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ORIGINAL ARTICLE

Beards Increase the Speed, Accuracy, and Explicit Judgments of Facial Threat

Barnaby J. W. Dixson[1,2] · Claire L. Barkhuizen[3] · Belinda M. Craig[3,4]

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Abstract

Objectives To test whether intra-sexual selection has influenced perceptions of male facial hair. We predicted that beards would increase the speed and accuracy of perceptions of angry but not happy facial expressions. We also predicted that bearded angry faces would receive the highest explicit ratings of masculinity and aggressiveness, whereas higher prosociality ratings would be ascribed to clean-shaven happy faces.

Methods A total of 106 participants, ranging from 17 to 59 years of age (M = 27.27, SD = 10.03); 59 were female and 47 were male (44.3%) completed an emotion categorization tasks and an explicit ratings task. Participants viewed faces of the same men when bearded, clean-shaven, and 10 days of natural growth (i.e. stubble) when posing angry and happy facial expressions.

Results Angry facial expressions were categorised most rapidly and with the greatest accuracy on bearded faces, followed by faces with stubble then clean-shaven faces. Conversely, happy facial expressions were categorised most rapidly and with the greatest accuracy on clean-shaven faces, followed by stubbled faces then bearded faces. Irrespective of facial expression, full bearded faces received the highest ratings of masculinity followed by faces with stubble then clean-shaven faces. Aggressiveness ratings were highest for angry faces with full beards, followed by angry faces with stubble, with clean-shaven angry faces receiving the lowest ratings. In contrast to our prediction, bearded smiling faces were rated as significantly more prosocial than stubbled and clean-shaven smiling faces.

Conclusions These findings contribute further evidence that men's beardedness represents an intra-sexually selected badge of status that enhances nonverbal threat potentially by augmenting underlying masculine facial structures.

Keywords Sexual selection · Human beings · Facial hair · Face perception

✉ Barnaby J. W. Dixson
bdixson@usc.edu.au

Extended author information available on the last page of the article

Introduction

Sexually selected ornaments are some of the most visually striking and individually variable male characteristics (Andersson, 1994). In some cases, ornamentation serves to enhance sexual attractiveness to females resulting in sexual selection for indirect genetic benefits (e.g., health, immunity) or direct benefits (e.g. resources, protection) (Kokko et al., 2006). Sexual selection also shapes weaponry employed during agonistic contests over territories and mating opportunities (Emlen, 2008; Rico-Guevara and Hurme, 2019) and ornamental markers of social rank and status (McCullough et al., 2016). While the last 30 years of research has focussed predominantly on how female choice has shaped male ornaments (Kokko et al., 2006), recent research highlights how intra-sexual selection may have favored male secondary sexual characters in mammals (Wiens & Tuschhoff, 2020), including humans (Petersen & Higham, 2020; Puts, 2016).

In humans, facial hair represents a potential target of sexual selection by female choice and male-male competition (Dixson et al., 2005; Grueter et al., 2015). Beards are strikingly sexually dimorphic, appearing first in late childhood, developing further under the actions of androgens during puberty, with full expression typically evident at young adulthood (Randall, 2008). While muscularity and masculine craniofacial shape require testosterone for their expression (Griggs et al., 1989; Whitehouse et al., 2015), facial hair develops as testosterone is converted into dihydrotestosterone via the enzyme 5-alpha reductase 2 (Randall, 2008). How androgens exert effects on the density, patterning, and distribution of facial hair is genetically determined (Adhikari et al., 2016). Thus, men's beardedness may co-vary with other androgen-dependent secondary sexual traits (Dixson et al., 2016), so that individuals could have well-developed muscularity and facial masculinity but less profuse facial hair owing to their genetic predispositions (Imperato-McGinley and & Zhu, 2002).

