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ORIGINAL ARTICLE

Facial Masculinity and Beardedness Determine Men's Explicit, but Not Their Implicit, Responses to Male Dominance

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Abstract Sexual dimorphism in facial shape and beardedness are salient human secondary sexual traits that enhance perceptions of men's social dominance. The majority of this evidence, however, comes from studies measuring explicit ratings. To our knowledge, few studies have tested whether facial masculinity and beardedness are implicitly associated with dominance. In the current study, we use a within-subjects design to test whether facial masculinity and beardedness drive implicit reactions and overt ratings of male dominance. Participants viewed stimuli depicting the same men when clean-shaven, with heavy stubble, and fully bearded that were morphed to be either more masculine or less masculine using computer graphic software. Participants completed an affective priming word categorisation task as well as explicit ratings of social dominance. No facilitation effects were observed for masculinised or bearded faces on implicit judgements relating to dominance. In contrast, results revealed that masculinized versions of clean-shaven, stubbled and fully bearded faces received higher explicit dominance ratings than feminized versions. However, the effects of facial masculinity were largest within clean-shaven stimuli and decreased as faces became more hirsute, suggesting that facial masculinity had diminishing returns on dominance ratings. Our results support a role for masculine facial shape and beardedness in explicit, but not implicit, judgments of dominance among men.

Keywords Masculinity · Dominance · Facial masculinity · Facial hair · Affective prime

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Introduction

Human visual systems have evolved to rapidly process identity, sex, age, and emotional expression from faces (Little et al. 2011). While dynamic facial expressions drive many overt behavioral interactions (Blair 2003), static facial features also provide important information that underpin aspects of mate choice and the assessment of potential rivals (Little et al. 2011). Mate choice and same sex competition imposes sexual selection on the evolution of ornamentation and weaponry in males across a wide range of taxa (Kokko et al. 2003) and may have shaped the evolution of sexual dimorphism in body composition (Wells 2007), cutaneous characters (van den Berghe and Frost 1986), vocal pitch (Puts 2010), facial and body hair (Dixson and Rantala 2016), and aspects of facial structure (Whitehouse et al. 2015) in humans.

Considerable research has focussed on whether morphological differences between men and women have been shaped by mate choice (Gangestad and Scheyd 2005; Grammer et al. 2003) or same sex competition (Puts 2010, 2016). Oestrogen dependent traits in women such as breast morphology (Dixson et al. 2015; Dixson et al. 2011), gynoid fat distribution (Brooks et al. 2015; Singh et al. 2010), lighter skin complexion (Law Smith et al. 2006) and feminine facial shape (Marcinkowska et al. 2014) provide cues to health and fertility that tend to enhance attractiveness to men. However, women's preferences for androgen dependent masculine facial features in men are more mixed (Rhodes 2006; Scott et al. 2013) and in some cases masculinity reduces male facial attractiveness (Perrett et al. 1998). Likewise, beardedness enhances men's attractiveness to women in some studies (Janif et al. 2014; Dixson and Rantala 2016; Pellegrini 1973; Reed and Blunk 1990) but not in others (Dixson et al. 2013; Dixson and Vasey 2012; Muscarella and Cunningham 1996; Feinman and Gill 1977; Wogalter and Hosie 1991), while in other cases preferences between clean-shaven faces and those with full beards are more equivocal (Dixson and Brooks 2013; Saxton et al. 2016; Neave and Shields 2008). Even within traits for which women typically state strong preferences, such as deeper vocal pitch (Puts et al. 2006) and muscularity (Frederick and Haselton 2007; Dixson et al. 2014), effect sizes for ratings of dominance tend to be greater than those for attractiveness (Puts 2010). Variation among women in their preferences may be context-dependent (Scott et al. 2014; but see Zietsch et al. 2015), becoming stronger when considering mates for short-term rather than long-term relationships and when the likelihood of conception is greater (Gildersleeve et al. 2014).

Across diverse taxa, weaponry, such as claws, horns and canines can serve directly in intra-sexual contest competition (Emlen 2008). Among the anthropoid primates, visually conspicuous secondary sexual traits provide information used by males to assess the sexual maturity, dominance and rank of other males (Dixson et al. 2005; Grueter et al. 2015). Growing evidence supports the view that intra-sexual competition has played an important role in the evolution of men's secondary sexual traits and agonistic behaviours (Puts 2010, 2016; Puts et al. 2015; Archer 2009). Competition among males ancestrally, when female choice for mates may have been more limited than in contemporary industrialised societies, may have shaped the evolution of many of men's secondary sexual traits (Puts et al. 2015). Cues of formidability may serve to curtail aggressive and costly fights, aid in mate guarding and ultimately translate into greater mating and reproductive success (Puts et al. 2015).

A large body of research reports that explicit judgments of men's dominance and aggressiveness are enhanced by craniofacial masculinity (Perrett et al. 1998; DeBruine et al. 2006; Spisak et al. 2012) and beardedness (Geniole and McCormick 2015; Dixson and Brooks 2013; Dixson and Vasey 2012; Saxton et al. 2016; Neave and Shields 2008). Further, facial masculinity is associated with measures of men's upper body strength (Fink et al. 2007; Windhager et al. 2011; Holzleitner and Perrett 2015; Sell et al. 2009) and behavioural dominance (Geniole et al. 2015; Pound et al. 2009). Similarly, men with beards report feeling more masculine and dominant than when clean-shaven (Wood 1986), have higher serum levels of testosterone (Knussman and Christiansen 1988), and endorse more stereotypical masculine gender roles in heterosexual relationships (Oldmeadow and Dixson 2016). Men with higher self-reported social dominance and men with greater stature are also less sensitive to cues of facial dominance than men of shorter stature and lower self-reported social dominance (Watkins, Jones and DeBruine, 2010; Watkins et al. 2010a, b). Recently, it was shown that men who received a dose of exogenous testosterone were more likely to pick a more masculine version of their face than men who received a placebo (Welling et al. 2016). Taken together, these findings suggest that androgen dependent facial shape and beardedness are used by other males to assess age, sexual maturity, rank and dominance, supporting the view that male secondary sexual traits function in intra-sexual communications (Puts 2010, 2016; Puts et al. 2015).

While studies measuring explicit ratings of dominance reveal that facial masculinity and beardedness are associated with masculinity and dominance, the extent to which such judgments extend to implicit associations of male dominance remains to be determined. Given that facial features may reveal the potential threat an individual poses (Geniole et al. 2015), it would be advantageous to assess these cues in as little time as possible. For example, brain imaging has shown that the amygdala plays a role in the automatic coding of facial characteristics associated with trustworthiness (Engell et al. 2007). Thus, facial cues may elicit implicit, as well as explicit, appraisals of many sociosexual attributes, including dominance.

