the association between anthropometric femininity for body and face was not significant although it was previously shown to correlate highly (Confer, Perilloux, & Buss, 2010; Scheib, Gangestad, & Thornhill, 1999). Similarly unexpected was that facial WHR was higher for women. Previous studies showed higher scores for men due to its association testosterone levels during development (Carré & McCormick, 2008; Verdonck et al., 1999). Additionally, facial femininity which is considered a particularly important predictor for attractiveness in women (Fink & Penton-Voak, 2002, Penton-Voak et al., 2001), did not differ significantly between the sexes in this sample and was largely unrelated to self-rated attractiveness. This lack of consistency within this sample may highlight that, compared to previous studies, women were either not as feminine or men were not as masculine.

Future studies would also benefit from overcoming some of the limitations of the present study. For both sexes the sample size was relatively low given the nature of the study. Several correlations were tending toward the predicted directions but failing to reach significance. Striving for larger sample sizes in future would allow for stronger conclusions to be drawn and help improve generalisability of studies of this nature.

Although scale reliability for all traits was high and showed internal validity, it does not guarantee that individuals who score high or low on these traits behave accordingly in the real world as all psychological traits were assessed through self-report. Future research could employ observations in naturalistic settings. Although difficult to attain, these would be ecologically

valid (Carré & McCormick, 2008). Alternatively, observer-rated personality may be used to attain additional accuracy in measuring expression on psychological traits (Connelly & Ones, 2010).

Another viable direction for future research would be to analyse the temporal affects that changes in physical strength, masculinity and femininity have on the psychological traits. A longitudinal design may give insight into whether personality changes, for example aggression, in accordance with changes in physical formidability and bodily attractiveness.

Even if the psychological traits are ecologically valid they cannot prove a causal relationship between physical strength and attractiveness with the psychological traits they predict simply because correlations do not prove causality (Holland, 1986). For example an alternative suggestion may be that people who have a higher sense of power and are more extraverted are more likely to engage in physical exercise and thus increase muscle mass (Lukaszewski & Roney, 2011).

A further limitation is sample bias. All the participants were university students or had gone to university, meaning that not only was there little cultural variance but additionally the sample not socially stratified. Particularly the degree of education may have been an important caveat because higher levels of education have been associated with lower testosterone, delinquency, and aggression (Archer, 2006). Additionally, a lower socioeconomic status has been linked to increased display of anti-social behaviour (van Bokhoven, 2006). This may partly explain the lack of results between the aggression measures in this sample (Sell, Tooby, et al., 2009). Consequently, including individuals who did not attain higher education certificates and individuals of lower socio-economic status would be another valuable addition. Further bias may have been introduced because a large part of the participants stemmed from courses with a sport science background. These may have been more active and fit than individuals from the general population.

Strength of the Study

This study assessed numerous psychological traits, many of which have previously only been studied in isolation, all together in one single sample. This gave valuable insight into the associations between these various traits and the anthropometric predictors.

The methods of the study also ensured a high degree of measurement accuracy and reliability by employing technologically advanced equipment, including 3D cameras and a 3D body scanner. Being able to extract composite scores, which were able to measure overall body

dimensions is an important factor considering the variance and subjectivity used to assess individuals' strength and attractiveness. This helped to attain ecological validity.

Conclusion

The present study contributed to understanding the link between an individual's physical condition and psychological traits. The findings of this study partly support the idea that the expression of personality traits is dependent on physical health and fitness. Strength in men predicts a number of personality variables that are each socially empowering and associated with status seeking, social influence and increased access to resources (Nettle, 2005). The lack of findings for women in this study, for whom femininity did not predict personality traits merits further research. For either sex aggression was not clearly associated with strength or attractiveness. The same was the case for dominance. For men, a large number of psychological traits are predicted by muscularity and self-rated attractiveness and the psychological traits that drove these inter-correlations were further examined. The theoretical predictions of the above described theories predict a high expression of psychological traits that are associated with status seeking and attaining access to resources (Anderson et al., 2012). These include extraversion, entitlement, and success in conflict, and utility of aggression, all of which correlated positively with an individual's sense of power and all of these were predicted by muscularity. For females, sense of power also correlated highly with the personality traits except for the aggression scales.

