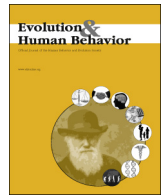




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## Original Article

Developmental changes in children's facial preferences<sup>☆</sup>Lynda G. Boothroyd<sup>a,\*</sup>, Elizabeth Meins<sup>a,b</sup>, Jovana Vukovic<sup>a,c</sup>, D. Michael Burt<sup>a</sup><sup>a</sup> Department of Psychology, Durham University, South Road, Durham, DH1 3LE<sup>b</sup> Department of Psychology, University of York<sup>c</sup> School of Education and Social Science, Texas A&M University

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## ABSTRACT

Facial averageness, symmetry, health, and femininity are positively associated with adults' judgements of attractiveness, but little is known about the age at which preferences for individual facial traits develop. We investigated preferences for these facial traits and global attractiveness in 4- to 17-year-olds ( $N = 346$ ). All age groups showed preferences for globally attractive faces. Preferences for averageness, symmetry, and health did not emerge until middle childhood and experienced apparent disruption or stasis around age 10- to 14-years; femininity was not preferred until early adulthood, and this preference was seen only in girls. Children's pubertal development was not clearly related to any facial preferences, but the results are consistent with the suggestion that early adrenal hormone release may play an activating role in mate preferences, while other constraints may delay further increases in preferences during later puberty.

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Research over the last decade has shed light on the characteristics that underlie adults' judgements of global attractiveness in a given face, suggesting that attractiveness may be a 'compound' trait in which multiple aspects contribute to global attractiveness. For example, both men and women rate male and female faces as more attractive if they are more average (have facial proportions closer to the population mean), symmetrical, and healthy-looking, and find femininity (having facial proportions in the female direction of the male–female continuum) attractive in female faces (e.g., Boothroyd, Lawson, & Burt, 2009; Langlois, Roggman, & Musselman, 1994; Perrett et al., 1998, 1999; Rhodes, Geddes, Jeffery, Dziurawiec, & Clark, 2002). Given that these preferences may confer adaptive advantages in mate choice, such as indicating healthier genotypes (e.g. Jones et al., 2004; Lie, Rhodes, & Simmons, 2008; Rhodes et al., 2007; Roberts et al., 2005; Thornhill & Gangestad, 2006), or fertility (Law-Smith et al., 2006), it is relevant to ask whether such preferences change across development in a manner which is compatible with a mate-choice oriented perspective.

Neonates and older infants show preferences (as indexed by looking times) for some faces over others in a manner consistent with adult judgements of global attractiveness (Langlois, Ritter, Roggman, & Vaughn, 1991; Slater, Quinn, Hayes, & Brown, 2000; Slater et al., 1998). Moreover, from age 6, children concord with adults in terms of the faces they report as being attractive (Cavior & Lombardi, 1973; Cross & Cross,

1971; Kissler & Bauml, 2000). However, although children from age 11 do appear to show preferences for femininity, symmetry, and averageness in faces (Little et al., 2010; Saxton, DeBruine, Jones, Little, & Roberts, 2009, 2011, Saxton et al., 2010), evidence regarding pre-pubertal facial preferences for specific traits is both scarce and contradictory.

Studies exploring pre-pubertal facial preferences have focused exclusively on infants and have explored preference for averageness and symmetry with mixed results. Rubenstein, Kalakanis, and Langlois (1999) found that 6-month-olds preferred an average of 32 faces to an unattractive face, whereas Rhodes et al. (2002) found tentative evidence for a preference for distinctive (the opposite of average) faces in 5- to 8-month-olds. Similarly, while Rhodes et al. (2002) also reported a weak preference for asymmetric faces, Samuels, Butterworth, Roberts, Graupner, and Hole (1994) found no symmetry preference in 4- to 15-month-olds. Moreover, these studies suffer from various methodological shortcomings. For example, in comparing preferences for a composite face versus a real face, Rubenstein et al. (1999) confounded averageness in shape with the smooth skin arising from the compositing process. Comparing this composite with a real-life unattractive face also means that this study tells us nothing about whether infants prefer an average composite over real faces deemed to be of middling or high attractiveness. In Samuels et al.'s (1994) study, the adult participants failed to show a symmetry preference, suggesting that there may have been problems with their facial stimuli. Finally, Rhodes et al.'s data only showed a difference between stimuli in terms of the 'longest look', and not in overall viewing times. Thus, little is known about the age at which children begin to prefer the established specific markers of attractiveness in adults' facial preferences discussed above, or what determines the onset of adult-like preferences.