In the current study we assess possible implicit attitudes relating to perceived dominance using an affective prime task. Where explicit ratings may be subject to demand characteristics (Fazio et al. 1995), implicit testing paradigms are thought to tap automatic and unconsciously activated attitudes by using tasks that are not transparent to participants and do not require verbalisation. Affective primes test the strength of implicit attitudes by presenting participants with a prime stimulus before quickly displaying a target word that must be categorised by the participant. In principle, if the prime stimulus evokes an attitude that is congruent with the target word, participants will respond faster on average. This congruency effect has been replicated across numerous studies (for review see Fazio 2001; Klauer and Klauer and Musch 2003; Bargh 1997). Affective primes have been successfully used in order to evaluate implicit attitudes associated with facial stimuli (e.g. Koranyi et al. 2013; Li and Lu 2014; Palermo and Schmalzl 2006; Yang et al. 2012; Banse 2001). Here we use as priming stimuli male facial images varying in natural levels of facial hair that were experimentally manipulated to enhance or supress masculine shape cues via computer graphic software. These stimuli were paired with target words that were either related to dominance or submissiveness selected from previous literature assessing explicit ratings of facial dominance.

We predicted that facial hair and facial masculinity would have positive main effects on explicit ratings and implicit associations, so that full beards and more masculine facial shape would be more rapidly associated with dominance and rated as looking the most dominant. We also predicted that beards and facial shape would act in concert to determine our outcome measures, with full beards with masculine facial shapes being most rapidly associated with dominance and rated as looking the most dominant.

Materials and Methods

Participants

Sixty males (*M* = 20.12, *SD* = 3.32) were recruited to take part in the study. All participants were undergraduates who were fluent in English and living in Australia, 50 of whom received course credit for participating in the experiment and the remaining ten participants volunteered without course credit. 63.3 % of participants self-identified as Australian, 13.3 % were Chinese, 3.3 % were Taiwanese, 3.3 % were British, 3.3 % were Central/South American, 1.7 % were North American, 5 % were Asian, 1.7 % were Sri Lankan, 1.7 % Swedish, 1.7 % were Turkish and 1.7 % elected not to answer this question. The majority (86.7 %) were heterosexual, 5 % were bisexual, 6.7 % were homosexual and 1.6 % elected not to answer this question. While all 60 participants completed both the explicit and implicit tasks, one participant's data from the implicit responses was corrupted, leaving 59 participants (*M* = 19.97, *SD* = 3.13) for that analysis.

Face Stimuli

Image Set

Six men (mean age ± SD = 23.95 ± 3.43 years, range 20–31) of European descent were photographed when clean-shaven, with 10 days of regrowth (heavy stubble) and with at least four weeks of untrimmed growth (full beard), posing front-on with neutral facial expressions. These six identities were randomly drawn from a larger image set of 36 individuals (Janif et al. 2014) and served as stimuli in the present study.

Masculinity Manipulation

Facial masculinity was manipulated via JPsychomorph software (Tiddeman et al. 2001). A sexual dimorphism continuum was defined as the vector difference between an average male and an average female face, created by averaging 50 Caucasian male and 50 female face images, respectively, not including the stimulus identities of the current study. The average male and female faces were matched for overall colour content using the Match Color tool in Photoshop (vCS5.1). This ensured that morphs created using this continuum would not differ in overall hue from their original image, but permitted variation of local colour cues that likely contribute to perceived facial structure.

For each stimulus identity, the three variants (clean-shaven, heavy stubble and full beard) were each then morphed (using JPsychomorph) to create two images in which masculinity was increased by 50 % (by morphing parallel to the male-female vector, in the direction of the average male face) and decreased by 50 % (by morphing parallel to the male-female vector, in the direction of the average female face), respectively. Six stimulus identities that had been masculinized and feminized, respectively, at three stages of facial hair resulted in a 36-image stimulus set for the current study. These images were then refined in Photoshop to ensure each had sharp edges at the sides of the neck, smooth pupils (by replacing irises in the morphs with irises from the original image) and were presented on a consistent background colour. Removal of artifacts around the neck and eyes ensured the morphs looked as much like un-manipulated photographs as the original images. Each image measured 1458 × 2292 pixels and was presented in grayscale (Fig. 1).

Affective Prime Target Words

All participants completed an affective priming procedure (Fazio et al. 1986). The affective prime portion of the study employed a three: facial hair (clean shaven, stubble, full beard) by two: facial dimorphism (masculine, feminine) by two: target word category (dominant, submissive) design. Five words relating to dominance (menace, threat, fight, violent, strong) and submissiveness (meek, timid, weak, gentle, soft) were used as target words in the affective prime. These words were sourced from terminology previously employed in literature investigating explicit perceptions of male dominance and submissiveness (Hundhammer and Mussweiler 2012; Sanchez et al. 2006; Skowronski et al. 2010).

Procedure

Prior to beginning the experiment, participants were told that they were taking part in a reaction time task. Each participant completed the study individually and the true nature of the affective prime component (implicit effects of dominance in male faces) was concealed until debriefing at the conclusion of the experiment.

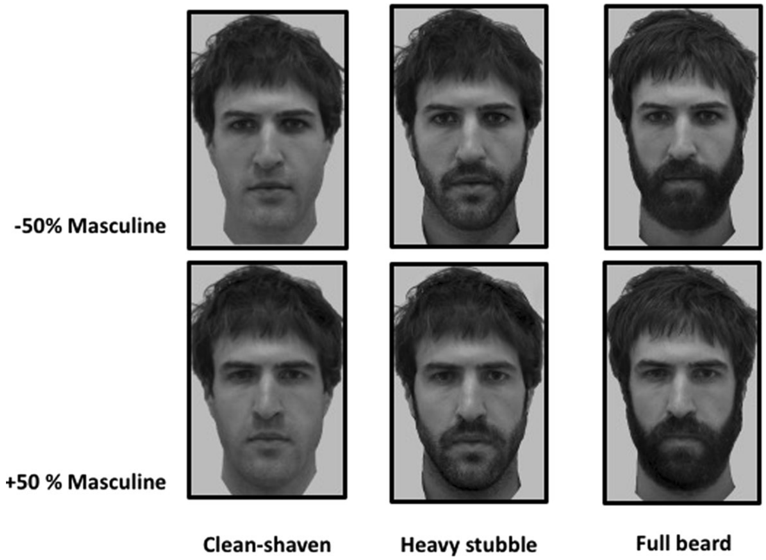

Fig. 1 An example of the stimuli used in this study. Images show the same individual in each of the three categories of facial hair (clean-shaven, stubble and fully bearded) manipulated to appear 50 % less masculine (top panel) and 50 % more masculine (bottom panel)