References

3dMD. (2012). Information about 3D cameras and accuracy downloaded from manufacturer's website, http://www.3dmd.com/3dMDface/, 2012.

[TC]². (2010). Information about scanner accuracy downloaded from manufacturer's website, http://www.tc2.com/index_3dbodyscan.html, 2012.

Adler, N. E., Epel, E., Castellazzo, G., & Ickovics, J. (2000). Relationship of subjective and objective social status with psychological and physical health in healthy white women. *Health Psychology, 19,* 586–592.

Anderson, C., & Berdahl, J. L. (2002). The experience of power: Examining the effects of power on approach and inhibition tendencies. *Journal of Personality and Social Psychology, 83,* 1362–1377.

Anderson, C., & Galinsky, A. D. (2006). Power, optimism, and risk-taking. *European Journal of Social Psychology, 36*(4), 511-536. doi: 10.1002/ejsp.324

Anderson, C., John, O. P., & Keltner, D. (2012). The personal sense of power. *Journal of personality, 80*(2), 313-344.

Anderson, C., John, O. P., Keltner, D., & Kring, A. M. (2001). Who attains social status? Effects of personality and physical attractiveness in social groups. *Journal of Personality and Social Psychology, 81,* 116-132. doi: 10.1037//0022-3514.81.1.116

Anderson, C., Spataro, S., & Flynn, F. J. (2008). Personality and organizational culture as determinants of influence. *Journal of Applied Psychology, 93,* 702–710.

Asendorpf, J. B., & Wilpers, S. (1998). Personality effects on social relationships. *Journal of Personality and Social Psychology, 74,* 1531-1544.

Brewer, G., Archer, J., & Manning, J. (2007). Physical attractiveness: the objective ornament and subjective self-ratings. *Journal of Evolutionary Psychology, 5,* 29–38.

Brown, D. (1991). *Human Universals*. New York, NY: McGraw–Hill.

Burriss, R. P., Welling, L. L. M., & Puts, D. A. (2011). Mate-preference drives mate-choice: Men's self-rated masculinity predicts their female partner's preference for male facial masculinity. *Personality and Individual Differences, 51,* 1023-1027.

Buss, D. M. (2009). How can evolutionary psychology successfully explain personality and individual differences? *Perspectives on Psychological Science, 4*(4), 359-366.

Carré, J. M., & McCormick, C. M. (2008). In your face: facial metrics predict aggressive behaviour in the laboratory and in varsity and professional hockey players. *Proceedings of the Royal Society B: Biological Sciences, 275*(1651), 2651-2656. doi: 10.1098/rspb.2008.0873

Carré, J. M., McCormick, C. M, Mondloch, C. J. (2009). Facial structure is a reliable cue of aggressive behaviour. *Psychological Science, 20*(10), 1194-1198.

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology, 67*, 319–333.

Cherek, D. R. (1981). Effects of smoking different doses of nicotine on human aggressive behaviour. *Psychopharmacology, 75*, 339-345. doi: d10.1007/BF00435849

Connelly, B. S., Ones, D. S. (2010). An other perspective on personality: Meta-analytic integration of observers' accuracy and predictive validity. *Psychological Bulletin, 136*(6), 1092-1122. doi: 10.1037/a0021212

Costa, P. T., & McCrae, R. R. (1985). *The NEO personality inventory (NEO-PI) manual*. Odessa, FL: Psychological Assessment Resources.

Costa, P. T., & McCrae, R. R. (1992). *Revised NEO personality inventory (NEO-PI-R) professional manual*. Odessa, FL: Psychological Assessment Resources.

Confer, J. C., Perilloux, C., & Buss, D. M. (2010). More than just a pretty face: men's priority shifts toward bodily attractiveness in short-term versus long-term mating contexts. *Evolution and Human Behavior, 31*(5), 348-353.

Daly, M., & Wilson, M. (1988). *Homicide*. New York, NY: Aldine de Gruyter.

Denissen, J. J. A., & Penke, L. (2008). Motivational individual reaction norms underlying the Five-Factor model of Personality: First steps towards a theory based conceptual framework. *Journal of Research in Psychology, 42*, 1285-1302.