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If certain facial characteristics are deemed attractive because they signal the quality of a potential mate, one might expect to see onset of, or significant increase in, preferences for these characteristics at puberty. However, it is important to bear in mind that puberty involves a number of stages that may begin as early as age 6. Adrenarche marks the commencement of release of the hormone dehydroepiandrosterone (DHEA), which is then converted into testosterone and estradiol. Although DHEA levels tend to increase sharply at age 10, the approximate age at which individuals of both sexes may tend to report first experiencing sexual attractions (as argued by McClintock & Herdt, 1996), levels begin increasing at approximately age 6 (de Peretti & Forest, 1976). In a related but separate process, full puberty requires gonadarche (maturation of, and onset of sex hormone release from, the ovaries or testes). Sexual attraction starts during adrenarche, but hormones released at gonadarche finalize sexual and sociocognitive development (Boxer, Levinson, & Petersen, 1989; de Peretti & Forest, 1976).

Previous research has suggested that age-related changes in hormones may underlie developmental changes in preferences for facial averageness, symmetry, and femininity (e.g., Little et al., 2010; Saxton, DeBruine et al., 2009; Saxton et al., 2010, 2011). However, none of these studies included children younger than age 11, precluding any investigation into how the initial stages of puberty impact on the development of facial preferences. Moreover, as discussed by Saxton et al. (2010), there are considerable individual differences in the age at which children go through the stages of puberty, meaning that one cannot rely merely on age as an index of pubertal development. While Saxton, DeBruine et al. (2009), Saxton et al. (2011, 2010) did consider pubertal stage independent of age, and showed relatively little evidence for puberty affecting preferences, they again only considered children of 11 years and upwards.

Across the same age range as adrenal and gonadal hormones are released, however, other changes in the cognitive architecture underlying face processing are taking place and may also contribute to changing preferences. The cognitive constraints on face processing are likely to ease as children get older. Cognitive skills in face processing come online and mature at different rates, with configural processing (recognizing faces by the relative locations of features) lagging behind individual feature processing (recognition by specific features). Although both types of processing have been demonstrated to exist in infancy, they do not reach adult levels until the teenage years (for discussion see e.g., Anzures, Mondloch, & Lackner, 2009; Hayden, Bhatt, Reed, Corbly, & Joseph, 2007; Scott & Nelson, 2006). Thus, children's judgements of attractiveness may become more similar to those of adults as they get older because of increasing expertise in the perceptual and processing skills required to evaluate aspects of attractiveness. While this approach might predict relatively early emergence of weak preferences (in line with the early start of basic processing skills as discussed above) and steady improvement thereafter, there is reason to believe that cognitive constraints would briefly re-emerge during puberty and may temporarily dampen preferences. Facial recognition paradigms have been shown for some years to display an apparent 'dip' in performance around 12- to 13-years (e.g. Carey, Diamond, & Woods, 1980; Chung & Thomson, 1995; Lawrence et al., 2008). Recently, this dip has been suggested to arise from a widespread recalibration in socio-cognitive processing as puberty brings mating and mating-relevant behaviours online (Scherf, Behrmann, & Dahl, 2012). Importantly, these authors propose that pubertal hormones are directly responsible for this temporary disruption in facial processing and suggest that the same patterns might be observed in facial attraction as are seen in facial recognition. The weak evidence for pubertal effects reported by Saxton et al. above, may thus be a result of their participants already experiencing this disruption, highlighting the need to incorporate earlier as well as later stages of hormonal release when examining the potential effects of puberty on facial preferences.

## 1. The present study

The present study is the first to investigate facial preferences in individuals ranging in age from pre-adrenarche until adulthood. We sought to explore the developmental trajectories of preferences for four specific facial characteristics: averageness, symmetry, femininity, and apparent health. As well as addressing age-related changes in facial preferences, we investigated how children's pubertal development related to their preferences for specific facial features. Given the fact that girls reach sexual maturity at younger ages than do boys, we also explored how sex related to children's developing facial preferences.

