Children's Judgements of Facial Hair are Influenced by Biological Development and Experience

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Abstract

Adults use features such as facial hair to judge others' social dominance and mate value, but the origin of these judgments is unknown. We sought to determine when these associations develop, which associations develop first, and whether they are associated with early exposure to bearded faces. We presented pairs of bearded and clean-shaven faces to children (2-17 years old; N=470) and adults (18-22 years; N = 164) and asked them to judge dominance traits (strength, age, masculinity) and mate choice traits (attractiveness, parenting quality). Young children associated beardedness with dominance traits but not mate choice traits. This pattern became more extreme during late childhood and gradually shifted toward adult-like responses during early adolescence. Responses for all traits were adult-like in late adolescence. Finally, having a bearded father was associated with positive judgments of bearded faces for mate choice traits in childhood and both mate choice and dominance traits in adolescence.

Keywords: face perception; child development; facial hair; dominance; evolution.

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Humans are experts in perceiving information from faces. This expertise leads us to make rapid and automatic judgements about a variety of traits including gender, ethnicity, emotion, attractiveness, symmetry, averageness and mate quality (Boothroyd et al., 2014; Pascalis & Kelley, 2009; Todorov, 2017). How we come to associate such a range of traits with faces is currently unknown, although our attention to faces is evident from the earliest phases of development. In the hours after birth – and possibly even while in utero - infants prefer to look at shapes that resemble faces (Mondloch, Lewis, Budreau, Maurer, Dannemiller, Stephens, & Kleiner-Gathercoal, 1999; Reid et al., 2017). Early exposure also seems to impact infants' face preferences – infants bias attention toward their mother's face (Sugden & Marquis, 2017), and prefer to look at female faces if they have a female caregiver and male faces if they have a male caregiver (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002; Slater et al., 2000). Thus, very early face processing is associated with familiarity and is flexible in response to social experiences (Pascalis & Kelley, 2009; Quinn et al., 2008).

Expertise in face judgements emerges throughout childhood, gradually improving with age. For some trait judgements, such as attractiveness, children as young as 6 years show clear preferences (Boothroyd, et al, 2014). However, for other traits, such as facial masculinity, health, symmetry, and averageness, children's preferences emerge unevenly between 4 and 14 years of age (Boothroyd et al, 2014). Children's preferences for healthy looking faces emerge between 6-8 years, while preferences for facial symmetry and averageness emerge around 9 years of age (Boothroyd et al, 2014; Vingilis-Jaremko & Maurer, 2013a, 2013b). Judgements about facial femininity and masculinity become adult-like between 11 and 17 years (Boothroyd et al., 2014;

Little et al., 2010), although children as young as 3 years associate masculine faces with strength (Terrizzi, Brey, Shutts, & Beier, 2019).

Children's preferences for some facial traits – such as masculinity, health, symmetry, and averageness - show early spikes around 9 years, followed by a decrease in preferences in early adolescence, finally reaching adult-like levels around 17 years of age (Boothroyd et al, 2014). This apparent reorganization of preferences may be due to the large physical, hormonal, and social developmental changes that occur during adolescence (Scherf et al., 2012). In particular, adolescence marks changes in peer-related interactions and a shift in facial recognition away from adult caregivers and toward same age peers (Picci & Scherf, 2016; Scherf et al., 2012). The neuroendocrine changes that accompany pubertal development may underpin developmental switch points at which adult-like preferences for facial attributes emerge (Boothroyd & Vukovic, 2018), marking adolescent's emerging sexual maturity.

Beards are an overt signal of masculinity and represent the most pronounced sexually dimorphic trait in humans (Dixson et al., 2005; Grueter et al., 2015). Facial hair has strong effects on first impressions of men's faces, influencing a variety of trait judgements. In particular, beards impact judgments of traits related to dominance such that adults rate bearded faces as looking older, stronger, more aggressive, and more masculine than clean-shaven faces (Dixson & Brooks, 2013; Neave & Shields, 2008). Beards also enhance judgments related to mate-choice decisions (Dixson et al., 2017; 2019) with bearded faces judged as being a more suitable parent (Dixson & Vasey, 2012; Neave & Shields, 2008; Stower et al., 2019), although evidence that women find facial hair attractive is more mixed (Dixson et al., 2018a, 2018b) and is influenced by pregnancy, motherhood and parity (Dixson, Tam & Awasthy, 2013; Dixson et al., 2018a; Dixson, Kennedy-Costantini, Lee, & Nelson, 2019).

Whether children also view beards as indicative of either dominance or mate-choice traits is unknown. However, as children reach adolescence, traits such as facial hair could shift from being a trait of adult caregivers to a trait that can be displayed by same age peers. Sex differences in facial hair development first appear at 8-10 years, with boys' beards becoming more pronounced during adolescence and fully developed by young adulthood (Randall, 2008), although the majority of boys between 13-14 years of age do not have well developed beards (Hamilton, 1964). The presence of facial hair also impacts boys' judgments of their own attractiveness: pubertal boys state that the onset of facial hair development is the most important factor in their self-perceived attractiveness (Tobin-Richards, Boxer, & Peterson, 1983), suggesting that children become increasingly attentive to facial hair and its associated trait markers in middle childhood.

The developmental biology of beardedness from early adolescence leading into young adulthood, when competition to attract and retain partners is coming into prominence, suggests facial hair functions as an interpersonal sociosexual signal. However, no research has quantified the developmental trajectory of facial hair perceptions in children. In the current study, participants (N = 634) aged 2-21 years were asked to judge five sociosexual attributes relating to either mating contexts (physical attractiveness and parenting abilities) or dominance factors (age, masculinity, and physical dominance). Trait judgments were used to address hypotheses regarding how social and biological changes during ontogeny, adolescence, and young adulthood are associated with judgments of men's facial hair. We also quantified participant's exposure to facial hair from their fathers and surrounding social groups to ascertain whether visual exposure and learning underpin variation in face preferences.

Among younger (2-5 years) and older (6-9 years) children, we hypothesized that beards would reduce judgments of male attractiveness but would enhance judgments of age and masculinity and dominance. We also hypothesized that children with bearded fathers, or who interact with male acquaintances with facial hair, would judge beards more favorably on dimensions of attractiveness and parenting abilities as social exposure to beardedness has been shown to influence how adults judge facial hair (Dixson et al., 2013; Janif et al., 2014; Valentova et al., 2017). As beard growth emerges during adolescence (Randall, 2008), we predicted that physical attractiveness judgments and sensitivity to emerging formidability and social dominance should become more adult-like from early to late adolescence, leading in young adulthood.

Method

Participants

We included 634 participants (263 male): 470 child participants and 164 adult participants, ranging in age from 2-21 years. Participants were divided into five 4-year age blocks: Younger Children (N = 144; 76 male; range: 2,0-5,11 years; $mean_{age:}$= 4 yrs, 6 mos), Older Children (N = 136; 64 male; range: 6,0-9,11 years; m = 7 yrs, 11 mos), Younger Adolescents (N = 85; 76 male; range: 10,0-13,11 years; m = 11 yrs, 6 mos), Older Adolescents (N = 105; 21 male; range: 14,0-17,11 years; m = 15 yrs, 11 mos), and Adults (N = 164; 57 male; range: 18,0-21,11 years; m = 19 yrs, 9 mos). A power analysis using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) showed that to detect a small effect (f = .10, α= .05, 1-β= .95) of a 5 (age groups) x 5 (traits) repeated measures ANOVA, we would need a sample of 290 – our sample exceeds this number. Children were recruited while visiting a local museum, as well as from a database of families who volunteered to participate in developmental research at the

university. Adults were undergraduate students participating for course credit. This research was approved by the University of XXXXXXXXXX board of ethics (approval #2015001219).

Materials

Facial hair photographs. Thirty-seven men (mean age ± SD = 27.86 ± 5.75 years) of European ethnicity posed neutral facial expressions when clean-shaven and with 4-8 weeks of natural beard growth. Each poser was photographed using a Canon digital camera (8.0 megapixels resolution) and sat 150cm from the photographer under controlled lighting (Dixson et al., 2017).