Dixson, B. J., Grimshaw, G. M., Linklater, W. L., & Dixson, A. F. (2011). Eye tracking of men's preferences for female breast size and areola pigmentation. *Archives of Sexual Behavior, 40*, 51-58. doi: 10.1007/s10508-010-9601-8

Ekman, P. (1973). Darwin and facial expression: A century of research in review. In P. Ekman (Ed.). New York, NY: Academic.

Emerson, R. M. (1962). Power dependence relations. *American Sociological Review, 27*, 31–41.

Fink, B., & Penton-Voak, I. S. (2002). Evolutionary psychology of facial attractiveness. *Current Directions in Psychological Science, 11*(5), 154-158.

Fink, B., Täschner, K., Neave, N., Hugill, N., & Dane, L. (2010). Male faces and bodies: Evidence of a condition-dependent ornament of quality. *Personality and Individual Differences, 49*, 436-440. doi: 10.1016/j.paid.2010.04.013

Fiske, S. T. (1993). Controlling other people: The impact of power on stereotyping. *American Psychologist, 48*, 621–628.

Frederick, D. A., & Haselton, M. G. (2007). Why is muscularity sexy? Tests of the fitness indicator hypothesis. *Personality and Social Psychology Bulletin, 33*(8), 1167-1183. doi: 10.1177/0146167207303022

Galinsky, A. D., Gruenfeld, D. H., & Magee, J. C. (2003). From power to action. *Journal of Personality and Social Psychology, 85*, 453–466.

Gallup, A. C., White, D. D., & Gallup, G. G. (2007). Handgrip strength predicts sexual behavior, body morphology, and aggression in male college students. *Evolution and Human Behavior, 28*(6), 423-429. doi: 10.1016/j.evolhumbehav.2007.07.001

Gangestad, S. W., & Scheyd, G. J. (2005). The evolution of human physical attractiveness. *Annual Review of Anthropology, 34*, 523-548. doi: 10.1146/

Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-offs and strategic pluralism. *Behavioral and Brain Sciences, 23*, 573-644.

Gangestad, S. W., & Thornhill, R. (2003). Facial masculinity and fluctuating asymmetry. *Evolution and Human Behavior, 24*(4), 231-241. doi: 10.1016/s1090-5138(03)00017-5

Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., & Gough, H. G. (2006). The international personality item pool and the future of public-domain personality measures. *Journal of Research in Personality, 40*(1), 84-96. doi: 10.1016/j.jrp.2005.08.007

Grammer, K., Fink, B., Møller, A. P., & Thornhill, R. (2003). Darwinian aesthetics: Sexual selection and the biology of beauty. *Biological Reviews, 78*(3), 385-407. doi: 10.1017/s1464793102006085

Hawley, P. H. (1999). The ontogenesis of social dominance: A strategy-based evolutionary perspective. *Developmental Review, 19*, 97-132.

Holland, P. W. (1986). Statistics and causal inference. *Journal of the American Statistical Association, 81(*396), 945-960.

Holtzman, N. S., & Strube, M. J. (2010). Narcissism and attractiveness. *Journal of Research in Personality, 44*, 133-136.

Houston, J. M., Harris, P., McIntire, S., & Francis, D. (2002). Revising the competitiveness index using factor analysis. *Psychological Reports, 90*, 31-34. doi: 10.2466/pr0.2002.90.1.31

Jasienska, G., Ziomkiewicz, A., Ellison, P. T., Lipson, S. F., & Thune, I. (2004). Large breasts and narrow waists indicate high reproductive potential in women. *Proceedings of the Royal Society B: Biological Sciences, 271*(1545), 1213-1217.

Kallman, D. A., Plato, C. C., & Tobin, J. D. (1990). The role of muscle loss in the age-related decline of grip strength: Cross-sectional and longitudinal perspectives. *Journal of Gerontology, 45*, 82–88.

Kaplan, H. S., & Gangestad, S. W. (2005). Life history theory and evolutionary psychology. In D. M. Buss (Eds.), *The handbook of evolutionary psychology* (pp. 68-96). New York, NY: Wiley.