Affective Prime

The priming task followed standard protocol for the paradigm (Fazio et al. 1986) and was controlled using Direct-RT (Jarvis 2016). Participants were instructed to stay focused on the screen at all times throughout the task and to begin whenever they were ready. Onscreen instructions informed participants that a face would briefly flash on the screen followed by a target word which they were to categorise as dominant or submissive using either the '/' (submissive) or 'z' (dominant) keys on the keyboard in front of them. Participants were told to keep their index fingers on these keys at all times throughout the experiment. Twelve practice trials followed using two stimulus identities (masculinised and feminised at three levels of facial hair growth: 12 images in total) that did not appear in the experiment proper. Participants then began the six blocks of test trials.

Each block consisted of 60 trials, followed by a rest period before commencing the next block. Each trial began with a fixation period (500 ms) of the characters 'XXXXXXX' displayed centrally followed by the affective prime: one of the 36 facial stimuli (200 ms) in the centre of the screen. A blank screen then appeared for 100 ms, before the target word appeared in the centre of the screen. Participants then categorised the word as dominant or submissive using the keyboard. If a participant responded within 200 ms of the facial stimuli appearing (i.e. before the target word appeared), a message informed them that they had responded too quickly and to wait until the target stimulus appeared on subsequent trials. Similarly, if responses occurred after 2000 ms participants were told that they needed to respond quicker on subsequent trials. Trials were separated by a 1000 ms inter-trial interval and continued across the six test blocks until all combinations of face primes and target words had been rated.

Explicit Dominance Ratings

Once the affective prime task had been completed, participants began the explicit rating task. This involved rating the same 36 faces as used in the affective prime task, presented in random order, for dominance on a scale from 1 (not dominant) to 10 (extremely dominant).

Results

Affective Prime

Response times for incorrect (18.1 %), and overly short (<200 ms) or long (>1750 ms) responses (1.2 %) were excluded prior to calculating means. Correct response times (RTs) were then averaged across each stimulus/target combination (i.e. clean-shaven, masculine, dominant) before being entered into a 3 (facial hair) X 2 (facial dimorphism) X 2 (word category) repeated-measures ANOVA.

There was a main effect of word category (Table 1), such that RTs to dominant words ($M = 643.97$, $SD = 121.52$ ms) were significantly faster than those to submissive words ($M = 660.57$, $SD = 137.98$ ms, $d = 0.13$). No other significant main effects or interactions emerged from the model (Table 1).

Table 1 Repeated-measures ANOVA testing effects of facial hair (clean-shaven, stubble, full beards), facial masculinity (high, low) and word category (dominant, submissive) on response times

	df	F	P	Partial Eta^2
Facial hair	2,116	0.281	0.755	0.005
Facial masculinity	1,58	0.230	0.633	0.004
Word category	1,58	7.467	0.008	0.114
Facial hair x facial masculinity	2,116	1.268	0.285	0.021
Facial hair x word category	2,116	0.299	0.742	0.005
Facial masculinity x word category	1,58	2.270	0.137	0.038
Facial hair x facial masculinity x word category	2,116	1.249	0.291	0.021

Explicit Dominance Ratings

Explicit ratings of dominance were averaged across stimulus identities within each condition and entered as the dependent variable in a 3 (facial hair) × 2 (facial dimorphism) repeated-measures ANOVA (Table 2).

There was a significant main effect of facial hair on explicit ratings of dominance (Table 2). Faces with full beards (M = 6.03, SD = 1.24) were rated as more dominant than faces with stubble, (M = 5.01, SD = 1.16; t(59) = 8.44, p < .001, d = 0.85), and clean-shaven faces, (M = 4.13, SD = 1.32; t(59) = 10.16, p < .001, d = 1.48). Faces with stubble were rated as more dominant than clean-shaven faces, (t(59) = 7.95, p < .001, d = 0.71). There was also a significant main effect of facial masculinity (Table 2), so that dominance ratings were higher for masculine faces (M = 5.24, SD = 1.06) than feminised faces (M = 4.87, SD = 1.12, d = 0.35).

There was also a significant facial hair × facial masculinity interaction (Table 2). Comparisons within each facial category found that masculine faces were judged as significantly more dominant than feminised faces for clean-shaven (t(59) = 5.62, p < .001), stubble (t(59) = 3.69, p < .001), and fully bearded (t(59) = 2.91, p = .005) faces. Comparisons across all categories revealed that masculinised faces with full beards were rated as significantly more dominant than masculinised and feminised versions of faces with stubble and masculinised and feminised versions of clean-shaven faces, (all ≥ t(59) 7.45, all p ≤ .001; Fig. 2). Feminised faces with full beards were rated as significantly more dominant than masculinised and feminised versions of clean-shaven faces or faces with stubble (all ≥ t(59) 5.22, all p ≤ .001; Fig. 2). Masculinised faces with stubble were rated significantly higher than feminised and masculinised

Table 2 Repeated-measures ANOVA testing effects of facial hair and facial masculinity on dominance ratings

	df	F	P	Partial Eta^2
Facial hair	2,118	87.797	<0.001	0.598
Facial masculinity	1,59	35.841	<0.001	0.378
Facial hair x Facial masculinity	2,118	4.715	0.011	0.074