Facial composites. The clean-shaven and bearded photographs were used to construct composite stimuli using the Webmorph software package (DeBruine & Tiddeman, 2016). 189 facial landmarks were identified on each image, and composite images were created by randomly selecting five of the thirty-seven individuals and averaging shape and color information of the clean-shaven images, as well as the corresponding bearded versions of the same individuals (Dixson et al., 2018; McIntosh et al., 2017). For an example of the stimuli see Figure 1. Of the resulting composite photos, we randomly selected 20 of the posers for inclusion in the study.

Figure 1. Examples of the male stimuli used in this study. Images are of composites comprised of the same five individuals when clean-shaven (left image) and with full beards (right image).

Procedure

To ensure child participants understood the task, they first completed 3 practice trials using animal pictures. For example, when presented pictures of a giraffe and a chicken, the experimenter asked children to determine "Which animal looks taller?"[1] As expected, 96% of children selected the target animal on these trials.

Next, participants were asked to judge the 20 pairs of bearded and clean-shaven faces. They judged the face pairs on five traits, each of which was phrased in a child-friendly manner: 1) Physical Strength (participants were asked "Who looks stronger?"), 2) Age ("Who looks older?"), 3) Masculinity ("Who looks most like a man?"), 4) Attractiveness ("Who looks best?"), and 5) suitability as a Parental Figure ("Who looks most like a dad?"). The trait questions were blocked and presented in a randomized order. Four of the face pairs were randomly assigned to each trait question. Within the trait blocks, the order of face pairs was randomized. Child participants completed the study on a tablet, guided by an experimenter while adult participants completed the study on a computer.

To ensure participants interpreted our trait questions as we expected, a final block of five questions presented two pictures for each trait that varied widely on those traits. For example, for the question "Who looks most like a man?" participants were presented a picture of a man and a woman. For the question "Who looks oldest?" participants were shown a child and a senior

[1] Children were also presented a snake and a mouse ("which looks longer") and a koala and a fish ("which looks softer").

citizen. As expected, 94% of participants selected the correct image for these trials (range = 87% - 98%; see Table S1 in the Supplemental Information for picture pairings and means).

Parents of child participants were asked to provide information about whether their child's father regularly had a beard and whether their child interacted with male relatives or acquaintances who had a beard. Adult participants were asked to provide information about their father's beardedness when they were a child and whether they interacted with male relatives or acquaintances who had a beard when they were a child. In addition, adult participants were asked to provide information about their current exposure to acquaintances with beards. Beardedness was rated on a 0 (No visible facial hair) to 4 (Full beard/goatee) Likert scale (Figure S1).

Results

Study data can be found at: https://osf.io/ehkpt/?view_only=396bf13048ac406f9a6fceebdd70d69d.

Although here we analyze participants aged 2-21 years, in light of comments raised by a reviewer, we also analyzed our data excluding children under the age of three years (N=12). The pattern of results did not change so we elected to retain all participants in our analyses, but these additional analyses can be read in full in the Supplemental Text.

Responses vs. Chance

To determine which traits were most salient for each age group, we first determined which trait judgements were farthest from chance responding (set at 0.50) for each age group. For Young Children, Attractiveness judgements were farthest from chance (difference from chance = -.15), whereas for Older Children, Age judgements were farthest from chance (.46). For Young Adolescents, Older Adolescents and Adults, Masculinity judgments were farthest from chance (.27, .34, .27, respectively). These data suggest that young children most

consistently view beards as being unattractive, and later in childhood view them as an indicator of age. It is not until children reach adolescence that they view beards as most strongly indicating masculinity.

We next conducted a series of t-tests to determine whether the proportion of bearded faces selected by participants was different from chance responding (set at 0.50). We conducted tests for each of the five traits, for each age group, resulting in 25 t-tests and thus used a Bonferroni corrected alpha threshold, set at .05/25 = 0.002. See Table S2 for t-test details.

Dominance Traits.

Strength. All five age groups associated beardedness with strength, selecting bearded faces more often than would be expected by chance when asked which face looked stronger (all *p*s < .001).

Age. Of the five age groups, all but the Older Adolescents associated beardedness with age, selecting bearded faces more often than would be expected by chance when asked which face looked older (all *p*s < .001). Older Adolescent's responses were not different to chance ($p = .025$).

Masculinity. Older Children, Younger Adolescents, Older Adolescents, and Adults all associated beardedness with masculinity, selecting bearded faces more often than would be expected by chance (all *p*s < .001). However, Younger Children's responses were not different to chance ($p = .43$).

Mate Choice Traits.

Attractiveness. Younger Children, Older Children, and Young Adolescents did not associate beardedness with attractiveness, selecting bearded faces less often than would be

expected by chance when asked which face looked best (all *p*s < .001). In contract, responses by Older Adolescents and Adults were not different from chance (*p*s > .030).

Parental Figure. Across the five age groups, Older Children did not associate beardedness with being a parental figure, selecting bearded faces less often than would be expected by chance ($p = .001$). Responses for all other age groups were not different from chance (*p*s > .054).

Like adults, children as young as 2-5 years associated bearded faces with dominance traits, although Younger Children did not yet associate masculinity with beardedness. In contrast, children did not associate beardedness with the mate choice traits. Children avoided bearded faces when asked about attractiveness, although this avoidance disappeared in older adolescence. Children also did not associate beardedness with being a parental figure, a finding in line with the adult results.

Developmental Patterns

We next examined the influence of age group on trait judgments by conducting a 5 (trait) x 5 (age group) mixed design repeated measures ANOVA[2]. The DV was the proportion of trials in which participants selected the bearded face and effects were followed up with Bonferroni-corrected post-hoc tests. Within each of the five traits we compared the performance of all age groups, resulting in 10 comparisons per trait. Thus, we conducted 50 comparisons in total and adjusted our alpha threshold to .05/50 = 0.001. Where appropriate, Greenhouse-Geisser corrections were applied to address violations of sphericity.

[2] An initial analysis including participant gender found a main effect of gender ($p = .003$) but no interactions with age group or trait (all *p*s > .73). Thus, we did not further examine gender.

The main effects of trait, $F(3.75, 2355.43) = 155.84$, $p < .001$, $\eta_p^2 = .20$, and age, $F(4, 629) = 16.84$, $p < .001$, $\eta_p^2 = .097$, were superseded by a trait x age interaction, $F(14.98, 2355.43) = 11.36$, $p < .001$, $\eta_p^2 = .06$ (Figure 2). To further examine this interaction, we conducted a series of one-way ANOVAs, examining the impact of age on each individual trait. See Figure S2 in the Supplemental Information for box plots for each trait, by age. Information on all comparisons can be found in the Supplemental Information in Table S3, but here we focus on the ages at which children's responses become adult-like.