Keller, M.C., & Miller, G. (2006). Resolving the paradox of common, harmful, heritable mental disorders: Which evolutionary genetic models work best? *Behavioral and Brain Sciences, 29*, 385–452.

Langlois, J. H., Kalakanis, L., Rubenstein, A. J., Larson, A., Hallam, M., & Smoot, M. (2000). Maxims or myths of beauty? A meta-analytic and theoretical review. *Psychological Bulletin, 126*, 390-423.

Lassek, W. D., & Gaulin, S. J. C. (2006). Changes in body fat distribution in relation to parity in American women: A covert form of maternal depletion. *American Journal of Physical Anthropology, 131*(2), 295-302.

Lassek, W. D., & Gaulin, S. J. C. (2008). Waist-hip ratio and cognitive ability: Is gluteofemoral fat a privileged store of neurodevelopmental resources? *Evolution and Human Behavior, 29*, 26−34.

Lassek, W. D., & Gaulin, S. J. C. (2009). Costs and benefits of fat-free muscle mass in men: Relationship to mating success, dietary requirements, and natural immunity. *Evolution and Human Behavior, 30*, 322-328.

Law Smith, M. J. L., Perrett, D. I., Jones, B. C., Cornwall, R. E., Moore, F. R., Feinberg, D. R., Boothroyd, L. G., Durrani, S. J., Stirrat, M. R., Whiten, S., Pitman, R. M., Hillier, S. G. (2006). Facial appearance is a cue to oestrogen levels in women. *Proceedings of the Royal Society of London Series B, 273*, 135–140.

Little, A. C., Jones, B. C., Waitt, C., Tiddeman, B. P., Feinberg, D. R., Perrett, D. I., Apicella, C. L., Marlowe, F. W. (2008). Symmetry is related to sexual dimorphism in faces: Data across culture and species. *PLoS ONE, 3*(5), e2106. doi: 10.1371/journal.pone.0002106

Lukaszewski, A. W., & Roney, J. R. (2011). The origins of extraversion: Joint effects of facultative calibration and genetic polymorphism. *Personality and Social Psychology Bulletin, 37*(3), 409-421. doi: 10.1177/0146167210397209

Lund, O. C. H., Tamnes, C. K., Mouestue, C., Buss, D. M., & Vollrath, M. (2007). Tactics of hierarchy negotiation. *Journal of Research in Personality, 41*, 25-44.

Meier, B. P., Robinson, M. D., Carter, M. S., & Hinsz, V. B. (2010). Are sociable people more beautiful? A zero-acquaintance analysis of agreeableness, extraversion, and attractiveness. *Journal of Research in Personality, 44*(2), 293-296. doi: 10.1016/j.jrp.2010.02.002

Moore, F. R., Cornwell, R. E., Law Smith, M. J., Al Dujaili, E. A. S., Sharp, M., & Perrett, D. I. (2011). Evidence for the stress-linked immunocompetence handicap hypothesis in human male faces. *Proceedings of the Royal Society B: Biological Sciences, 278*(1706), 774-780. doi: 10.1098/rspb.2010.1678

Muthén, L. K., & Muthén, B. O. (1998-2011). Mplus User's Guide. Sixth Edition. Los Angeles, CA: Muthén & Muthén.

Nettle, D. (2005). An evolutionary approach to the extraversion continuum. *Evolution and Human Behavior, 26*, 363-373. doi: 10.1016/j.evolhumbehav.2004.12.004

Nettle, D. (2006). The evolution of personality variation in humans and other animals. *American Psychologist, 61*(6), 622-631. doi: 10.1037/0003-066X.61.6.622

Newman, M. L., Holden, G. W., & Delville, Y. (2005). Isolation and the stress of being bullied. *Journal of Adolescence, 28*, 343-357.

Oldfield, R. C. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsychologia, 9*, 97-113.

Özener, B. (2012). Facial width-to-height ratio in a Turkish population is not sexually dimorphic and is unrelated to aggressive behavior. *Evolution and Human Behavior, 33*(3), 169-173.