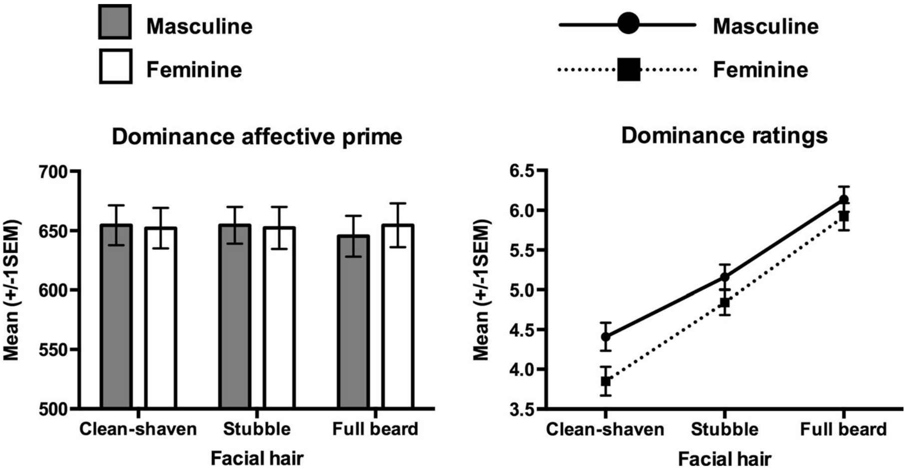

Fig. 2 The left panel shows the mean response times (± 1 SEM) following the dominance affective prime to faces varying in facial hair (clean-shaven, stubble and fully bearded) that had been morphed to appear more masculine (grey bars) and more feminine (white bars). The right panel shows shows the mean dominance ratings (± 1 SEM) to faces varying in facial hair (clean-shaven, stubble and fully bearded) that had been morphed to appear more masculine (circular symbol on solid line) and more feminine (square symbol on dashed line)

clean-shaven faces, (all $\geq t(59)$ 6.02, all $p \leq .001$; Fig. 2). Feminised faces with stubble were also rated higher than masculinised and feminised versions of clean-shaven faces, (all $\geq t(59)$ 3.32, all $p \leq .01$; Fig. 2).

This interaction could reflect effects of facial masculinity being larger within clean-shaven faces compared to faces with any facial hair, which would suggest diminishing effects of facial masculinity on dominance ratings with advancing levels of beardedness. However, it could be that the additive effect of facial hair is larger for feminised compared to masculinised faces, which would further suggest diminishing returns to facial masculinity on dominance ratings as facial hair increases. Effect sizes were indeed larger for comparisons within clean-shaven faces (d = 0.40) compared with faces with stubble (d = 0.27) and full beards (d = 0.17). Further, when faces were feminised, effect sizes for beards vs. stubble (d = 0.85) and beards vs. clean-shaven faces (d = 1.51) were higher than the same comparisons for masculinised versions of faces (ds = 0.80, 1.33 respectively). Effect sizes between stubbled and clean-shaven faces were also higher for feminised (d = 0.74) than masculinised faces (d = 0.59). This suggests diminishing returns to facial masculinity as faces become more hirsute and that additive effects of facial hair are incrementally larger within feminised than masculinised faces (Fig. 2).

Implicit and Explicit Measures

To test whether implicit responses to dominance were predictive of explicit ratings of dominance we correlated scores on the two measures. Participants may simply have slower reaction times across all stimuli and high dominance ratings across all stimuli. This could produce a correlation between the two measures that is unrelated to either implicit or explicit responses towards dominance in male faces. By computing difference scores, we can calculate whether effects of facial characteristics produce consistent differences in perceptions of dominance across levels of facial hair and facial masculinity between the two measures.

We calculated the average difference between masculine and feminine face affective prime response times for each of the three levels of facial hair for dominant target words (i.e. masculine bearded face reaction times minus feminine bearded face reaction times, etc.). We then calculated the difference between explicit dominance ratings for masculine and feminine faces within each of the three levels of facial hair (i.e. ratings for masculinized clean-shaven faces minus ratings for feminised clean-shaven faces). After controlling for these effects, no significant correlations were observed between explicit and implicit measures of dominance for clean-shaven stimuli ($N = 59$, $r = -.13$, $p = .320$), stimuli with stubble ($r = -.16$, $p = .239$) or full bearded stimuli ($r = -.08$, $p = .537$).

We repeated this process for each level of facial hair for masculinised and feminised faces. We first calculated the difference between bearded and stubbled faces, then the difference between bearded and clean-shaven faces, and finally, the difference between stubbled and clean-shaven faces for masculine and feminine faces separately for implicit and explicit responses. For masculine faces, no correlations were observed between implicit and explicit measures of the difference between bearded and stubbled faces ($r = .05$, $p = .711$), between bearded and clean-shaven faces, ($r = -.02$, $p = .908$), or between stubbled and clean-shaven faces ($r = -.04$, $p = .777$). For feminised faces, no significant correlations were observed between differences for bearded and stubbled faces ($r = -.13$, $p = .342$), between bearded and clean faces ($r = -.17$, $p = .200$), or between stubbled and clean-shaven faces ($r = -.20$, $p = .132$).

We then tested whether main effects of facial hair or masculinisation correlated across implicit and explicit measures. We calculated the difference between masculinised and feminised faces across all levels of facial hair, and conversely the differences between each level of facial hair averaged across masculinised and feminised conditions. We found a significant negative correlation between the difference score of masculine and feminine faces across implicit and explicit measures, ($r = -.28$, $p = .035$), indicating that the effect of masculinised faces on perceived dominance on one task predicted an effect on the other. However, we interpret this finding with caution, given the large number of correlations calculated and the small size of the correlation. No significant correlations were observed for differences between bearded and stubbled faces ($r = -.08$, $p = .535$), bearded and clean-shaven faces ($r = -.12$, $p = .356$), or stubbled and clean-shaven faces ($r = -.16$, $p = .233$) when averaged over masculine and feminine conditions.

Discussion

In many mammals, weaponry like claws, horns or canines serve directly in contest competition with conspecifics (Emlen 2008). In other cases, secondary sexual traits provide information regarding age, dominance and rank within social groups (Sheehan and Bergman 2016; Grueter et al. 2015; Dixson et al. 2005). Converging evidence suggests men's secondary sexual traits also play a strong role in intra-sexual communication of age, masculinity and dominance (Puts 2010, 2016) and function during intra-sexual agonistic displays (Puts et al. 2015). We hypothesised that facial masculinity and beardedness would receive high explicit ratings of dominance and receive the most rapid associations with dominance in an affective prime task. We found that facial hair and facial masculinity enhanced ratings of men's dominance. However, neither trait exerted significant effects on implicit responses to male dominance. Our findings have implications for understanding the role of men's secondary sexual traits during intra-sexual assessments.