Beards positively influence judgments of men's age (Neave & Shields, 2008), masculinity (Addison, 1989; Dixson & Brooks, 2013), social status (Dixson & Vasey, 2012), dominance (Saxton et al., 2016; Sherlock et al., 2017), strength (Gray et al., 2020; Nelson et al., 2019), and aggressiveness (Geniole & McCormick, 2015; Mefodeva et al., 2020; Muscarella & Cunningham, 1996). Compared to clean-shaven men, bearded men report stronger feelings of masculinity (Wood, 1986), higher dominance and assertiveness (Mefodeva et al., 2020), and men desire facial hair more for themselves than among their male contemporaries (Jach & Moroń, 2020). However, evidence that beards enhance male attractiveness varies between studies, samples, and populations (Dixson, 2019, 2021). This variation appears unrelated to women's fertility (Dixson et al., 2018a, b), self-perceived mate value (Clarkson et al., 2020) or strategies to secure short-term mates (Stower et al., 2020). Instead, beards are more frequent among men from countries with higher economic inequality and greater parasite prevalence (Dixson & Lee, 2020; Pazhoohi & Kingstone, 2020) and are more attractive among women living in larger cities, where women's preferences for beards were higher and average incomes were lower (Dixson et al., 2017b) and in countries with male-biased

sex ratios (Dixson et al., 2019b). Further, marriage announcements in the *London Illustrated News Magazine* between 1842–1871 (Robinson, 1976) featured more bearded men during those years with more men than women in the marriage market (Barber, 2001). Thus, facial hair may operate as an attractive ornament under prevailing social, ecological, and economic conditions that favour stronger male-male competition.

Facial hair may enhance perceptions of male age, dominance, and aggressiveness by embellishing underlying masculine facial morphology, including the prominence of the midface and thickness of the jaw (Goodhart, 1960; Guthrie, 1970). Indeed, ratings of intra-sexually relevant traits increase linearly with the quantity of facial hair, with bearded faces receiving the highest ratings of masculinity, dominance, and aggressiveness followed by heavy stubble, then light stubble, with clean-shaveness rated lowest (Dixson & Brooks, 2013; Neave & Shields, 2008). Experimentally increasing facial masculinity via computer graphics techniques in clean-shaven, stubbled, and full bearded faces revealed men's dominance ratings for masculine over feminine faces were strongest within clean-shaven faces but decreased as facial hair increased (Sherlock et al., 2017). Mefodeva et al (2020) also reported diminishing returns for facial masculinity on ratings of masculinity, dominance, and aggressiveness in bearded compared to clean-shaven faces, with the least masculine bearded face receiving significantly higher ratings for all traits than the most masculine clean-shaven faces. A study quantifying facial masculinity in the same men photographed when clean-shaven and with full beards revealed small linear associations between facial masculinity and ratings of masculinity and dominance that were far smaller than the overall effect of beards on masculinity and dominance ratings (Dixson et al., 2017a). When rating composite faces of the same men when clean-shaven and bearded morphed to reflect small and large jaws, participants rated clean-shaven composites with large jaw as more masculine and dominant than smaller jaws, whereas no effect of jaw size on ratings was found within bearded stimuli. Further, bearded faces with small jaws received higher masculinity and dominance ratings than clean-shaven faces with large jaws (Dixson et al., 2017a). These studies demonstrate that beards increase perceptions of masculine formidability by amplifying underlying masculine facial traits.

Beyond enhancing ratings of masculinity and dominance, male faces with exaggerated masculine traits may augment perception of aggressive facial displays as the craniofacial cues that define masculine faces (e.g., brow ridge, jaw size and midface robustness) structurally overlap with the muscular movements employed during angry facial expressions (Becker et al., 2007; Craig & Lee, 2020). Sell et al (2014) demonstrated that angry facial expressions may communicate male formidability as people rated each of the seven muscular movements associated with angry facial expression manipulated one at a time as augmenting physical strength. As beards may increase perceived intra-sexual formidability by enhancing the prominence of the jaw (Dixson et al., 2017a; Mefodeva et al., 2020; Sherlock et al., 2017), facial hair may also augment the saliency of angry facial expressions (Goodhart, 1960; Guthrie, 1970). A cross-cultural study between New Zealand and Samoa found that the same men photographed when clean-shaven and with full beards posing standardised angry facial expressions

were rated as significantly more aggressive when bearded than clean-shaven (Dixson & Vasey, 2012). Directly testing the prediction that beards enhance perception of anger, Craig et al (2019) found that beards increased the speed and accuracy of categorising angry facial expressions over happy facial expressions and that beards augmented ratings of masculinity and aggressiveness. While it was speculated that the presence of a full beard enhanced the size and angularity of the jaw line facilitating recognition of anger, only stimuli depicting full beardedness and clean-shaven conditions were employed.