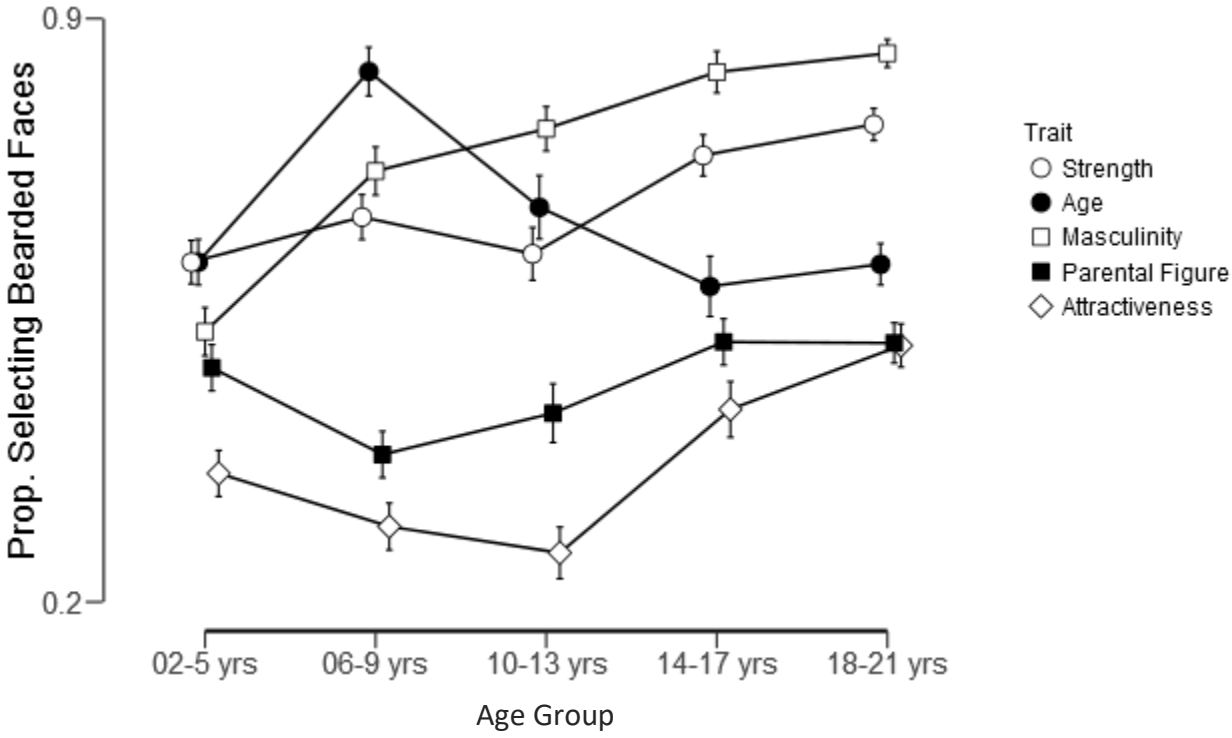

Figure 2. The proportion of participants selecting the bearded face for each trait across age group. *Note:* Maximum = 1.0. Error bars represent standard error.

Dominance Traits.

Strength. The main effect of age, $F(4, 629) = 8.051$, $p < .001$, $\eta_p^2 = .05$, showed that Younger Children, Older Children, and Early Adolescents (mean range = .61-.66) were all less likely than adults to select the bearded face when asked which was strongest ($ps \leq .001$). Late Adolescents and Adults (mean range = .74-.77) were similarly likely to select the bearded face ($p = .319$).

Age. The main effect of age, $F(4, 629) = 13.68$, $p < .001$, $\eta_p^2 = .08$, showed that all child age groups (mean range = .58-.67) were similar to adults (mean = .61) in their likelihood of selecting the bearded face when asked which looked older ($ps > .118$), with the exception of the Older Children. Older Children (mean = .84) were more likely than adults to select bearded faces ($p < .001$).

Masculinity. The main effect of age, $F(4, 629) = 27.94$, $p < .001$, $\eta_p^2 = .15$, showed that Younger Children and Older Children (mean range = .52-.72) were less likely than adults to select the bearded face when asked which looked more like a man ($ps < .001$). Early Adolescents, Late Adolescents, and Adults (Mean range = .77-.86) were similarly likely to choose bearded faces ($ps < .024$).

Overall, children showed a sharp increase in attributions of beardedness to dominance traits in older childhood (6-9 years old), becoming more adult-like by late adolescence (14-17 years old). This pattern of results echoes previous work (Boothroyd et al, 2014) suggesting that children become increasingly attentive to facial traits of dominance before puberty and over the course of adolescence become more adult-like.

Mate Choice Traits.

Attractiveness. The main effect of age, $F(4, 629) = 12.44$, $p < .001$, $\eta_p^2 = .07$, showed that Younger Children, Older Children, and Early Adolescents (mean range = .26-.35) were all

less likely than adults to select the bearded face when asked which looked best (*p*s < .001). Late Adolescents and Adults (mean range = .43-.51) were similarly likely to select the bearded face (*p* = .063).

Parental Figure. The main effect of age, $F(4, 629) = 3.80$, $p = .005$, $\eta_p^2 = .024$, showed that all child age groups (mean range = .38-48) were similar to adults (mean = .51) in their likelihood of selecting the bearded face when asked which looked like a dad (*p*s > .067), with the exception of the Older Children. Older Children (mean = .38) were less likely than adults to select bearded faces ($p < .001$).

Overall, children showed a sharp decrease in attributions of beardedness to attractiveness, becoming adult-like only in older adolescence. However, this pattern did not emerge when asked who looked most like a parent. These data suggest that children are more likely to associate beardedness with (un)attractiveness than they are to associate it with parenting.

Beard exposure

We also examined whether participant's exposure to beardedness influenced their judgments of the bearded faces across traits. We received data regarding beard exposure from 291 child participants ($N_{2\text{-}5\ years} = 43$; $N_{6\text{-}9\ years} = 81$; $N_{10\text{-}13\ years} = 66$, $N_{14\text{-}17\ years} = 101$) and 161 adults.

For child and adult participants, we examined whether their likelihood of selecting a bearded face was correlated with the amount of beardedness of their father, or of family acquaintances, during their childhood (on a 0-4 Likert scale). For adult participants, we also examined whether their current exposure to beards (via acquaintances) correlated with their likelihood of selecting bearded faces for the traits. As these analyses were exploratory, we used a less stringent correction for multiple comparisons than the Bonferroni correction used earlier.

Here, as we conducted comparisons for each of the five traits within each age group, we used a corrected alpha threshold set at .05/5 = 0.01.

When looking at whether childhood exposure to beardedness influenced trait judgments, across the whole sample father's beardedness influenced judgments who looked like a Parental Figure (r = .13, p = .004). Within the child age groups, judgements of Attractiveness were related to father's beardedness only for Older Children (r = .31, p = .005). When fathers' beardedness was coded as a dichotomous Yes/No variable, across the whole sample beardedness influenced judgments of Strength (r_s = .135, p = .002). Within the child age groups, judgments of Strength were related to father's beardedness only for Older Adolescents (r_s = .380, p < .001).

For adults, father's beardedness during childhood did not influence any of the trait judgments (rs < .06). However, broadening childhood exposure ratings to include fathers and acquaintances resulted in a relationship between Attractiveness and beard exposure (r = .20 p = .011). Finally, current exposure to people with beards did not influence trait judgments of adults (rs < .13). Table S4 in the Supplemental Information contains the correlation tables of all beardedness variables analyzed.

Discussion

We present the first evidence that facial hair strongly impacts children's judgments of traits related to dominance and mate choice, and that these two groups of traits show different developmental trajectories. Across childhood, bearded faces were positively associated with dominance traits but negatively associated with mate choice traits. Children's sensitivity to both groups of traits demonstrated early onset, but their judgements reached mature levels at different points in adolescence: associations between beardedness and dominance traits became adult-like in Early Adolescence (10-13 years), whereas associations between beardedness and mate choice

traits became adult-like in Late Adolescence (14-17 years). Finally, exposure to bearded faces in childhood impacted mate choice and dominance judgments of bearded faces. Overall, our results suggest that adult-like judgements about dominance and mate choice emerge gradually and are separable. We explore each of these findings in detail below.

Children as young as 2-5 years associated beardedness with dominance traits, linking bearded faces with masculinity, strength, and age. Young children also avoided bearded faces when asked about attractiveness although this aversion increased into early adolescence, indicating that links between beardedness and mate choice traits develop more gradually. For adolescents, judgments of beards as reflecting masculinity, strength, fathering skills, and attractiveness increased significantly from early to late adolescence, becoming more adult-like during this period. Patterns of judgments at late adolescence did not differ significantly from those made by adults, suggesting that although children are sensitive to beards, the onset of adult-like judgments of beards occurs during sexual maturation. This shift may stem from biological and psychological changes that shape social development during adolescence (Scherf et al., 2012). Children's developing awareness of gender roles and expectations, which emerge around 3-4 years of age and grow in complexity throughout later childhood and adolescence, may contribute to their judgments of dominance and attractiveness traits (Bem, 1989; Hale, Crouter, & Whiteman, 2003). Pubertal neuroendocrine changes may also influence changes in face perception, including increased preferences for same-age peers (Picci & Scherf, 2016), detection of subtle facial expressions (Motta-Mena & Scherf, 2016), and sensitivity to sex-specific characters when judging attractiveness (Little et al., 2010). Our findings demonstrate that beardedness is linked to dominance and mate choice traits well before the onset of puberty but become adult-like late in adolescence, emerging along different time courses.