We found that beards and facial masculinity both exerted significant effects on ratings on men's dominance, which replicates several previous studies (Saxton et al. 2016; Neave and Shields 2008; Dixson and Vasey 2012; Perrett et al. 1998). However, we found no implicit associations between men's beardedness, facial masculinity, or their combination, on men's implicit responses to male dominance. This result was surprising given the amount of empirical support that implicit processes underpin gaze cueing towards facial expressions of dominance (Terburg et al. 2011) and that androgen-dependent facial features enhance ratings of men's formidability and dominance (Puts et al. 2015; Sell et al. 2012). We did observe a main effect whereby dominance related target words were categorised quicker. This indicates a clear statistical difference in the recognition of the target words' respective categories, confirming that there was sufficient variance in the response times to potentially detect differential effects of the primes. The predicted interaction between the targets and primes failed to emerge, however, suggesting that levels of masculinity and beardedness (beyond simply being male) in the affective primes did not differentially prime responses to dominance related words.

There are both strengths and limitations to the use of implicit measures from social psychology to study effects of facial morphology on dominance perceptions. The primary advantage of implicit measures is the circumvention of explicit and conscious responses, providing access to automatically activated attitudes (Fazio et al. 1986). However, a key limitation is that priming effects are subject to influences such as the strength of the prime and the valence associated with response categories (Fazio 2001). With regards to the priming stimulus in the present study, there is no reason to believe that they were insufficient in their strength to elicit implicit attitudes. Previous research has found that face images can be used successfully as affective primes (e.g. Koranyi et al. 2013; Banse 2001; Li and Lu 2014; Palermo and Schmalzl 2006; Yang et al. 2012) and that complex, feature-based images are capable of being processed as primes. For example, Livingston and Brewer (2002) manipulated the physiognomy of African-American facial primes to have high prototypical features or low prototypical features. The degree of prototypicality of facial physiognomy influenced the strength of automatic evaluations in an effective priming task. Thus, not only can feature-based primes elicit automatic responses, but variation in these features also produces variation in the automatic evaluations elicited (Maddox 2004; Maddox and Dukes 2008). More recent research has shown priming effects of facial emotional expression (e.g. angry, fearful, or, happy), which is similarly based on feature-based processing, and that these effects were consistent across multiple face prime stimuli (Yeung et al. 2015). Masculinity in faces is similarly the result of multiple facial characteristics (i.e. jaw size, brow ridge thickness, cheekbone height, width-to-height ratios) influencing feature-based evaluations. Given previous research, it seems unlikely that the absence of automatic evaluations in response to masculine or feminine faces is a consequence of the characteristics of the primes themselves. This is also the case for levels of facial hair, which require much more simple visual processing (i.e. attention to presence or absence of facial hair).

It is also unlikely that error in categorising target words contributed to the absence of priming effects. While 18.1 % inaccuracy is higher than in similar affective prime paradigms (e.g. 6 % in Koranyi et al. 2013), it is not entirely unexpected given the relative novelty of the categories employed (i.e. dominant vs. submissive). Furthermore, we observed a main effect of target type, such that dominant words were categorised faster on average, indicating discriminant responses in both categorisation (81.9 % accuracy) and latency. This is consistent with the affective priming literature, which demonstrates greater impact of negatively evaluated stimuli than positive (for review see Klauer 1997). In the present study, dominant words are likely to have been perceived as more negative (e.g. menace, threat, fight, violent, strong), which may account for more rapid responses. Yet, this did not interact with the characteristics of the prime as would be expected in the context of implicit attitudes. It appears that while facial stimuli primes may evoke attitudes in affective prime tasks, masculine and/or bearded faces may not elicit implicit attitudes pertaining to dominance.

Analysis of explicit ratings, in contrast, revealed a significant interaction between facial hair and the facial masculinity manipulation on men's ratings of male dominance. As predicted, masculinised versions of faces that were clean-shaven, had stubble or had full beards were rated as looking more dominant than their feminized counterparts. However, effects of masculinity on dominance ratings were reduced as faces displayed more pronounced facial hair. Thus, clean-shaven masculinized faces were rated as significantly less dominant than feminized faces with light stubble. This diminishing return of facial masculinity suggests that facial hair may enhance sexually dimorphic features that are judged as giving men a more masculine and socially dominant appearance. It might be assumed that ancestral males were typically bearded, essentially masking sexually dimorphic craniofacial shape. Interestingly, men's facial width-to-height ratio, a measure that is associated with ratings of men's dominance and aggressiveness (Geniole et al. 2015), was found to predict ratings of men's aggressiveness in both bearded and clean-shaven versions of the same male, although bearded faces were rated as more aggressive looking than clean-shaven faces overall (Geniole and McCormick 2015). Present day populations differ markedly in natural distribution of facial and body hair. For example, the! Kung hunter-gatherers grow little facial compared to neighbouring Kavango subsistence farmers (Winkler and Christiansen 1993), whereas Ainu hunter-gatherers of Japan remain some of the most hirsute individuals ever documented (Harvey and Brothwell 1969). Limited cross-cultural data suggest that beards are more consistently associated with male dominance than attractiveness (Dixson and Vasey 2012; Neave and Shields 2008; Saxton et al. 2016). Yet men can easily groom or remove their beards, essentially manipulating their perceived masculinity. While much of the variation in facial hair grooming may simply reflect trends in fashion, data from 1842 to 1971 among men in London revealed that facial hair was more common when the marriage market was more female biased (Barber 2001), possibly as men when augment their masculinity when intra-sexual competition is strongest. However, when facial hair becomes too common it is judged as less attractive than when it is rare, suggesting that negative frequency dependence may underpin some of the variation in facial hair fashions (Janif et al. 2014). Although further cross-cultural research remains a priority, temporal fluctuations in the frequencies of facial may be influenced by mating market dynamics that could include the strength of intra-sexual competition.

There are limitations to the explicit ratings portion of the study design that should be highlighted. Firstly, we only used six male identities in the explicit ratings of dominance. While this is the same number as has been used in some previous studies (Saxton et al. 2016), other studies have used larger stimulus sets (Janif et al. 2014). We chose this number to avoid participant fatigue in our within-subjects design. However, we acknowledge that future studies looking in more detail at how underlying natural variation in facial morphometrics interact with beardedness to determine judgments of men's sociosexual attributes using a larger sample of faces would be valuable. Further, there is evidence that wearing a beard changes men's feelings of masculinity and confidence (Wood 1986) that may have translated into greater confidence or dominance when posing neutral expressions in the photographs. Such effects have been found to influence judgments of faces in other studies. For example, t-shirt color influences judgments of facial attractiveness despite it not being visible to raters (Roberts et al. 2010). Given that wearing a false beard enhances men's self-perceived masculinity (Wood 1986), we acknowledge that some subtle effects of confidence may have transferred onto the ratings of dominance ascribed to bearded over clean-shaven faces. Unfortunately, our study cannot account for the effects of growing or removing facial hair on men's self-perceived confidence. Subtle differences in skin complexion and facial fatigue between the time periods in which photographs were taken could also have contributed to how facial hair was judged. Finally, our sample of raters was ethnically mixed while the stimuli we employed was restricted to males of European descent. Extending our study to include more diverse stimuli and raters will therefore be important. For the present, our results provide preliminary experimental evidence that facial hair plays a more salient role in driving judgments of male dominance than experimentally manipulating facial masculinity. However, the mechanisms by which men gain an advantage, if any, in mate competition by enhancing their beardedness remains a challenge for future research to tackle.