To this end, the current study tested the hypothesis that increasing levels of facial hair will facilitate recognition of angry facial expressions. We hypothesised that light facial hair (i.e. stubble) will augment implicit and explicit impressions of angry facial expressions over clean-shaven faces due to enhancing masculine structural cues (i.e. jaw size and facial shape). We also hypothesised that full beards would increase the speed and accuracy of angry expressions over faces with stubble by further emphasising facial length and jaw size while drawing attention to the inner facial features associated with anger expressions (i.e. teeth, eyes, and brow ridge). Participants were presented with photographs of the same men with a full beard, stubble (i.e. 10 days of natural growth), and clean-shaven in two separate tasks. In task 1, participants completed a response time task, categorizing emotional expressions (angry; happy) on clean-shaven, stubbled, and bearded faces. We hypothesised that increasing the volume of facial hair would facilitate recognition of anger. Thus, we predicted that when judging angry facial expressions, bearded faces would be categorised fastest and with most accuracy, followed by stubbled faces then clean-shaven faces. While happy facial expressions would be categorised fastest and with most accuracy on clean-shaven faces, followed by stubbled faces, then bearded faces. In task 2, participants rated the same stimuli for masculinity, prosociality, and aggressiveness. We hypothesised that angry faces would be judged as most masculine and aggressive on bearded faces, followed by faces with stubble then clean-shaven faces. We also hypothesised clean-shaven smiling faces would be rated as the most prosocial followed by faces with stubble then full bearded faces.

Method

Participants

A power analysis was conducted using G*Power 3.1.9.2 (Faul et al., 2009), to determine the sample size required to detect a medium effect ($d = 0.438$), with α of 0.05, and a power of 0.80. It was estimated that a minimum of 43 participants would be required for both analyses. This effect size was based on the Facial hair × Emotion interaction reported by Craig et al. (2019), which the current study is replicating and extending. Participants were recruited from first-year undergraduate student pools and received course credit. The final sample included 126 participants who provided complete data sets, ranging from 17 to 59 years of age ($M = 28.75$, $SD = 11.26$); 68 were female (54%) and 54 were male (43%), and 4 (3%) did not respond.

Stimuli

Photographs of 10 young adult Caucasian males (Mage = 23.50, SD age = 3.57, range 20–30 years) were taken from a stimulus set used in previous research (Dixson & Vasey, 2012). All men were photographed with happy and angry expressions when clean-shaven, with stubble (defined as 10 days untrimmed facial hair growth), and with a full beard (approximately 8 weeks of untrimmed facial hair growth). The emotional expressions in the stimulus set were generated using instructions to activate action units, based on the Facial Action Coding System (Ekman & Friesen, 1978). The final stimulus set consisted of 60 photographs (10 bearded angry, 10 bearded happy, 10 stubbled happy, 10 stubbled angry, 10 clean-shaven angry and 10 clean-shaven happy images). In this stimulus set the same individuals were presented clean-shaven, with stubble, and with a full beard, controlling for possible effects of differences in facial structure or expression. The images were edited to remove clothing and placed upon a uniform grey background 485 × 709 pixels in size (Fig. 1).

Procedure

The response time measures, ratings tasks, and procedure were adapted from Craig et al. (2019). All measures, manipulations, and exclusions were reported, and no further data were collected after analyses had been conducted. We distributed a link to the study with an accompanying invitation via a link on first year online participant recruitment pages. Participants were directed via the online link to an online testing environment hosted by Inquisit 5 Web software (De Clercq et al., 2003; Inquisit 5, Computer software, 2016). After providing their informed consent, participants were directed to complete an emotion categorization task, followed by an explicit rating task, and lastly, a demographic survey where participants provided their age, gender, and cultural/ethnic background.