Our results are also consistent with previous research in which children in middle childhood show a spike in associations between traits and faces, followed by a decrease during adolescence, then gradually reaching adult-like levels (Boothroyd et al, 2014). In our study, 6-9-year-olds showed the strongest associations between bearded faces and masculinity, age, and strength, and avoided bearded faces when asked about attractiveness. Children's strong preferences related to these traits gradually decreased between 10 and 17 years, with 14-17-year-olds showing adult-like associations. Our findings support theories suggesting that the onset of hormonal changes in late childhood reorganizes interpretations of others' appearances (Boothroyd et al, 2014; Herdt & McClintock, 2000; Scherf et al., 2012).

Across our sample, social exposure to beards impacted judgments of bearded faces for both mate choice and dominance traits. These relationships may also be impacted to some extent by developmental stage. For Older Children, father's beardedness correlated positively with judgments of attractiveness and for Older Adolescents, father's beardedness was associated with judgments of strength. Our findings suggest that while children do not judge beards favourably for attractiveness or parenting, their social exposure to beards attenuates negative judgments. For adolescents, the onset of sexual maturity is associated with shifts towards adult-like preferences and social exposure to beards from fathers (and other male acquaintances) contributes to how beards are judged.

The associations between preferences for facial hair when judging parental qualities, and the degree of facial hair among participant's fathers suggests an imprinting-like phenomenon. Although preferences among adults when judging the attractiveness of beards were only at chance-level, these preferences and those of late adolescents were significantly higher than other age groups. Further, when analyzing across our entire sample father's beardedness was positively

associated with judgments of attractiveness and parenting abilities. However, when we examined individual age groups, preferences were related to father's beardedness only for 6-9-year-olds, corresponding with a period of socio-cognitive reorganization (Boothroyd, et al, 2014; Scherf et al., 2012). It is possible that exposure to a father's beard influences this reorganization process, although this small support for imprinting-like phenomena should be taken with caution until more conclusive effects are reported (Rantala & Marcinkowska, 2011).

Perceptions of beardedness differed across childhood and adolescence, perhaps owing to changes in how children interact with adults. During infancy, allomaternal care from female genetic and non-genetic kin is critical for the well-being of mothers and survival of infants, defining the cooperative nature of human families (Hrdy, 2016). In contrast, the role of fathers is more varied across cultures (Sear & Mace, 2008). Thus, greater exposure to female faces may bias preferences towards feminine faces in young children (Quinn et al., 2002; Sugden & Marquis, 2017). During early and especially late childhood, beards communicate age, masculinity and strength to children, perhaps because beards exaggerate the masculine facial features associated with judgments of dominance and aggressiveness (Craig, Nelson, & Dixson, 2019; Dixson et al., 2017; Sherlock et al., 2017). That toddlers and older children - who are more mobile and require care and protection - are sensitive to beards suggests beards may communicate both dominance and protective qualities. In early and late adolescence, attractiveness judgments become more similar to adults' and remain important in communicating masculinity and dominance. By adulthood, perceptions of fathering qualities are closely matched with attractiveness, with judgments of masculinity and dominance being significantly higher than all other trait judgments.

In summary, our findings indicate that although children associate beardedness with traits related to dominance and mate choice, these associations show distinct developmental patterns and develop throughout childhood. We also confirm past research that beards operate primarily as a badge of status and maturity rather than as an attractive ornament, enhancing judgements of masculinity, age, dominance and aggressiveness that secondarily influence women's mate preferences (Dixson et al., 2017b, 2019b) potentially as long-term and paternally investing partners (Dixson et al., 2019a, Neave & Shields, 2008; Štěrbová, Tureček, & Kleisner, 2019). Whether dominance and aggressiveness judgments of bearded men are associated with higher men's mating and reproductive success remains an open question. For the present, our study provides the first data on the ontogeny of perceptions of men's facial hair and highlights how judgments of a highly sexually dimorphic trait can vary from childhood to young adulthood.

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Supplemental Information

Table S1.

Images Used and Average Accuracy on Control Questions, by Trait and Age Group.

	Target Image	Non-Target Image	Younger Children	Older Children	Younger Adolescents	Older Adolescents	Adults	Mean
Strength			0.98	1.00	0.99	0.95	0.98	0.98
Age			0.88	1.00	1.00	0.98	0.99	0.97
Masculinity			0.92	1.00	1.00	0.96	0.98	0.97
Attractiveness			0.65	0.92	0.96	0.93	0.96	0.88
Parental Figure			0.63	0.96	0.98	1.00	0.99	0.91
Mean			0.81	0.98	0.99	0.96	0.98	0.94

Note: Maximum = 1.0.

Figure S1. Questions related to beard density for father's beard.

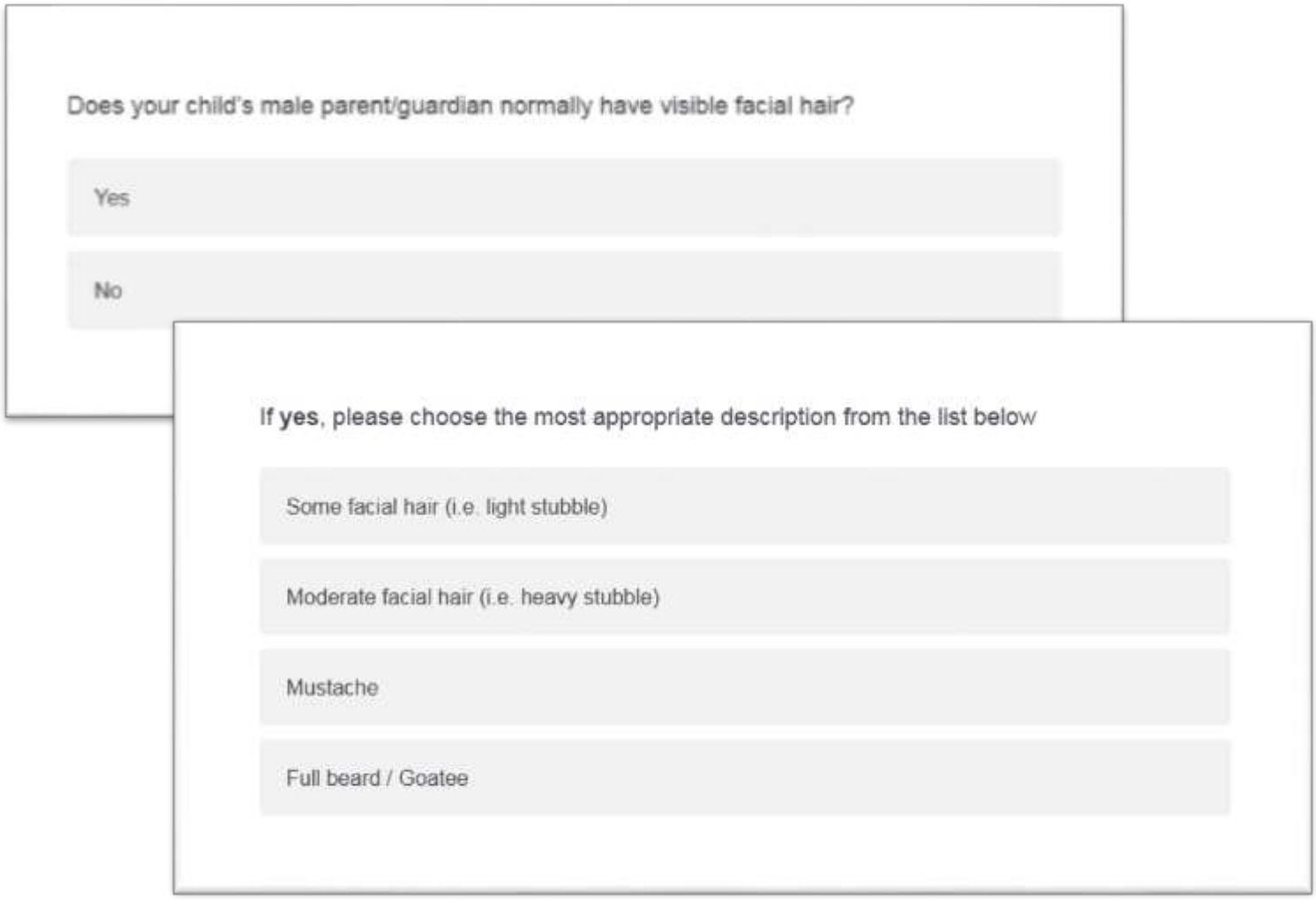


Table S2.