Based on the literature discussed above, we predicted that (a) preferences for facial characteristics associated with adults' judgements of attractiveness will increase with age, (b) adult-like facial preferences will appear or significantly increase around early puberty (some point between 6 and 10 years of age), and (c) disruption of facial preferences may be seen around age 10- to 14-years (and may be linked to the mid-puberty stage).

## 2. Method

### 2.1. Participants

Participants fell into six age groups designed to capture children in the different phases of adrenal and gonadal hormone production: age 4 to 5 (all hormones at floor), age 6 to 8 (DHEA starting to rise), age 9 (increasing DHEA), age 10 to 12 (high DHEA, early gonadarche), age 13 to 14 (late gonadarche), and age 17 (adult). Initially, 401 participants were recruited; however data from 55 children were excluded due to evidence of bias in responding on the face task (responding with the same key more than 10 times), leaving 346 (176 male). With regard to participants' ethnicity, 74.6% were White, 15.8% were Asian, 5.0% were Afro-Caribbean, and 4.6% were 'mixed race' or 'other'. Active consent was obtained from parents/guardians, and participants verbally assented on the day of the testing. The study was approved by the appropriate university ethics committee, and all participants were tested in accordance with APA ethical principles for research.

### 2.2. Materials and methods

#### 2.2.1. Procedure

All participants viewed the faces on computer screens. The 4- to 5-year-olds completed the facial preference task verbally with an experimenter, either individually or in a closely supervised group of 2 or 3. Participants in all other age groups were tested in groups, which ranged in size from 6 participants for the younger ages (7 and 11 years) to 27 participants for the older ages. For all except the 9-year-old sample, data collection was conducted in the school's computer room. Participants were seated at individual computer monitors that were screened at the side to prevent children viewing each other's responses. The 9-year-olds were involved in an ongoing longitudinal study and completed the task alone at a computer in the university's developmental laboratory.

Children aged 5 to 7 years completed the 80 trial face test in one sitting with short breaks as needed. Children received a reward of a sticker for each 20 trials that they completed. The 9-year-olds completed the 80 trials in two equal blocks, with a break in between during which they completed a questionnaire on their family (note that these questionnaire data are not reported here). Participants ranging in age from 11 to 17 years completed half of the 80 trials, followed by the Pubertal Development Scale (see below), and then the remaining 40 trials of the face preference test. Each image was shown once in block 1 and once in block 2, such that the two blocks were identical in content. In order to rule out that the differing

questionnaires alone could elicit changes in the 9-year-olds' versus the older participants' preferences, first and second block scores were compared. For all facial traits, there was no main effect of block on preferences (all  $F_s < 1.2$ , all  $p_s > 0.25$ ) and no interaction between block and age group (all  $F_s < 1$ , all  $p_s > 0.4$ ). For all age groups, the procedure lasted between 15 and 20 minutes.

### 2.2.2. Stimulus format

Although 'masked' images (in which hair and clothes are blanked out, leaving only the face) are commonly used in research with adults (e.g., DeBruine, Jones, Smith, & Little, 2010), researchers have used unmasked images with children (e.g., Saxton and colleagues' image set are all unmasked). In order to establish whether masked or unmasked images were more appropriate for the age range of children in the present study, a pilot study involving 22 individuals (14 boys) ranging from 6 to 16 years of age was conducted. Participants were asked to indicate whether they preferred the high- or low-trait versions of faces which varied on averageness or femininity (as described below) for both masked and unmasked faces. The masked and unmasked faces did not differ on proportion of high-trait faces chosen for averageness,  $t(21) = 0.00$ ,  $p > .99$ , or femininity,  $t(21) = 1.48$ ,  $p = .16$ . However, given the low power of these tests, confidence intervals for mean scores were examined to determine the likelihood of any true effects. The confidence interval for averageness was symmetric around zero, while that for femininity was asymmetric, such that it was more likely that the effect was more marked for unmasked images. Based on these results, and the fact that unmasked images have greater familiarity and ecological validity, we used unmasked stimuli in the main study.

### 2.2.3. Attractiveness stimuli

Front-facing, non-smiling images of eight male and eight female individuals, selected for differing attractiveness from previous research (Boothroyd, Jones, Burt, DeBruine & Perrett, 2008) and the CALPAL database (<http://vitallongevity.utdallas.edu/facedb/>), were paired so that each pair included an image of an attractive individual and an unattractive individual of the same sex. All individuals were aged between 18 and 26 years. There were four pairs of female images and four pairs of male images. The relative attractiveness of the resulting eight pairs of images was pre-rated by 104 adults who indicated for each pair which face they found more attractive. Across all adult raters, the putatively more attractive stimuli were selected on 94.8% of trials, showing strong validity of the face pairings.