Fig. 1 An example of the faces used in the current study. The photographs show the same man posing happy (upper row) and angry expressions (lower row) when clean-shaven, with stubble and with full beards

Response Time Task

On each trial a fixation cross was presented for 1000 ms followed by the target face which was displayed for up to 3000 ms or until the participant responded. To account for variations in screen size and resolution across participants, the images were standardised to take up 35% of the screen height with a fixed aspect ratio. There was a 500 ms intertrial interval. Participants were instructed that faces would appear on the screen one at a time. They were asked to categorise each face as either "happy" or "angry" as quickly as possible by pressing the "A" and "L" keys. Response mapping was counterbalanced across participants. Text reminders on response keys were presented on screen throughout the experiment. Participants completed a short (10-trial) practice task prior to the main task. Participants were provided with error feedback and their mean response time only in the practice task. In the main task, each of the 60 target faces were displayed twice resulting in 120 trials with stimulus order randomised for each participant.

Rating Task

Participants were instructed to rate the masculinity, aggression, and prosociality of 60 images presented in the response time task. Prosociality was defined as "someone who is positive, helpful, and friendly, or someone who would act in a way that benefits others". Participants were instructed that the task was a person-rating task based on first impressions, that there are no right or wrong answers, and to rate each person as quickly as they could. Participants were shown faces one at a time and rated each one on three dimensions: masculinity, aggressiveness and prosociality, by clicking and dragging a slider from 1 (not at all) to 9 (very much) for each dimension.

Statistical Analyses

Incorrect responses, response times faster than 100 ms and those more than three standard deviations away from each participant's mean response time were removed (Craig et al., 2019). Response times and error rates were then averaged and were submitted to separate 3 (Facial hair: bearded, stubble, clean-shaven) × 2 (Emotional expression: happy, angry) repeated-measures ANOVAs. Masculinity, dominance, and prosociality ratings were also submitted to separate (Facial hair: bearded, stubble, clean-shaven) × 2 (Emotional expression: happy, angry) repeated-measures ANOVAs. All effect sizes are partial-eta square (η_p^2). Where necessary, follow up comparisons were conducted using two-tailed paired-samples *t*-tests with Cohen's *d* as the reported effect sizes.

Results

Response Times A significant main effect of emotion, $F(1, 125) = 4.69$, $p = 0.032$, $\eta_p^2 = 0.036$, reflects participants were faster to recognise happy than angry faces, $t(125) = 2.17$, $p = 0.032$, $d = 0.19$. There was no main effect of facial hair, $F(2,$

250) = 2.22, $p = 0.111$, $\eta_p^2 = 0.017$. The significant emotion × facial hair interaction $F(2, 250) = 15.85$, $p < 0.001$, $\eta_p^2 = 0.113$, reflects bearded angry faces were recognised significantly faster than clean-shaven angry faces, $t(125) = 2.76$, $p = 0.007$, $d = 0.25$, but not stubbled angry faces, $t(125) = 1.31$, $p = 0.193$, $d = 0.12$. Stubbled angry faces were recognised faster than clean-shaven angry faces, $t(125) = 2.13$, $p = 0.035$, $d = 0.19$. In contrast, clean-shaven happy faces were recognised significantly faster than bearded happy faces, $t(125) = 5.16$, $p < 0.001$, $d = 0.46$, but not stubbled happy faces, $t(125) = 1.73$, $p = 0.086$, $d = 0.15$. Stubbled happy faces were recognised significantly faster than bearded happy faces, $t(125) = 3.31$, $p < 0.001$, $d = 0.29$ (Fig. 2A).

Response Errors There was a significant main effect of emotion, $F(1, 125) = 15.50$, $p < 0.001$, $\eta_p^2 = 0.110$. Participants were more accurate in recognising happy than angry faces, $t(125) = 3.94$, $p < 0.001$, $d = 0.35$. There was no main effect of facial hair, $F(2, 250) = 0.87$, $p = 0.421$, $\eta_p^2 = 0.007$. There was a significant emotion × facial hair interaction, $F(2, 250) = 10.69$, $p < 0.001$, $\eta_p^2 = 0.079$. Bearded angry faces were more accurately recognised than clean-shaven angry faces, $t(125) = 3.37$, $p < 0.001$, $d = 0.30$, but not stubbled angry faces, $t(125) = 1.32$, $p = 0.190$, $d = 0.12$. Stubbled angry faces were more accurately recognised than clean-shaven angry faces, $t(125) = 2.29$, $p = 0.024$, $d = 0.20$. Conversely, clean-shaven happy faces were recognised significantly more accurately than bearded happy faces, $t(125) = 2.86$, $p = 0.005$, $d = 0.25$, but not stubbled happy faces, $t(125) = 1.10$, $p = 0.272$, $d = 0.10$. Stubbled happy faces were not recognised more accurately than bearded happy faces, $t(125) = 1.76$, $p = 0.080$, $d = 0.16$ (Fig. 2B).