T-test information for each trait, by age group, compared to chance.

One Sample T-Test

						95% Confidence Interval		
		t statistic	df	p	Mean difference	Lower	Upper	Cohen's d
Younger Children (2-5 years)	Strength	3.994	143	< .001	0.1076	0.554	0.661	0.3328
	Age	3.751	143	< .001	0.1076	0.551	0.664	0.3126
	Masculinity	0.784	143	0.434	0.0243	0.463	0.586	0.0653
	Parental Figure	-0.637	143	0.525	-0.0191	0.422	0.540	-0.0531
	Attractiveness	-5.305	143	< .001	-0.1458	0.300	0.409	-0.4421
Older Children (6-9 years)	Strength	5.69	135	< .001	0.162	0.606	0.718	0.488
	Age	13.87	135	< .001	0.336	0.788	0.884	1.189
	Masculinity	7.06	135	< .001	0.217	0.656	0.778	0.605
	Parental Figure	-3.92	135	< .001	-0.123	0.315	0.439	-0.336
	Attractiveness	-7.15	135	< .001	-0.210	0.232	0.348	-0.613
Younger Adolescence (10-13 years)	Strength	3.50	84.0	< .001	0.1176	0.551	0.685	0.379
	Age	4.85	84.0	< .001	0.1735	0.602	0.745	0.526
	Masculinity	9.25	84.0	< .001	0.2676	0.710	0.825	1.004
	Parental Figure	-1.95	84.0	0.054	-0.0735	0.352	0.501	-0.212
	Attractiveness	-7.74	84.0	< .001	-0.2412	0.197	0.321	-0.840
Older Adolescence (14-17 years)	Strength	8.933	104	< .001	0.2357	0.683	0.788	0.8718
	Age	2.274	104	0.025	0.0786	0.510	0.647	0.2219
	Masculinity	13.652	104	< .001	0.3357	0.787	0.884	1.3323

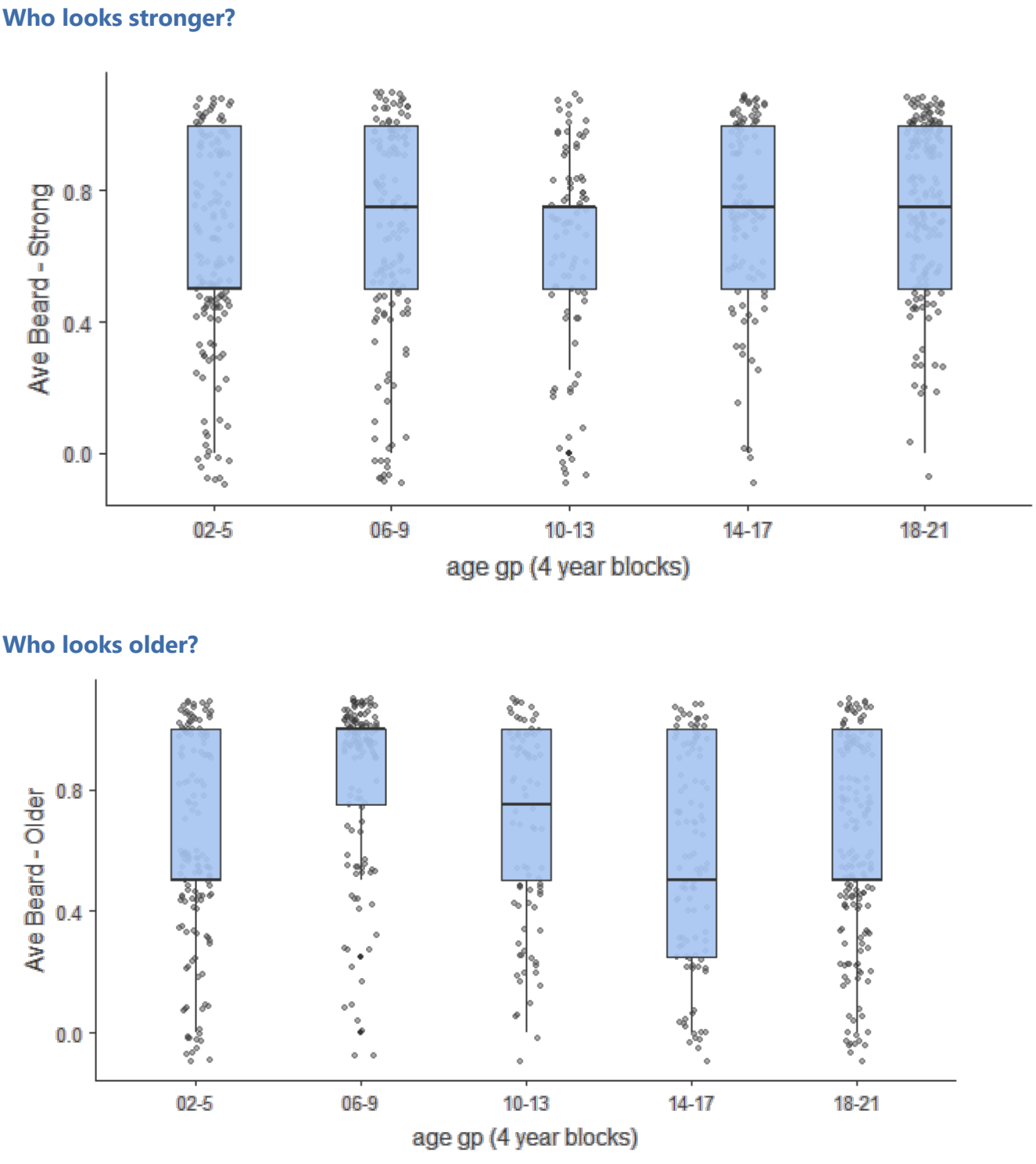
One Sample T-Test

						95% Confidence Interval		
		t statistic	df	p	Mean difference	Lower	Upper	Cohen's d
	Parental Figure	0.388	104	0.699	0.0119	0.451	0.573	0.0378
	Attractiveness	-2.194	104	0.030	-0.0690	0.369	0.493	-0.2141
Adults (18-21 years)	Strength	13.866	163	< .001	0.27287	0.734	0.812	1.0828
	Age	4.156	163	< .001	0.10518	0.555	0.655	0.3245
	Masculinity	22.112	163	< .001	0.35823	0.826	0.890	1.7266
	Parental Figure	0.423	163	0.673	0.01067	0.461	0.561	0.0330
	Attractiveness	0.286	163	0.775	0.00762	0.455	0.560	0.0224