### 2.2.4. Femininity, health, averageness, and symmetry stimuli

Stimuli were drawn from previously published research (Boothroyd et al., 2009). Four male and four female fake identities were each created by generating computer-graphic composite images of six individual faces of undergraduate students (aged 18 to 25) using the program psychomorph (Rowland & Perrett, 1995; Tiddeman, Burt, & Perrett, 2001). These 'individual' faces were then manipulated to create the test stimuli. Briefly, the 'individual' face was manipulated along the given dimension (symmetry, averageness, femininity, health) in both a positive and negative direction to create two new faces (for details of how these dimensions were constructed see Boothroyd et al., 2009). Thus, for each of the four dimensions, there were eight male and eight female faces. In order to confirm that young children were able to perceive the differences between individuals within pairs (as the changes can appear very subtle) 6 children aged 4 years of age were shown the femininity pairs and 8 four-year-olds were shown the averageness pairs presented either as normal, or as two identical versions (i.e., the high trait versions together or the low trait versions together) and asked whether the faces were the same or different. Children were significantly more accurate than chance at identifying 'same' versus 'different' trials (one-sample t-tests against 50%; femininity:  $t_5 = 2.91$ ,  $p = .034$ ; averageness:  $t_7 = 3.99$ ,  $p < .005$ ).

Only two children for each trait performed at chance level (half of trials were correct); all other children performed at greater than chance level.

### 2.2.5. Facial preference task

Participants were presented with a pair of faces on a computer screen with the instruction "Choose the face you find more attractive" at the top of the screen. The experimenter explained the procedure to the youngest three groups (4- to 9-year-olds); where children did not understand the question, they were told that attractive meant the face they preferred or liked better. All participants selected their chosen face using an extended forced choice paradigm. Having chosen which face was more attractive, participants then rated the degree to which they preferred the face using a scale at the bottom of the computer screen. Participants could indicate that they liked their chosen face "a lot more", "more", "a bit more", or "a little bit more". These responses were read out by the experimenter to the 4- to 5-year-olds, who then indicated verbally how much they preferred the chosen face. Participants viewed each pair of faces twice, giving eight male and eight female trials per trait. Each participant was given a score indicating the proportion of trials in which the more attractive/symmetric/average/feminine/healthy face was selected. Although these forced choice scores correlated highly with scores based on strength of preference for the high trait face ( $r_s$  ranged from .73 to .84), use of forced choice data minimized the risk that younger participants would conceptualize the relative preference options differently to older participants.

### 2.2.6. Pubertal development

The Pubertal Development Scale (PDS; Petersen, Crockett, Richards, & Boxer, 1988) was completed using maternal-report for the 9-year-olds, and self-report for the 10- to 17-year-olds. Petersen et al. (1988) found that maternal-report was most similar to physician ratings of pubertal development prior to age 11, whereas self-report was more accurate in older children. The PDS asks respondents to estimate their (or their child's) development on five key physical traits directly or indirectly affected by adrenarche or gonadarche: height, skin changes, pubic hair, breast development and menarche (girls), and facial hair and voice breaking (boys). For each physical trait, response options were: not yet started (1 point), barely started (2 points), definitely started (3 points), seems complete (4 points). Scores range from 5 for those who have not experienced any changes, to 20 for those who have completed all changes. Participants were coded into pubertal stages (pre-, early-, mid-, late-, and post-pubertal) on the basis of their scores, as per Petersen et al.