Fig. 2 Data are the mean (±1 standard error) of emotion categorization speed in milliseconds (**A**) and number of incorrect responses (**B**) for angry and happy facial expressions on male faces when clean-shaven (dashed line and black triangle), with stubble (dotted line and blue circle), and full beards (solid line and red box)

Aggressiveness Ratings There was a main effect of emotion, $F(1, 126) = 666.75$, $p < 0.001$, $\eta_p^2 = 0.841$. Participants gave higher aggressiveness ratings to angry than smiling facial expressions, $t = 25.82$, $p < 0.001$, $d = 2.29$. There was a main effect of facial hair, $F(2, 252) = 14.44$, $p < 0.001$, $\eta_p^2 = 0.103$. Beards received significantly higher aggressiveness ratings than stubbled, $t = 2.41$, $p = 0.018$, $d = 0.21$, and clean-shaven faces, $t = 4.66$, $p < 0.001$, $d = 0.41$. Stubbled faces were rated significantly more aggressive than clean-shaven faces, $t = 3.54$, $p < 0.001$, $d = 0.31$. There was also a significant emotion × facial hair interaction, $F(2, 252) = 43.00$, $p < 0.001$, $\eta_p^2 = 0.254$. Bearded angry faces were rated as more aggressive than stubbled angry faces, $t = 5.03$, $p < 0.001$, $d = 0.45$, and clean-shaven faces, $t = 8.23$, $p < 0.001$, $d = 0.73$. Stubbled angry faces were rated as more aggressive than clean-shaven angry faces, $t = 4.78$, $p < 0.001$, $d = 0.42$. Differences between bearded happy, stubbled happy and clean-shaven happy faces were not statistically significant, all $t < 1.42$, $p > 0.159$, $d < 0.13$ (Fig. 3A).

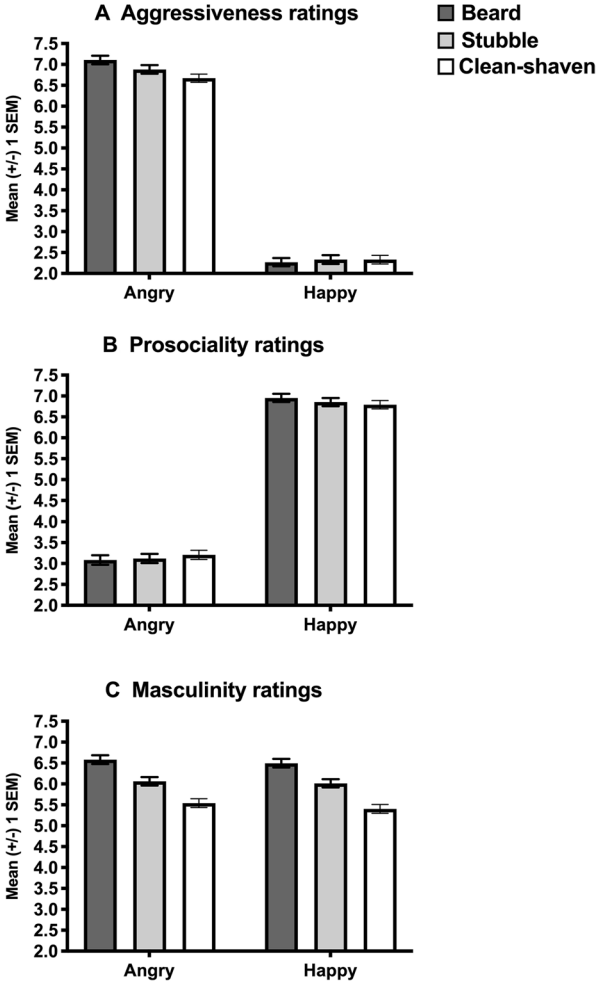

Fig. 3 Mean ratings (± 1 standard error) of aggressiveness (**A**), prosociality (**B**), and masculinity (**C**) for faces posing angry and happy emotional expressions when clean-shaven (white bars), with stubble (light grey bars) and full beards (dark grey bars)