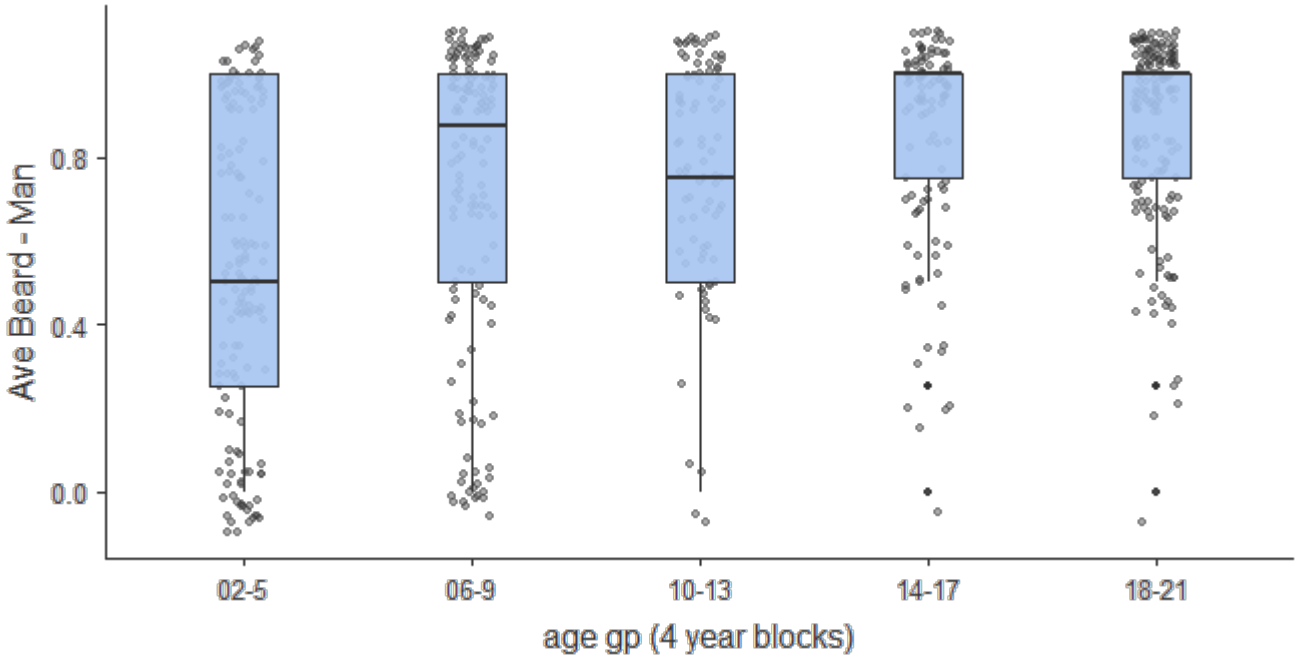
Note. H_a population mean ≠ 0.5. All tests are two-tailed.

Figure S2.

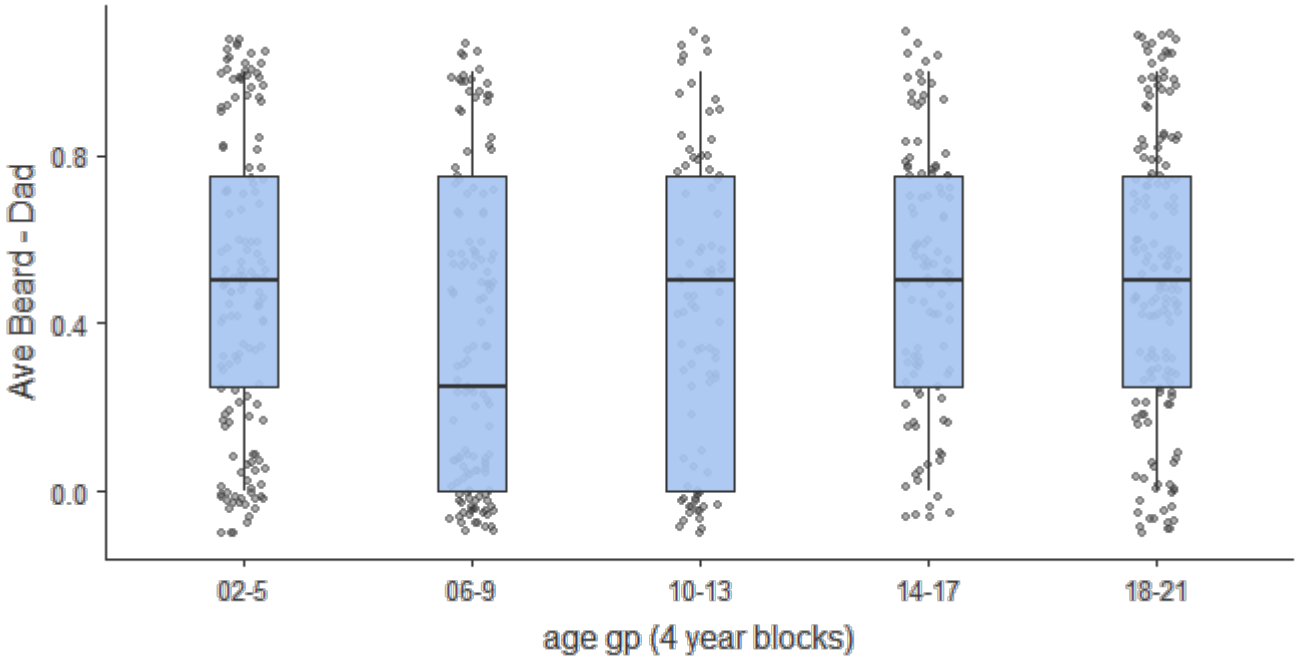
Box plots for each trait, presented by age, with individual data points.



Who looks most like a man?



Who looks most like a dad?



Who looks best?

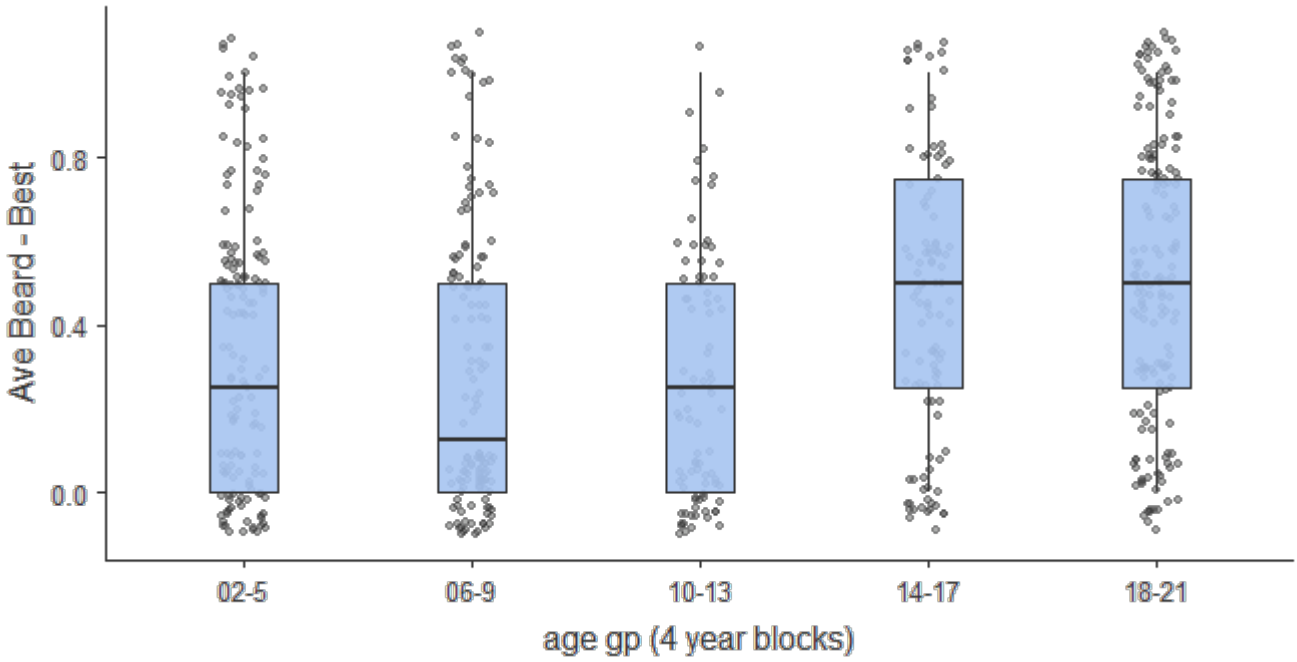


Table S3.

Post-hoc comparisons for each trait by age

Who looks stronger?

Post Hoc Comparisons - age gp (4 year blocks)

Comparison							
age gp (4 year blocks)		age gp (4 year blocks)	Mean Difference	SE	df	t	p
02-5	-	06-9	-0.0541	0.0356	629	-1.520	0.129
	-	10-13	-0.0100	0.0407	629	-0.246	0.806
	-	14-17	-0.1281	0.0382	629	-3.351	< .001
	-	18-21	-0.1652	0.0340	629	-4.857	< .001
06-9	-	10-13	0.0441	0.0412	629	1.071	0.284
	-	14-17	-0.0739	0.0387	629	-1.911	0.056
	-	18-21	-0.1111	0.0345	629	-3.216	0.001
10-13	-	14-17	-0.1181	0.0435	629	-2.717	0.007
	-	18-21	-0.1552	0.0398	629	-3.899	< .001
14-17	-	18-21	-0.0372	0.0372	629	-0.998	0.319

Who looks older?