Compliance with Ethical Standards

Ethics Statement All protocols were approved by the Human Ethics Committee at the University of Queensland and are in accordance with the 1964 Declaration of Helsinki. All participants provided informed consent before participating in this study and were free to withdraw from the research at any point.

References

Archer, J. (2009). Does sexual selection explain human sex differences in aggression? *Behavioral and Brain Sciences, 32*(3–4), 249–266. doi:10.1017/S0140525X09990951.

Banse, R. (2001). Affective priming with liked and disliked persons: prime visibility determines congruency and incongruency effects. *Cognition and Emotion, 15*(4), 501–520. doi:10.1080/0269993004200213.

Barber, N. (2001). Mustache fashion covaries with a good marriage market for women. *Journal of Nonverbal Behavior, 25*(4), 261–272.

Bargh, J. A. (1997). The automaticity of everyday life. In R. S. Wyer, & J. A. Bargh (Eds.), *The automaticity of everyday life*: *Advances in social cogntion* (Vol. 10., Vol. Book, Whole). Mahwah, N.J: Lawrence Erlbaum Associates

Blair, R. J. R. (2003). Facial expressions, their communicatory functions and neuro–cognitive substrates. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 358*(1431), 561–572. doi:10.1098/rstb.2002.1220.

Brooks, R. C., Shelly, J. P., Jordan, L. A., & Dixson, B. J. W. (2015). The multivariate evolution of female body shape in an artificial digital ecosystem. *Evolution and Human Behavior, 36*(5), 351–358. doi:10.1016/j.evolhumbehav.2015.02.001.

DeBruine, L. M., Jones, B. C., Little, A. C., Boothroyd, L. G., Perrett, D. I., Penton-Voak, I. S., et al. (2006). Correlated preferences for facial masculinity and ideal or actual partner's masculinity. *Proceedings of the Royal Society B: Biological Sciences, 273*(1592), 1355–1360. doi:10.1098/rspb.2005.3445.

Dixson, B. J., & Brooks, R. C. (2013). The role of facial hair in women's perceptions of men's attractiveness, health, masculinity and parenting abilities. *Evolution and Human Behavior, 34*(3), 236–241.

Dixson, B. J. W., & Rantala, M. (2016). The role of facial and body hair distribution in Women's judgments of Men's sexual attractiveness. *Archives of Sexual Behavior, 45*, 877–889.

Dixson, B. J., & Vasey, P. L. (2012). Beards augment perceptions of men's age, social status, and aggressiveness, but not attractiveness. *Behavioral Ecology, 23*, 481–490.

Dixson, A. F., Dixson, B. J., & Anderson, M. (2005). Sexual Selection and the Evolution of Visually Conspicuous Sexually Dimorphic Traits in Male Monkeys, Apes, and Human Beings. *Annual Review of Sex Research, 16*(1053–2528), 1–19.

Dixson, B. J., Vasey, P., Sagata, K., Sibanda, N., Linklater, W., & Dixson, A. (2011). Men's preferences for Women's breast morphology in New Zealand, Samoa, and Papua New Guinea. *Archives of Sexual Behavior, 40*(6), 1271–1279. doi:10.1007/s10508-010-9680-6.

Dixson, B. J., Tam, J. C., & Awasthy, M. (2013). Do women's preferences for men's facial hair change with reproductive status? *Behavioral Ecology, 24*(3), 708–716.

Dixson, B. J., Grimshaw, G. M., Ormsby, D. K., & Dixson, A. F. (2014). Eye-tracking women's preferences for men's somatotypes. *Evolution and Human Behavior, 35*(2), 73–79.

Dixson, B. J., Duncan, M., & Dixson, A. (2015). The role of breast size and areolar pigmentation in perceptions of Women's sexual attractiveness, reproductive health, sexual maturity, maternal nurturing abilities, and age. *Archives of Sexual Behavior, 44*(6), 1685–1695. doi:10.1007/s10508-015-0516-2.

Emlen, D. J. (2008). The evolution of animal weapons. *Annual Review of Ecology, Evolution, and Systematics, 39*(1), 387–413. doi:10.1146/annurev.ecolsys.39.110707.173502.

Engell, A. D., Haxby, J. V., & Todorov, A. (2007). Implicit trustworthiness decisions: automatic coding of face properties in the human amygdala. *Journal of Cognitive Neuroscience, 19*(9), 1508–1519. doi:10.1162/jocn.2007.19.9.1508.

Fazio, R. H. (2001). On the automatic activation of associated evaluations: an overview. *Cognition and Emotion, 15*(2), 115–141. doi:10.1080/0269993004200024.

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology, 50*(2), 229–238. doi:10.1037/0022-3514.50.2.229.

Fazio, R. H., Jackson, J. R., Dunton, B. C., & Williams, C. J. (1995). Variability in automatic activation as an unobtrusive measure of racial attitudes: a bona fide pipeline? *Journal of Personality and Social Psychology, 69*(6), 1013–1027. doi:10.1037/0022-3514.69.6.1013.

Feinman, S., & Gill, G. W. (1977). Females' response to males' beardedness. *Perceptual and Motor Skills, 44*(2), 533–534. doi:10.2466/pms.1977.44.2.533.

Fink, B., Neave, N., & Seydel, H. (2007). Male facial appearance signals physical strength to women. *American Journal of Human Biology, 19*(1), 82–87. doi:10.1002/ajhb.20583.

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.

Gangestad, S. W., & Scheyd, G. J. (2005). The evolution of human physical attractiveness. *Annual Review of Anthropology, 34*(1), 523–548. doi:10.1146/annurev.anthro.33.070203.143733.

Geniole, S. N., & McCormick, C. M. (2015). Facing our ancestors: judgements of aggression are consistent and related to the facial width-to-height ratio in men irrespective of beards. *Evolution and Human Behavior, 36*(4), 279–285.