## 3. Results

### 3.1. Preliminary analyses

Table 1 shows the mean ages and (for the oldest four age groups) the mean PDS scores. The PDS scores of all age groups between 9 and 17 years differed from each other,  $F(6, 323) = 279.78$ ,  $p < .001$ ; all Tukey's  $p < .001$ . The 9-year-old sample's scores differed from the

**Table 1**  
Descriptive statistics as a function of age group.

Age group	N	Mean age	Mean PDS
4- to 5-years	54 (23 male)	4.59 (0.5)	-
6- to 8-years	52 (24 male)	6.83 (0.7)	-
9-years	61 (33 male)	9.00 (0.0)	7.52 (2.2)
10- to 12-years	58 (30 male)	11.14 (0.4)	8.81 (2.0)
13- to 14-years	59 (41 male)	14.27 (0.5)	11.74 (2.9)
17-years	65 (26 male)	17.39 (0.4)	15.17 (2.0)

Standard deviations are in parentheses.  
Note: PDS = Pubertal Development Scale.



minimum PDS score of 5,  $t(89) = 8.97, p < .001, d = 1.90$ , indicating that some physical development associated with puberty had started by 9 years.

Scores for the proportion of high-trait faces preferred for each trait were entered into a mixed ANOVA where face sex (male, female) was a within subject factor, and participant sex and age group were between subjects factors. Face sex had a significant main effect in two cases, such that symmetry was valued more highly in the male stimuli than in the female stimuli,  $F(1, 334) = 7.93, p < .001$ , and global attractiveness was valued more highly in the female stimuli than in male stimuli,  $F(1, 334) = 13.58, p < .001$ . There was also an interaction between face sex and age group for attractiveness stimuli,  $F(5, 334) = 2.61, p = .013$ , but the overall pattern of results was the same in both male and female faces. There were no other main effects of face sex and no interactions between face sex and participant sex or age, and so male and female stimuli were analyzed together.

### 3.2. Age-related differences in facial preferences

#### 3.2.1. Attractiveness

Mean scores and confidence intervals for attractiveness preferences are shown in Fig. 1. Relations between age group and attractiveness preferences were investigated in a child gender x age group ANOVA. There was a main effect of age group on attractiveness preferences,  $F(5, 378) = 52.25, p < .001, \eta^2 = .40$ . Post-hoc pairwise comparisons showed that (a) attractiveness preferences of 4- to 5-year-olds were weaker than those of all other age groups ( $ps < .01$ ); (b) attractiveness preferences of 6- to 8-year-olds were weaker than those of all older age groups ( $ps < .05$ ); and (c) the 9-year-old, 10- to 12-year-old, 13- to 14-year-old, and 17-year-old groups did not differ in attractiveness preferences. There was no main effect of child gender,  $F(1, 378) = 2.26, p = .134, \eta^2 = .004$ , and no interaction between child gender and age group,  $F(5, 378) = 0.38, p = .864, \eta^2 = .004$ .

One sample t tests, comparing proportion of attractive faces chosen to chance (0.5), showed that all groups showed directional preferences for the more attractive faces (see Table 2).

#### 3.2.2. Symmetry

Mean scores and confidence intervals for symmetry preferences are shown in Fig. 2. Relations between age group and symmetry preferences were investigated in a child gender x age group ANOVA.

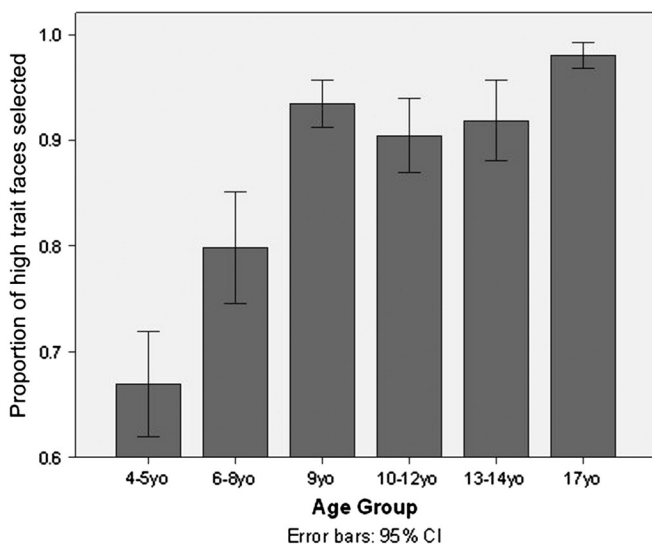


Fig. 1. Age-related changes in the proportion of trials in which the more attractive face was selected.

Table 2

Results of one sample t-tests comparing proportion of high-trait faces selected compared to chance (0.5).