Post Hoc Comparisons - age gp (4 year blocks)

Comparison							
age gp (4 year blocks)		age gp (4 year blocks)	Mean Difference	SE	df	t	p
02-5	-	06-9	-0.22876	0.0390	629	-5.8599	< .001
	-	10-13	-0.06589	0.0447	629	-1.4755	0.141
	-	14-17	0.02907	0.0419	629	0.6938	0.488
	-	18-21	0.00246	0.0373	629	0.0659	0.948
06-9	-	10-13	0.16287	0.0451	629	3.6080	< .001
	-	14-17	0.25783	0.0424	629	6.0789	< .001
	-	18-21	0.23121	0.0379	629	6.1065	< .001
10-13	-	14-17	0.09496	0.0476	629	1.9934	0.047
	-	18-21	0.06835	0.0436	629	1.5664	0.118
14-17	-	18-21	-0.02661	0.0408	629	-0.6522	0.515

Who looks most like a man?

Post Hoc Comparisons - age gp (4 year blocks)

Comparison							
age gp (4 year blocks)		age gp (4 year blocks)	Mean Difference	SE	df	t	p
02-5	-	06-9	-0.1926	0.0359	629	-5.363	< .001
	-	10-13	-0.2433	0.0411	629	-5.924	< .001
	-	14-17	-0.3114	0.0385	629	-8.080	< .001
	-	18-21	-0.3339	0.0343	629	-9.736	< .001
06-9	-	10-13	-0.0507	0.0415	629	-1.222	0.222
	-	14-17	-0.1188	0.0390	629	-3.045	0.002
	-	18-21	-0.1413	0.0348	629	-4.057	< .001
10-13	-	14-17	-0.0681	0.0438	629	-1.553	0.121
	-	18-21	-0.0906	0.0401	629	-2.257	0.024
14-17	-	18-21	-0.0225	0.0375	629	-0.600	0.549

Who looks most like a dad?

Post Hoc Comparisons - age gp (4 year blocks)

Comparison							
age gp (4 year blocks)		age gp (4 year blocks)	Mean Difference	SE	df	t	p
02-5	-	06-9	0.10406	0.0410	629	2.5360	0.011
	-	10-13	0.05443	0.0469	629	1.1596	0.247
	-	14-17	-0.03100	0.0440	629	-0.7040	0.482
	-	18-21	-0.02977	0.0392	629	-0.7595	0.448
06-9	-	10-13	-0.04963	0.0475	629	-1.0460	0.296
	-	14-17	-0.13507	0.0446	629	-3.0296	0.003
	-	18-21	-0.13383	0.0398	629	-3.3626	< .001
10-13	-	14-17	-0.08543	0.0501	629	-1.7062	0.088
	-	18-21	-0.08420	0.0459	629	-1.8358	0.067
14-17	-	18-21	0.00123	0.0429	629	0.0288	0.977

Who looks best?

Post Hoc Comparisons - age gp (4 year blocks)

Comparison							
age gp (4 year blocks)		age gp (4 year blocks)	Mean Difference	SE	df	t	p
02-5	-	06-9	0.0637	0.0393	629	1.621	0.106
	-	10-13	0.0953	0.0450	629	2.120	0.034
	-	14-17	-0.0768	0.0422	629	-1.820	0.069
	-	18-21	-0.1535	0.0376	629	-4.086	< .001
06-9	-	10-13	0.0316	0.0455	629	0.695	0.487
	-	14-17	-0.1405	0.0427	629	-3.289	0.001
	-	18-21	-0.2172	0.0381	629	-5.695	< .001
10-13	-	14-17	-0.1721	0.0480	629	-3.588	< .001
	-	18-21	-0.2488	0.0439	629	-5.661	< .001
14-17	-	18-21	-0.0767	0.0411	629	-1.866	0.063

Table S4.

Correlations Between Beard Exposure and Selection of Bearded Faces by Trait

Age Group	Relationship to Participant	Scale	Physical Strength	Age	Masculinity	Attractiveness	Parental Figure
Younger Children	Father	0-4	0.047	0.148	0.264	0.188	0.319*
		Yes/No	-0.004	0.187	0.332*	0.140	0.179
	Father or Acquaintance	0-4	0.158	-0.131	0.283	-0.081	0.211
		Yes/No	0.120	-0.199	0.242	0.263	0.000
Older Children	Father	0-4	0.128	-0.028	-0.129	0.311**	0.264*
		Yes/No	0.174	0.020	-0.045	0.100	0.139
	Father or Acquaintance	0-4	-0.013	-0.081	-0.109	0.233*	0.149
		Yes/No	-0.030	-0.114	-0.046	0.154	0.122
Younger Adolescents	Father	0-4	-0.022	-0.112	0.174	-0.059	0.230
		Yes/No	0.004	-0.074	0.205	0.089	0.169
	Father or Acquaintance	0-4	-0.093	-0.061	0.017	-0.127	-0.045
		Yes/No	-0.109	-0.069	0.140	0.003	0.027
Older Adolescents	Father	0-4	0.199*	-0.128	-0.127	0.026	0.159
		Yes/No	0.380***	-0.024	0.044	0.027	0.248*
	Father or Acquaintance	0-4	0.161	-0.151	-0.176	0.132	0.155
		Yes/No	0.317**	-0.014	0.038	0.062	0.168
Adults	Father	0-4	-0.013	-0.033	-0.054	0.047	-0.062
		Yes/No	-0.012	0.004	-0.049	-0.033	-0.046
	Father or Acquaintance	0-4	0.010	-0.086	-0.032	0.202*	0.083
		Yes/No	-0.039	-0.056	-0.045	0.048	0.032
	Current Acquaintances or Self	0-4	-0.043	-0.057	-0.092	0.132	-0.051
		Yes/No	-0.010	-0.006	-0.139	-0.010	-0.040
Whole Sample	Father	0-4	0.078	-0.070	0.019	0.110*	0.128**
		Yes/No	0.139**	-0.027	0.088*	0.106*	0.124**
	Father or Acquaintance	0-4	0.037	-0.077	-0.051	0.067	0.080
		Yes/No	0.084	-0.074	0.061	0.105*	0.095*

Note: Range = -1.0 to 1.0. Pearson's *r* shown for 0-4 scale, Spearman's rho (r_s) shown for Yes/No scale. Yes/No variable coding: 0 = No, 1-4 = Yes. * = $p < .05$, ** = $p < .01$, *** = $p < .001$.

Supplemental Text: Analyses including only participants 3 years of age and older.

Results

Responses vs. Chance

To determine which traits were most salient for each age group, we first determined which trait judgements were farthest from chance responding (set at 0.50) for each age group. For Young Children, Attractiveness judgements were farthest from chance (difference from chance = -.15), whereas for Older Children, Age judgements were farthest from chance (.46). For Young Adolescents, Older Adolescents and Adults, Masculinity judgments were farthest from chance (.27, .34, .27, respectively). These data suggest that young children most consistently view beards as being unattractive, and later in childhood view them as an indicator of age. It is not until children reach adolescence that they view beards as most strongly indicating masculinity.

We next conducted a series of t-tests to determine whether the proportion of bearded faces selected by participants was different from chance responding (set at 0.50). We conducted tests for each of the five traits, for each age group, resulting in 25 t-tests and thus used a Bonferroni corrected alpha threshold, set at .05/25 = 0.002. See Table S2 for t-test details.

Dominance Traits.

Strength. All five age groups associated beardedness with strength, selecting bearded faces more often than would be expected by chance when asked which face looked stronger (all *p*s < .001).

Age. Of the five age groups, all but the Older Adolescents associated beardedness with age, selecting bearded faces more often than would be expected by chance when asked which

face looked older (all *p*s < .001). Older Adolescent's responses were not different to chance (*p* = .025).

Masculinity. Older Children, Younger Adolescents, Older Adolescents, and Adults all associated beardedness with masculinity, selecting bearded faces more often than would be expected by chance (all *p*s < .001). However, Younger Children's responses were not different to chance (*p* = .28).

Mate Choice Traits.