Geniole, S. N., Denson, T. F., Dixson, B. J., Carré, J. M., & McCormick, C. M. (2015). Evidence from meta-analyses of the facial width-to-height ratio as an evolved cue of threat. *PloS One, 10*(7), e0132726.

Gildersleeve, K., Haselton, M. G., & Fales, M. R. (2014). Do women's mate preferences change across the ovulatory cycle? A meta-analytic review. *Psychological Bulletin, 140*(5), 1205.

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.

Grueter, C. C., Isler, K., & Dixson, B. J. (2015). Are badges of status adaptive in large complex primate groups? *Evolution and Human Behavior, 36*(5), 398–406. doi:10.1016/j.evolhumbehav.2015.03.003.

Harvey, R. G., & Brothwell, D. R. (1969). Biosocial aspects of Ainu hirsuteness. *Journal of Biosocial Science, 1*(02), 109–124.

Holzleitner, I. J., & Perrett, D. I. (2015). Perception of strength from 3D faces is linked to facial cues of physique. *Evolution and Human Behavior.*

Hundhammer, T., & Mussweiler, T. (2012). How sex puts you in gendered shoes: sexuality-priming leads to gender-based self-perception and behavior. *Journal of Personality and Social Psychology, 103*(1), 176.

Janif, Z. J., Brooks, R. C., & Dixson, B. J. (2014). Negative frequency-dependent preferences and variation in male facial hair. *Biology Letters, 10*(4), 20130958.

Jarvis, B. G. (2016). DirectRT. (2010.2.103.1115 ed.). New York, NY: Empirisoft Corporation

Klauer, K. C. (1997). Affective priming. *European Review of Social Psychology, 8*(1), 67–103. doi:10.1080/14792779643000083.

Klauer, K. C, & Musch, J. (2003). Affective priming: findings and theories. In J. Musch, & K. C. Klaur (Eds.), *The psychology of evaluation*: *Affective processes in cognition and emotion*. Mahwah, NJ: Lawrence Erlbaum.

Knussman, R., & Christiansen, K. (1988). Attributes of masculinity and androgen level. *Homo, 39*, 45–50.

Kokko, H., Brooks, R., Jennions, M. D., & Morley, J. (2003). The evolution of mate choice and mating biases. *Proceedings of the Royal Society of London*. *Series B: Biological Sciences, 270*(1515), 653–664. doi:10.1098/rspb.2002.2235.

Koranyi, N., Gast, A., & Rothermund, K. (2013). "although quite nice, I was somehow not attracted by that person": attitudes toward romantically committed opposite-sex others are immune to positive evaluative conditioning. *Social Psychological and Personality Science, 4*(4), 403–410. doi:10.1177/1948550612467037.

Law Smith, M. J., Perrett, D. I., Jones, B. C., Cornwell, R. E., Moore, F. R., Feinberg, D. R., et al. (2006). Facial appearance is a cue to oestrogen levels in women. *Proceedings of the Royal Society B: Biological Sciences, 273*(1583), 135–140. doi:10.1098/rspb.2005.3296.

Li, T. T., & Lu, Y. (2014). The subliminal affective priming effects of faces displaying various levels of arousal: an ERP study. *Neuorscience Letters, 583*, 148–153. doi:10.1016/j.neulet.2014.09.027.

Little, A. C., Jones, B. C., & DeBruine, L. M. (2011). Facial attractiveness: evolutionary based research. *Philosophical Transactions of the Royal Society B: Biological Sciences, 366*(1571), 1638–1659. doi:10.1098/rstb.2010.0404.

Livingston, R. W., & Brewer, M. B. (2002). What are we really priming? Cue-based versus category-based processing of facial stimuli. *Journal of Personality and Social Psychology, 82*(1), 5–18. doi:10.1037//0022-3514.82.1.5.

Maddox, K. B. (2004). Perspectives on racial phenotypicality bias. *Personality and Social Psychology Review, 8*(4), 383–401. doi:10.1207/s15327957pspr0804_4.

Maddox, K. B., & Dukes, K. N. (2008). Social categorization and beyod: how facial features impact social judgements. In N. Ambady & J. J. Skowronski (Eds.), *First impressions* (pp. 205–233). New York: NY: Guilford.

Marcinkowska, U. M., Kozlov, M. V., Cai, H., Contreras-Garduño, J., Dixson, B. J., Oana, G. A., et al. (2014). Cross-cultural variation in men's preference for sexual dimorphism in women's faces. *Biology Letters, 10*(4), 20130850.

Muscarella, F., & Cunningham, M. R. (1996). The evolutionary significance and social perception of male pattern baldness and facial hair. *Ethology and Sociobiology, 17*(2), 99–117.

Neave, N., & Shields, K. (2008). The effects of facial hair manipulation on female perceptions of attractiveness, masculinity, and dominance in male faces. [doi:10.1016/j.Paid.2008.05.007]. *Personality and Individual Differences, 45*(5), 373–377.

Oldmeadow, J. A., & Dixson, B. J. (2016). The association between Men's sexist attitudes and facial hair. *Archives of Sexual Behavior, 45*, 891–899.

Palermo, R., & Schmalzl, L. (2006). Affective priming from faces: the influence of spatial frequency, prime duration and amygdala damage. *Australian Journal of Psychology, 58*, 87–87.

Pellegrini, R. J. (1973). Impressions of the male personality as a function of beardedness. *Psychology, 10*(1), 29–33.

Perrett, D. I., Lee, K. J., Penton-Voak, I., Rowland, D., Yoshikawa, S., Burt, D. M., et al. (1998). Effects of sexual dimorphism on facial attractiveness. [10.1038/29772]. *Nature, 394*(6696), 884–887.

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 B: Biological Sciences, 276*(1654), 153–159.

Puts, D. A. (2010). Beauty and the beast: mechanisms of sexual selection in humans. [doi: 10.1016/j.Evolhumbehav.2010.02.005]. *Evolution and Human Behavior, 31*(3), 157–175.

Puts, D. (2016). Human sexual selection. *Current Opinion in Psychology, 7*, 28–32. doi:10.1016/j.copsyc.2015.07.011.

Puts, D. A., Gaulin, S. J. C., & Verdolini, K. (2006). Dominance and the evolution of sexual dimorphism in human voice pitch. [doi: 10.1016/j.Evolhumbehav.2005.11.003]. *Evolution and Human Behavior, 27*(4), 283–296.