Prosociality Ratings There was a main effect of emotion, $F(1, 126) = 387.63$, $p < 0.001$, $\eta_p^2 = 0.755$, whereby happy faces received higher prosociality ratings than angry faces, $t = 19.69$, $p < 0.001$, $d = 1.75$. While there was no main effect of facial hair, $F(2, 252) = 0.41$, $p = 0.661$, $\eta_p^2 = 0.003$, there was a significant emotion × facial hair interaction, $F(2, 252) = 11.28$, $p < 0.001$, $\eta_p^2 = 0.082$. Clean-shaven angry faces were rated as more prosocial than stubbled, $t = 2.21$, $p = 0.029$, $d = 0.20$, and bearded, $t = 2.95$, $p = 0.004$, $d = 0.26$, angry faces. Prosociality ratings did not differ significantly between stubbled and bearded angry faces, $t = 0.84$, $p = 0.400$, $d = 0.08$. However, bearded happy faces were rated as more prosocial than stubbled, $t = 2.11$, $p = 0.036$, $d = 0.19$, and clean-shaven, $t = 2.98$, $p = 0.003$, $d = 0.26$, happy faces. Prosociality ratings did not differ significantly between stubbled and clean-shaven happy faces, $t = 1.35$, $p = 0.179$, $d = 0.12$ (Fig. 3B).

Masculinity Ratings There was no main effect of emotion, $F(1, 126) = 3.10$, $p = 0.081$, $\eta_p^2 = 0.024$. There was a main effect of facial hair, $F(2, 252) = 168.36$, $p < 0.001$, $\eta_p^2 = 0.572$. Beards received significantly higher masculinity ratings than stubbled, $t = 10.37$, $p < 0.001$, $d = 0.92$, and clean-shaven faces, $t = 14.00$, $p < 0.001$, $d = 1.24$. Stubbled faces were rated as significantly more masculine than clean-shaven faces, $t = 12.62$, $p < 0.001$, $d = 1.12$. There was no emotion × facial hair interaction, $F(2, 252) = 1.38$, $p = 0.253$, $\eta_p^2 = 0.011$ (Fig. 3C).

Discussion

The human beard may have evolved as an ornament that communicates aspects of intra-sexual formidability including masculinity, dominance, and aggressiveness by enhancing the underlying masculine facial structures associated with agonistic facial displays (Dixson, 2021). Past research has shown that beards increase the speed and accuracy of anger recognition as well as aggressiveness ratings (Craig et al., 2019; Dixson & Vasey, 2012). While these findings provide evidence that beards augment nonverbal threat by highlighting masculine facial shape and jaw structure, these experiments employed only the extremes of full beardedness and clean-shaven conditions. The current study included faces with stubble to test the hypothesis that facial hair facilitates recognition of angry faces by emphasising jaw structure.

Full beards increased the speed and accuracy of recognising angry facial expressions when compared to clean-shaven faces, replicating prior research (Craig et al., 2019). While beardedness also facilitated anger detection over stubbled faces, faces with stubble increased the speed and accuracy of anger detection over clean-shaven faces. Thus, facial hair increases perceived masculine facial structure, particularly the jawline, facilitating the detection and identification of angry facial expressions. In contrast to the effects of beardedness on angry faces, clean-shaveness increased the speed and accuracy of recognising happiness relative to bearded faces. This also replicates past findings that clean-shaven faces facilitate recognition of prosocial emotional displays, possibly by appearing less masculine than bearded faces (Craig et al., 2019). The current study also revealed

that happy expressions were recognised faster on stubbled faces than bearded faces. Recognition times for stubbled faces were closer to bearded faces for angry expressions, and clean-shaven faces for happy expressions. One explanation for our findings is that the presence of facial hair acts in different ways for different facial expressions. Facial hair may accentuate a masculine jawline even in the presence of light growth (stubble) facilitating anger recognition, but it could also mask facial cues relevant for recognising other facial expressions (e.g. sadness, and happiness; Craig et al., 2019). The current results suggest that this masking effect is more pronounced with additional facial hair growth (i.e., in the presence of a full beard).