Attractiveness. Younger Children, Older Children, and Young Adolescents did not associate beardedness with attractiveness, selecting bearded faces less often than would be expected by chance when asked which face looked best (all *p*s < .001). In contract, responses by Older Adolescents and Adults were not different from chance (*p*s > .030).

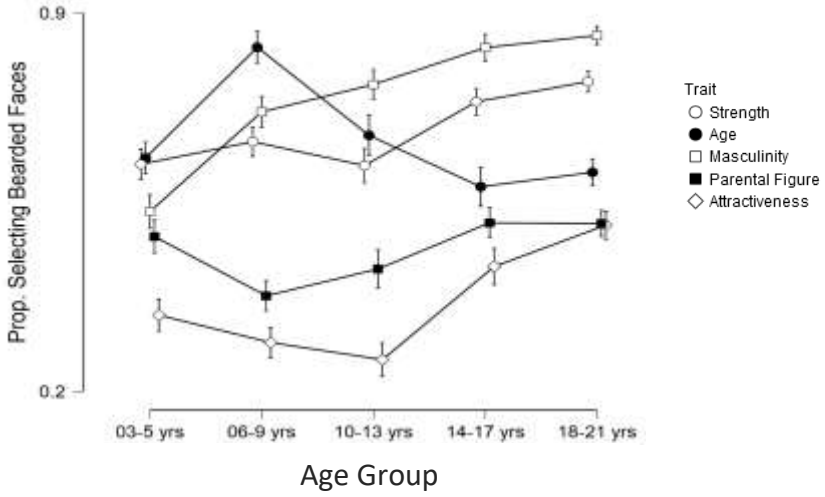
Parental Figure. Across the five age groups, Older Children did not associate beardedness with being a parental figure, selecting bearded faces less often than would be expected by chance (*p* = .001). Responses for all other age groups were not different from chance (*p*s > .054).

Like adults, children as young as 3-5 years associated bearded faces with dominance traits, although Younger Children did not yet associate masculinity with beardedness. In contrast, children did not associate beardedness with the mate choice traits. Children avoided bearded faces when asked about attractiveness, although this avoidance disappeared in older adolescence. Children also did not associate beardedness with being a parental figure, a finding in line with the adult results.

Developmental Patterns

We next examined the influence of age group on trait judgments by conducting a 5 (trait) x 5 (age group) mixed design repeated measures ANOVA[3]. The DV was the proportion of trials in which participants selected the bearded face and effects were followed up with Bonferroni-corrected post-hoc tests. Within each of the five traits we compared the performance of all age groups, resulting in 10 comparisons per trait. Thus, we conducted 50 comparisons in total and adjusted our alpha threshold to .05/50 = 0.001. Where appropriate, Greenhouse-Geisser corrections were applied to address violations of sphericity.

The main effects of trait, $F(3.74, 2308.82) = 155.8$, $p < .001$, $\eta_p^2 = .20$, and age, $F(4, 617) = 14.3$, $p < .001$, $\eta_p^2 = .085$, were superseded by a trait x age interaction, $F(14.97, 2308.82) = 11.0$, $p < .001$, $\eta_p^2 = .07$ (Figure 2). To further examine this interaction, we conducted a series of one-way ANOVAs, examining the impact of age on each individual trait. See Figure S2 in the Supplemental Information for box plots for each trait, by age. Information on all comparisons can be found in the Supplemental Information in Table S3, but here we focus on the ages at which children's responses become adult-like.



[3] An initial analysis including participant gender found a main effect of gender ($p = .003$) but no interactions with age group or trait (all ps > .73). Thus, we did not further examine gender.

Figure 2. The proportion of participants selecting the bearded face for each trait across age group. *Note:* Maximum = 1.0. Error bars represent standard error.

Dominance Traits.

Strength. The main effect of age, $F(4, 617) = 7.09$, $p < .001$, $\eta_p^2 = .04$, showed that Younger Children, Older Children, and Early Adolescents (mean range = .62-.66) were all less likely than adults to select the bearded face when asked which was strongest ($ps \leq .001$). Late Adolescents and Adults (mean range = .74-.77) were similarly likely to select the bearded face ($p = .319$).

Age. The main effect of age, $F(4, 617) = 13.0$, $p < .001$, $\eta_p^2 = .08$, showed that all child age groups (mean range = .58-.67) were similar to adults (mean = .61) in their likelihood of selecting the bearded face when asked which looked older ($ps > .118$), with the exception of the Older Children. Older Children (mean = .84) were more likely than adults to select bearded faces ($p < .001$).

Masculinity. The main effect of age, $F(4, 6179) = 24.6$, $p < .001$, $\eta_p^2 = .14$, showed that Younger Children and Older Children (mean range = .54-.72) were less likely than adults to select the bearded face when asked which looked more like a man ($ps < .001$). Early Adolescents, Late Adolescents, and Adults (Mean range = .77-.86) were similarly likely to choose bearded faces ($ps < .024$).

Overall, children showed a sharp increase in attributions of beardedness to dominance traits in older childhood (6-9 years old), becoming more adult-like by late adolescence (14-17 years old). This pattern of results echoes previous work (Boothroyd et al, 2014) suggesting that

children become increasingly attentive to facial traits of dominance before puberty and over the course of adolescence become more adult-like.

Mate Choice Traits.

Attractiveness. The main effect of age, $F(4, 617) = 12.4$, $p < .001$, $\eta_p^2 = .074$, showed that Younger Children, Older Children, and Early Adolescents (mean range = .26-.35) were all less likely than adults to select the bearded face when asked which looked best (ps < .001). Late Adolescents and Adults (mean range = .43-.51) were similarly likely to select the bearded face (p = .063).

Parental Figure. The main effect of age, $F(4, 617) = 3.87$, $p = .004$, $\eta_p^2 = .024$, showed that all child age groups (mean range = .38-49) were similar to adults (mean = .51) in their likelihood of selecting the bearded face when asked which looked like a dad (ps > .067), with the exception of the Older Children. Older Children (mean = .38) were less likely than adults to select bearded faces ($p < .001$).

Overall, children showed a sharp decrease in attributions of beardedness to attractiveness, becoming adult-like only in older adolescence. However, this pattern did not emerge when asked who looked most like a parent. These data suggest that children are more likely to associate beardedness with (un)attractiveness than they are to associate it with parenting.

Beard exposure

We also examined whether participant's exposure to beardedness influenced their judgments of the bearded faces across traits. We received data regarding beard exposure from 286 child participants ($N_{3\text{-}5\ years} = 38$; $N_{6\text{-}9\ years} = 81$; $N_{10\text{-}13\ years} = 66$, $N_{14\text{-}17\ years} = 101$) and 161 adults.

For child and adult participants, we examined whether their likelihood of selecting a bearded face was correlated with the amount of beardedness of their father, or of family acquaintances, during their childhood (on a 0-4 Likert scale). For adult participants, we also examined whether their current exposure to beards (via acquaintances) correlated with their likelihood of selecting bearded faces for the traits. As these analyses were exploratory, we used a less stringent correction for multiple comparisons than the Bonferroni-correction used earlier. Here, as we conducted comparisons for each of the five traits within each age group, we used a corrected alpha threshold set at .05/5 = 0.01.

When looking at whether childhood exposure to beardedness influenced trait judgments, across the whole sample father's beardedness influenced judgments of Attractiveness (r = .11, p = .011) and who looked like a Parental Figure (r = .12, p = .006). Within the child age groups, judgements of Attractiveness were related to father's beardedness only for Older Children (r = .31, p = .005). When fathers' beardedness was coded as a dichotomous Yes/No variable, across the whole sample beardedness influenced judgments of Strength (r_s = .135, p = .002). Within the child age groups, judgments of Strength were related to father's beardedness only for Older Adolescents (r_s = .380, p < .001).

For adults, father's beardedness during childhood did not influence any of the trait judgments (rs < .06). However, broadening childhood exposure ratings to include fathers and acquaintances resulted in a relationship between Attractiveness and beard exposure (r = .20 p = .011). Finally, current exposure to people with beards did not influence trait judgments of adults (rs < .13). Table S4 in the Supplemental Information contains the correlation tables of all beardedness variables analyzed.