Page, S. T., Amory, J. K., Bowman, F. F., Anawalt, B. D., Matsumoto, A. M., Bremner, W. J., & Tenover, J. L. (2005). Exogenous testosterone (T) alone or with finasteride increases physical performance, grip strength, and lean body mass in older men with low serum T. *Journal of Clinical Endocrinology & Metabolism, 90*(3), 1502-1510. doi: 10.1210/jc.2004-1933

Penke, L., Denissen, J. J. A., & Miller, G. F. (2007). The evolutionary genetics of personality. *European Journal of Personality, 21*, 549-587.

Penton-Voak, I. S., & Chen, J. Y. (2004). High salivary testosterone is linked to masculine male facial appearance in humans. *Evolution and Human Behavior, 25*(4), 229-241. doi: 10.1016/j.evolhumbehav.2004.04.003

Penton-Voak, I. S., Jones, B. C., Little, A. C., Baker, S., Tiddeman, B. P., Burt, D. M., & Perrett, D. I. (2001). Symmetry, sexual dimorphism in facial proportions and male facial attractiveness. *Proceedings of the Royal Society London B, 268*, 1617-1623.

Penton-Voak, I. S., Little, A. C., Jones, B. C., Burt, D. M., Tiddeman, B. P., & Perrett, D. I. (2003). Female condition influences preferences for sexual dimorphism in faces of male humans (Homo sapiens). *Journal of Comparative Psychology, 117*(3), 264-271.

Pound, N., Penton-Voak, I.S., & Surridge, A.K. (2009). Testosterone responses to competition in men are related to facial masculinity. *Proceedings of the Royal Society of London B, 276*(1654), 153-159.

Pratto, F., Sidanius, J., & Levin, S. (2006). Social dominance theory and the dynamics of intergroup relations: Taking stock and looking forward. *European Review of Social Psychology, 17*, 271–320.

Price, M. E., Dunn, J., Hopkins, S., & Kang, J. (2012). Anthropometric correlates of human anger. *Evolution and Human Behavior, 33*(3), 174-181. doi: 10.1016/j.evolhumbehav.2011.08.004

Price, M. E., Kang, J., Dunn, J., & Hopkins, S. (2011). Muscularity and attractiveness as predictors of human egalitarianism. *Personality and Individual Differences, 50*(5), 636-640. doi: 10.1016/j.paid.2010.12.009

Reise, S.P., Scheines, R., Widaman, K.F., & Haviland, M.G. (in press). Multidimensionality and structural coefficient bias in structural equation modeling. *Educational and Psychological Measurement*, published online 17 July 2012.

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin, 132*, 3-27.

Rhodes, G., Simmons, L. W., & Peters, M. (2005). Attractiveness and sexual behavior: Does attractiveness enhance mating success? *Evolution and Human Behavior, 26*(2), 186-201. doi: 10.1016/j.evolhumbehav.2004.08.014

Rhodes, G., Yoshikawa, S., Palermo, R., Simmons, L. W., Peters, M., Lee, K., Halberstadt, J., Crawford, J. R. (2007). Perceived health contributes to the attractiveness of facial symmetry, averganess, and sexual dimorphism. *Perception, 36*, 1244-1252.

Schaller, M., & Murray, D. R. (2008). Pathogens, personality, and culture: Disease prevalence predicts worldwide variability in sociosexuality, extraversion, and openness to experience. *Journal of Personality and Social Psychology, 95*, 212-221.

Scheib, J. E., Gangestad, S. W., & Thornhill, R. (1999). Facial attractiveness, symmetry, and cues of good genes. *Proceedings of the Royal Society of London B, 266*, 1318-1321.

Scheyd, G. J., Garver-Apgar, C. E., & Gangestad, S. W. (2008). Physical attractiveness: Signals of phenotypic quality and beyond. In & D. Krebs C. B. Crawford (Ed.), *Foundations of Evolutionary Psychology* (2nd ed., pp. 239−260). Hillsdale: NJ: Erlbaum.

Sell, A. (2006). Regulating welfare tradeoff ratios: Three tests of an evolutionary-computational model of human anger. *Dissertation Abstracts International, 66*(B), 4516.