Full beards also exerted strong effects on explicit judgments of facial masculinity, with ratings being significantly higher in bearded faces than stubbled and clean-shaven faces. Faces with stubble were also rated as significantly more masculine than clean-shaven faces. There were no differences in masculinity perceptions due to facial expressions. These results lend further support to past studies reporting masculinity ratings rise linearly with increasing facial hair (Dixson & Brooks, 2013; Neave & Shields, 2008), demonstrating that the presence of stubble on the facial regions reflecting the most pronounced sexual dimorphism, notably the prominence of the jaw, causatively determine judgments of facial masculinity (Dixson, 2018; Geniole et al., 2015). Analyses of men photographed when clean-shaven and with full beards found that while objective measures of facial masculinity and jaw size were positively associated with masculinity and dominance ratings, these effects were far smaller than the main effects of beardedness (Dixson et al., 2017a). Additionally, ratings of composite full bearded and clean-shaven faces manipulated to have large and small jaws revealed positive effects of jaw size in clean-shaven but not bearded faces. Moreover, irrespective of jaw size bearded faces were rated as significantly more masculine and dominant than clean-shaven faces (Dixson et al., 2017a). Other studies revealed that while facial masculinity increased ratings of masculinity, dominance, aggressiveness in clean-shaven masculine faces compared to feminine faces, the addition of facial hair augments ratings of male formidability above and beyond any effects of facial masculinity. Thus, feminine looking men with full beards were judged as more intra-sexually formidable than clean-shaven masculine looking men (Mefodeva et al., 2020; Sherlock et al., 2017). Beards may enhance perceptions of intra-sexually relevant traits by accentuating regions of the face where sexual dimorphism is most pronounced and masking regions of facial shape that appear less masculine.

Craniofacial masculinity is comprised of those features salient in posing angry facial expressions, which may explain why male faces communicate nonverbal expression of anger more efficiently than female faces (Becker et al., 2007). Given that stubble emphasises masculine facial features, we hypothesised that aggressiveness ratings would increase due to additive effects of facial hair. Indeed, full beardedness in concert with angry facial expressions received significantly higher aggressiveness compared to clean-shaven and stubbled faces posing angry facial expressions. Angry faces with stubble were also rated as significantly more aggressive than clean-shaven angry faces, providing the first evidence that the presence of

facial hair occurring around the facial regions involved in angry facial expressions augments perceptions of male threat displays. Aggressiveness ratings of happy faces did not differ as a function of facial hair. This pattern of results replicates past studies reporting that beards increased ratings of aggressiveness on faces posing angry facial expressions compared to the clean-shaven faces (Craig et al., 2019; Dixson & Vasey, 2012). However, beardedness may not relate directly to male fighting ability. Thus, analyses of contest competitions among professional mixed-martial arts fighters revealed that bearded fighters were not more successful than clean-shaven fighters (Dixson et al., 2018c). Whether effectiveness in performing angry facial expressions is related to success among men during actual intra-sexual conflict and whether the presence of full beards influences any outcomes would be important for future research to uncover.

Ratings of prosociality were highest for bearded faces posing smiling expressions, followed by smiling faces with stubble, with smiling clean-shaven faces receiving the lowest ratings. While this finding suggests male facial hair does not solely influence intra-sexually relevant traits, it replicates past findings (Craig et al., 2019). On one hand beardedness increases perceptions of positive social attributes like generosity, courageousness, self-confidence (Dixson & Brooks, 2013), competence and trustworthiness (Mittal & Silvera, 2020). Yet on the other hand facial hair reduces perceptions of warmth (Fetscherin et al., 2020) and increases perceptions of strength, dominance, and aggressiveness (Dixson, 2021). This may explain why some studies report women prefer beards over clean-shaven faces (Clarkson et al., 2020; Dixson et al., 2017a, b, 2018b; McIntosh et al., 2017), others reported that clean-shaveness is preferred over beards (Dixson & Vasey, 2012; Dixson et al., 2013; Geniole & McCormick, 2015; Muscarella & Cunningham, 1996), while others report intermediate levels of stubble determine men's attractiveness (Dixson & Brooks, 2013; Janif et al., 2014; Kim et al., 2018). In contrast, women's preferences for beards are more consistently higher when judging parenting skills than sexual attractiveness (Dixson & Brooks, 2013; Dixson et al., 2019a; Nelson et al., 2019; Stower et al., 2020), especially among mothers than women without children (Dixson et al., 2019a). Reproductive success was also higher among women in long-term relationships with bearded partners than women in relationships with clean-shaven partners (Štěrbová et al., 2019). Thus, the positive effects of beardedness on judgments of men's long-term value as paternally investing partners may explain higher ratings of prosociality ascribed to bearded smiling faces.