Trait	Child sex	Age group	t	df	d
Attractiveness		4- to 5-years	7.56***	75	0.87
		6- to 8-years	11.44***	69	1.37
		9-years	38.58***	60	4.94
		10- to 12-years	23.36***	57	3.07
		13- to 14-years	22.05***	58	2.87
		17-years	81.85***	65	10.07
Symmetry		4- to 5-years	0.77	75	0.09
		6- to 8-years	2.25*	69	0.27
		9-years	2.80**	60	0.36
		10- to 12-years	4.97***	57	0.65
		13- to 14-years	4.00***	58	0.52
		17-years	9.23***	65	1.13
Averageness		4- to 5-years	1.16	75	0.13
		6- to 8-years	0.34	69	0.04
		9-years	2.59*	60	0.33
		10- to 12-years	0.07	57	0.01
		13- to 14-years	2.00*	58	0.26
		17-years	5.46***	65	0.67
Femininity	Girls	4- to 5-years	0.00	42	0.00
		6- to 8-years	0.15	38	0.02
		9-years	1.40	27	0.26
		10- to 12-years	1.59	27	0.30
		13- to 14-years	0.53	17	0.13
		17-years	4.94***	65	0.78
	Boys	4- to 5-years	0.00	32	0.00
		6- to 8-years	1.29	30	0.23
		9-years	1.30	32	0.23
		10- to 12-years	0.54	29	0.10
		13- to 14-years	0.00	40	0.00
		17-years	0.06	25	0.01
Health	Girls	4- to 5-years	0.21	42	0.03
		6- to 8-years	2.65*	38	0.42
		9-years	2.63*	27	0.50
		10- to 12-years	3.36**	27	0.64
		13- to 14-years	3.33**	17	0.79
		17-years	12.38***	65	1.96
	Boys	4- to 5-years	1.51	32	0.26
		6- to 8-years	2.20*	30	0.40
		9-years	2.82**	32	0.49
		10- to 12-years	2.40**	29	0.44
		13- to 14-years	1.49	40	0.23
		17-years	5.29***	25	1.04

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

There was a main effect of age group on symmetry preferences,  $F(5, 378) = 16.07, p < .001, \eta^2 = .17$ . Post-hoc analyses showed the following significant pairwise comparisons: (a) 10- to 12-year-olds and 13- to 14-year-olds had stronger symmetry preferences than 4- to 5-year-olds and 6- to 8-year-olds ( $ps < .05$ ) (9-year-olds did not differ from any of these groups), and (b) 17-year-olds had stronger preferences than all other groups (all  $ps < .05$ ). There was no main effect of child gender,  $F(1, 378) = 0.47, p = .493, \eta^2 = .001$ , and no interaction between child gender and age group,  $F(5, 378) = 1.55, p = .172, \eta^2 = .02$ .

Table 2 shows the strength of preferences relative to chance (0.5) for the six age groups. As shown in Table 2, 4- to 5-year-olds had no directional preference for symmetry; all groups from 6 to 17 years had a preference for symmetry.

#### 3.2.3. Averageness

Mean scores and confidence intervals for averageness preferences are shown in Fig. 3. Relations between age group and averageness preferences were investigated in a child gender x age group ANOVA. There was a main effect of age group on averageness preferences,  $F(5, 378) = 3.32, p = .003, \eta^2 = .04$ . Post-hoc pairwise comparisons showed that 17-year-olds had stronger averageness preferences

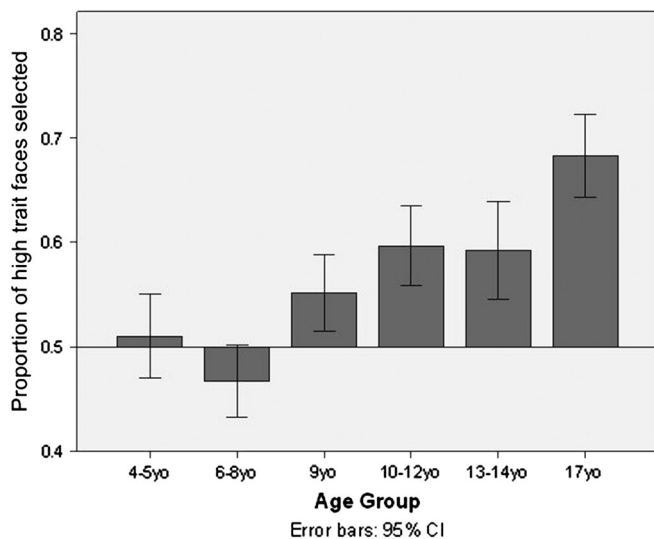


Fig. 2. Age-related changes in the proportion of trials in which the more symmetric face was selected.