Sell, A., Bryant, G. A., Cosmides, L., Tooby, J., Sznycer, D., von Rueden, C., Krauss, A., Gurven, M. (2010). Adaptations in humans for assessing physical strength from the voice. *Proceedings of the Royal Society B: Biological Sciences, 277*(1699), 3509-3518. doi: 10.1098/rspb.2010.0769

Sell, A., Cosmides, L., Tooby, J., Sznycer, D., von Rueden, C., & Gurven, M. (2009). Human adaptations for the visual assessment of strength and fighting ability from the body and face. *Proceedings of the Royal Society B: Biological Sciences, 276*(1656), 575-584. doi: 10.1098/rspb.2008.1177

Sell, A., Hone, L., & Pound, N. (2012). The importance of physical strength to human males. *Human Nature, 23*(1), 30-44. doi: 10.1007/s12110-012-9131-2

Sell, A., Tooby, J., & Cosmides, L. (2009). From the Cover: Formidability and the logic of human anger. *Proceedings of the National Academy of Sciences, 106*(35), 15073-15078. doi: 10.1073/pnas.0904312106

Singh, D., & Singh, D. (2011). Shape and significance of feminine beauty: An evolutionary perspective. *Sex Roles, 64*, 723-731. doi: 10.1007/s11199-011-9938-z

Smith, P. K., & Bargh, J. A. (2004). Nonconscious effects of power on basic approach and avoidance tendencies. *Social Cognition,* 26(1), 1-24

Snyder, J. K., Fessler, D. M. T., Tiokhin, L., Frederick, D. A., Lee, S. W., & Navarrete, C. D. (2011). Trade-offs in a dangerous world: Women's fear of crime predicts preferences for aggressive and formidable mates. *Evolution and Human Behavior, 32*(2), 127-137. doi: 10.1016/j.evolhumbehav.2010.08.007

Stephens, M. A. (1979). Test of fit for the logistic distribution based on the empirical distribution function. *Biometrika, 66*(3), 591-595.

Tiddeman, B. P., Duffy, N., & Rabey, G. (2000). Construction and visualisation of three-dimensional facial statistics. *Computer Methods and Programs in Biomedicine, 63,* 9-20.

Tooby, J., & Cosmides, L. (1990). On the universality of human nature and the uniqueness of the individual: The role of genetics and adaptation. *Journal of Personality, 58,* 17-67.

Trivers, R. L. (1999). The element of a scientific theory of self-deception. *New York Academy of Sciences, 187,* 111-126.

van Bokhoven, I., van Goozen, S. H. M., van Engeland, H., Schaal, B., Arseneault, L., Séguin, J. R., Assaad, J-M., Nagin, D. S., Tremblay, R. E. (2006). Salivary testosterone and aggression, delinquency, and social dominance in population-based longitudinal study of adolescent males. *Hormones and Behavior, 50*(1), 118-125.

Van Dongen, S., & Gangestad, S. W. (2011). Human fluctuating asymmetry in relation to health and quality: A meta-analysis. *Evolution and Human Behavior, 32*(6), 380-398. doi: 10.1016/j.evolhumbehav.2011.03.002

Vazire, S., & Mehl, M. R. (2008). Knowing me, knowing you: The accuracy and unique predictive validity of self-ratings and other-ratings of daily behavior. *Journal of Personality and Social Psychology, 95(5),* 1202-1216. doi: 10.1037/a0013314

Verdonck, A., Gaethofs, M., Carels, C., & de Zegher, F. (1999). Effect of low-dose testosterone treatment on craniofacial growth in boys with delayed puberty. *The European Journal of Orthodontics, 21*(2), 137-143. doi: 10.1093/ejo/21.2.137

Weston, E. M., Friday, A. E., & Liò, P. (2007). Biometric evidence that sexual selection has shaped the hominin face. *PLoS ONE, 2*(8), e710. doi: 10.1371/journal.pone.0000710

Wilt, J., & Revelle, W. (2008). Extraverion. In M.R. Leary & R.H. Hoyle (Eds.), *Handbook of individual differences in social behavior* (pp. 27-45). New York, NY: Guilford.

Zahavi, A. (1975). Mate selection – a selection for a handicap. *Journal of Theoretical Biology, 53,* 205-214.