A limitation of the current study was that the effects of beardedness on perceptions of facial expressions were restricted to a sample of stimuli that the current researchers have employed in other studies. While other researchers reported beards increase ratings of dominance and aggressiveness, a myriad of stimuli have been employed across studies including police identikits (Neave & Shields, 2008), computer composites (Gray et al., 2020), and facial hair created using make-up pencils (Muscarella & Cunningham, 1996). Further, facial surface information, including luminance between facial regions, skin tone, and skin complexion influence perceptions of physical attractiveness and dominance in male faces (Torrance et al., 2014). Facial hair may mask a weak jawline and unhealthy looking areas of skin on the cheeks (Dixson & Rantala, 2016) while giving some masculine definition

to facial shape and drawing attention to the mouth and eyes (Clarkson et al., 2020; Dixson et al., 2016, 2017a). Thus, facial hair could both amplify and mask facial regions employed in other important signals of emotion and facial regions involved in signalling health and attractiveness and future cross-cultural research on this issue would be valuable.

Our study was also limited to testing the effects of beardedness between angry and happy facial expressions. Beards may augment fearful facial expressions in the same manner as angry expressions, so that the signal amplification may relate more to the degree of arousal in the facial expression than any agonistic intent. Craig et al (2019) showed that sad facial expressions were recognised faster and with greater accuracy on clean-shaven than bearded faces, possibly as beards mask the lowered corners of the lips that define emotional expressions of sadness. Importantly, that study compared sad facial expressions with happy facial expressions, and it remains to be determined whether the same results would be obtained when comparing sad to angry facial expressions. Future research comparing how beards impact implicit and explicit judgments across a wider range of facial expressions of emotion will be important to determine whether perceptions of facial hair are specific to facial displays of anger.

Finally, our results are restricted to adults from Australia who may hold culturally specific views of beardedness and masculinity. Previous research has shown that male participants from Samoa and New Zealand rated bearded angry faces as more aggressive than clean-shaven angry faces (Dixson & Vasey, 2012). In that study, Samoan participants rated photographs of Polynesian male faces while New Zealand participants rated European male faces. Additional cross-cultural research employing ecologically appropriate stimuli in both large-scale and small-scale societies testing how facial hair determines the speed and accuracy in detecting angry facial expressions would be valuable. One way that large-scale replications across cultures can be achieved is through groups like the Psychological Science Accelerator (PSA) where projects are replicated across more than 300 labs spanning over 53 countries (Moshontz et al., 2018). Indeed, the PSA recently replicated the dominance-valence model of face perception (Oosterhof & Todorov, 2008) using data from 11,570 participants from 41 countries representing 11 world regions (Jones et al., 2021). For the present, our results show that facial hair enhances explicit and implicit perceptions of angry facial expressions in ways that suggest male facial hair operates as an ornamental badge of masculinity and dominance.

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Data Availability Data are available at the Open Science Framework.

Declarations

Ethical statement Ethics clearance from the University of Queensland's Behavioural and Social Sciences Ethical Review Committee and the School of Psychology's Ethics Review Panel (Ethics Approval Number: 18-PSYCH-4G-13-JMC) and The University of New England Human Research Ethics Committee HE20-103. These studies were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Conflict of interest The authors declare that they have no conflict of interest.

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Authors and Affiliations

Barnaby J. W. Dixson[1,2] · Claire L. Barkhuizen[3] · Belinda M. Craig[3,4]

[1] School of Health and Behavioural Sciences, University of the Sunshine Coast, Petrie, QLD, Australia

[2] School of Psychology, University of Queensland, Brisbane, QLD, Australia

[3] School of Psychology, University of New England, Armidale, NSW 2351, Australia

[4] Faculty of Health Sciences and Medicine, Bond University, Robina, QLD 2669, Australia