Puts, D. A., Bailey, D. H., & Reno, P. L. (2015). *Contest competition in men*. In The Handbook of Evolutionary Psychology: John Wiley & Sons, Inc..

Reed, J. A., & Blunk, E. M. (1990). The influence of facial hair on impression formation. *Social Behavior and Personality: An International Journal, 18*(1), 169–175. doi:10.2224/sbp.1990.18.1.169.

Rhodes, G. (2006). The evolutionary psychology of facial beauty. In *Annual review of psychology* (Vol. 57, pp. 199–226, Annual Review of Psychology). Palo Alto: Annual Reviews

Roberts, S. C., Owen, R. C., & Havlicek, J. (2010). Distinguishing between perceiver and wearer effects in clothing color-associated attributions. *Evolutionary Psychology, 8*(3), 350–364.

Sanchez, D. T., Kiefer, A. K., & Ybarra, O. (2006). Sexual submissiveness in women: costs for sexual autonomy and arousal. *Personality and Social Psychology Bulletin, 32*(4), 512–524.

Saxton, T. K., Mackey, L. L., McCarty, K., & Neave, N. (2016). A lover or a fighter? Opposing sexual selection pressures on men's vocal pitch and facial hair. *Behavioral Ecology, 27*(2), 512–519. doi:10.1093/beheco/arv178.

Scott, I., Clark, A., Boothroyd, L., & Penton-Voak, I. (2013). Do men's faces really signal heritable immunocompetence? *Behavioral Ecology, 24*, 579–589.

Scott, I. M., Clark, A. P., Josephson, S. C., Boyette, A. H., Cuthill, I. C., Fried, R. L., et al. (2014). Human preferences for sexually dimorphic faces may be evolutionarily novel. *Proceedings of the National Academy of Sciences, 111*(40), 14388–14393.

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 of London B: Biological Sciences, 276*(1656), 575–584.

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

Sheehan, M. J., & Bergman, T. J. (2016). A quality signaling–recognition trade-off at the level of the type of interaction not species: a response to comments on Sheehan and Bergman. *Behavioral Ecology, 27*, 2–13.

Singh, D., Dixson, B. J., Jessop, T. S., Morgan, B., & Dixson, A. F. (2010). Cross-cultural consensus for waist–hip ratio and women's attractiveness. *Evolution and Human Behavior, 31*(3), 176–181. doi:10.1016/j.evolhumbehav.2009.09.001.

Skowronski, J. J., Sedikides, C., Heider, J. D., Wood, S. E., & Scherer, C. R. (2010). On the road to self-perception: interpretation of self-behaviors can Be altered by priming. *Journal of Personality, 78*(1), 361–391.

Spisak, B. R., Dekker, P. H., Krüger, M., & Van Vugt, M. (2012). Warriors and peacekeepers: testing a biosocial implicit leadership hypothesis of intergroup relations using masculine and feminine faces. *PloS One, 7*(1), e30399–e30399.

Terburg, D., Hooiveld, N., Aarts, H., Kenemans, J. L., & van Honk, J. (2011). Eye tracking unconscious face-to-face Confrontations: Dominance Motives Prolong Gaze to Masked Angry Faces. *Psychological Science*, doi:10.1177/0956797611398492.

Tiddeman, B. P., Burt, D. M., & Perrett, D. I. (2001). Computer graphics in facial perception research. *IEEE Computer Graphics and Applications, 21*(5), 42–50.

van den Berghe, P. L., & Frost, P. (1986). Skin color preference, sexual dimorphism and sexual selection: a case of gene culture co-evolution?. [doi: 10.1080/01419870.1986.9993516]. *Ethnic and Racial Studies, 9*(1), 87–113. doi:10.1080/01419870.1986.9993516.

Watkins, C. D., Fraccaro, P. J., Smith, F. G., Vukovic, J., Feinberg, D. R., DeBruine, L. M., Jones, B. C. (2010a). Taller men are less sensitive to cues of dominance in other men. *Behavioral Ecology, 21*, 943–947.

Watkins, C. D., Jones, B. C., & DeBruine, L. M. (2010b). Individual differences in dominance perception: dominant men are less sensitive to facial cues of male dominance. *Personality and Individual Differences, 49*(8), 967–971.

Welling, L. L., Moreau, B. J., Bird, B. M., Hansen, S., & Carré, J. M. (2016). Exogenous testosterone increases men's perceptions of their own physical dominance. *Psychoneuroendocrinology, 64*, 136–142.

Wells, J. C. (2007). Sexual dimorphism of body composition. [doi: 10.1016/j.Beem.2007.04.007]. *Best Practice & Research Clinical Endocrinology & Metabolism, 21*(3), 415–430.

Whitehouse, A. J. O., Gilani, S. Z., Shafait, F., Mian, A., Tan, D. W., Maybery, M. T., et al. (2015). Prenatal testosterone exposure is related to sexually dimorphic facial morphology in adulthood. *Proceedings of the Royal Society of London B: Biological Sciences, 282*(1816). doi:10.1098/rspb.2015.1351.

Windhager, S., Schaefer, K., & Fink, B. (2011). Geometric morphometrics of male facial shape in relation to physical strength and perceived attractiveness, dominance, and masculinity. *American Journal of Human Biology, 23*(6), 805–814. doi:10.1002/ajhb.21219.

Winkler, E. M., & Christiansen, K. (1993). Sex hormone levels and body hair growth in! Kung san and Kavango men from Namibia. *American Journal of Physical Anthropology, 92*(2), 155–164.

Wogalter, M. S., & Hosie, J. A. (1991). Effects of cranial and facial hair on perceptions of age and person. [article]. *Journal of Social Psychology, 131*(4), 589–591.

Wood, D. R. (1986). Self-perceived masculinity between bearded and nonbearded males. *Perceptual and Motor Skills, 62*(3), 769–770. doi:10.2466/pms.1986.62.3.769.

Yang, J., Cao, Z., Xu, X., & Chen, G. (2012). The amygdala is involved in affective priming effect for fearful faces. *Brain and Cognition, 80*(1), 15–22. doi:10.1016/j.bandc.2012.04.005.

Yeung, S., Taylor, A., Rubino, C., & Barton, J. (2015). Valence, expression and identity effects in the affective priming paradigm. *Journal of Vision, 15*(12), 1375.

Zietsch, B. P., Lee, A. J., Sherlock, J. M., & Jern, P. (2015). Variation in Women's preferences regarding male facial masculinity is better explained by genetic differences than by previously identified context-dependent effects. *Psychological Science, 26*, 1440–1448.