compared with 10- to 12-year-olds ( $p = .010$ ), but there were no other significant pairwise contrasts. There was a trend for child gender to be associated with averageness preferences,  $F(1, 378) = 3.37$ ,  $p = .067$ ,  $\eta^2 = .01$ , with girls showing stronger preferences than boys, but no interaction between child gender and age group,  $F(5, 378) = 0.98$ ,  $p = .430$ ,  $\eta^2 = .01$ . Examining the strength of averageness preferences relative to chance, preferences for facial averageness were present in 9-year-olds, 13- to 14-year-olds and 17-year-olds; no other groups differed from chance (see Table 2).

### 3.2.4. Femininity

Mean scores and confidence intervals for femininity preferences are shown in Fig. 4. Relations between age group and femininity preferences were investigated in a child gender x age group ANOVA. There was a main effect of age group on femininity preferences,  $F(5, 378) = 3.09$ ,  $p = .005$ ,  $\eta^2 = .04$ ; there was also a child gender x age group interaction,  $F(1, 378) = 2.54$ ,  $p = .028$ ,  $\eta^2 = .03$ .

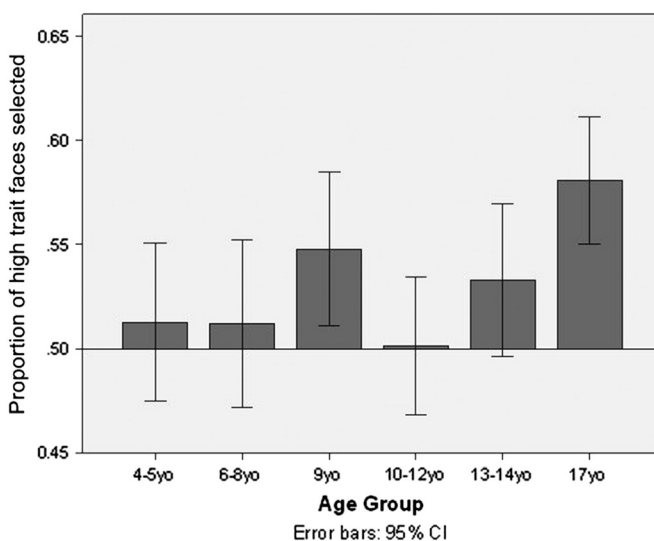


Fig. 3. Age-related changes in the proportion of trials in which the more average face was selected.

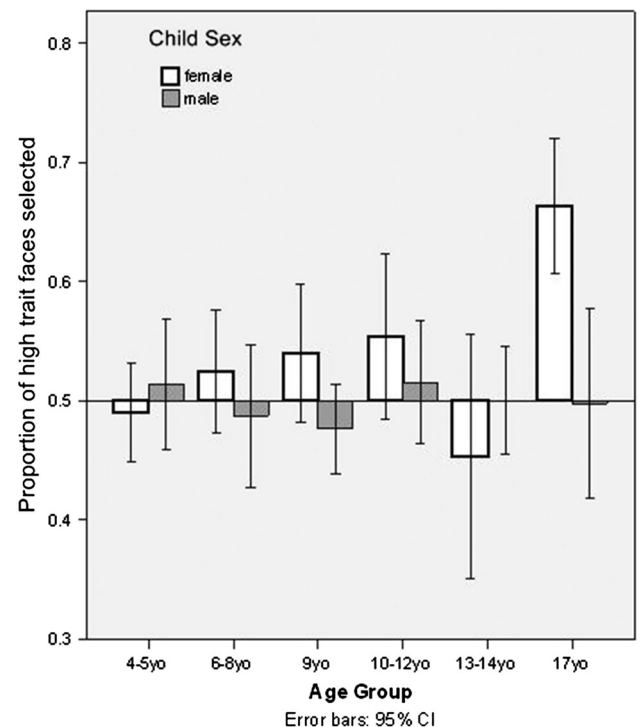


Fig. 4. Age-related changes in the proportion of trials in which the more feminized face was selected by child sex.

To explore this interaction, femininity preferences were analyzed separately for boys and girls. There was a main effect of age group on femininity preferences in girls  $F(5, 190) = 5.36$ ,  $p < .001$ ,  $\eta^2 = .12$ . Post-hoc analyses showed that 17-year-old girls had stronger femininity preferences than 4- to 5-year-old, 6- to 8-year-old, and 13- to 14-year-old girls ( $ps < .05$ ). The 9-year-olds and 10- to 12-year-olds did not differ from the other groups. There was no main effect of age group on boys' femininity preferences,  $F(5, 188) = 0.43$ ,  $p = .830$ ,  $\eta^2 = .01$ . One sample t-tests to compare preferences to chance showed that 17-year-old girls were the only participants to show a preference for femininity in faces (see Table 2).

### 3.2.5. Health

Mean scores and confidence intervals for health preferences are shown in Fig. 5. Relations between age group and health preferences were investigated in a child gender x age group ANOVA. There was a main effect of age group on preferences,  $F(5, 378) = 13.28$ ,  $p < .001$ ,  $\eta^2 = .14$ ; there was also a child gender x age group interaction,  $F(1, 378) = 2.94$ ,  $p < .001$ ,  $\eta^2 = .04$ .

To explore this interaction, health preferences were analyzed separately for boys and girls. There was a main effect of age group on health preferences in girls  $F(5, 190) = 18.06$ ,  $p < .001$ ,  $\eta^2 = .32$ . Post-hoc analyses showed the following significant pairwise comparisons: (a) 10- to 12-year-old girls had stronger health preferences compared to 4- to 5-year-olds ( $p = .012$ ), and (b) 17-year-old girls had stronger health preferences than all of the younger age groups (all  $ps < .05$ ). There was no main effect of age group on boys' health preferences,  $F(5, 188) = 1.75$ ,  $p = .126$ ,  $\eta^2 = .04$ .

One sample t-tests to compare preferences to chance showed that in girls, there was no preference for health in 4- to 5-year-olds, and a preference for health in all of the older age groups of girls (see Table 2). In boys, there was a non-significant trend toward health preferences in 4- to 5-year-olds, and a preference in all of the older groups with the exception of 13- to 14-year-old boys, who showed no health preference (see Table 2).

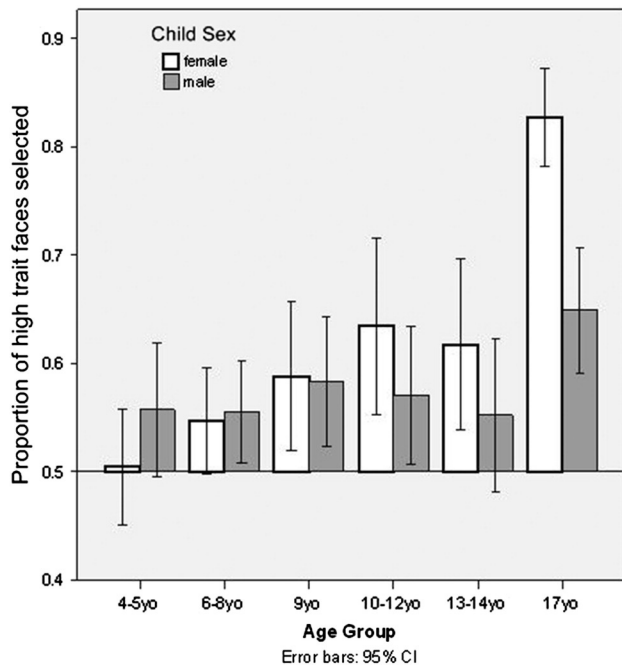


Fig. 5. Age-related changes in the proportion of trials in which the more healthy face was selected by child sex.

### 3.3. Relations between pubertal development and facial preferences

In order to consider the effects of puberty on the development of facial preferences, ANOVAs were repeated for participants aged 9- to 14-years with puberty stage instead of age group as a between subjects factor. Because age and puberty stage were confounded even in this limited range ( $r = .7$ ) it was not possible to enter age as a covariate as this would violate the assumptions of ANCOVA and entering age group as a factor would have led to some empty cells. Therefore we assessed again whether age group predicted preferences in this limited sample using child sex  $\times$  age group ANOVAs and found no main effects or interactions except one borderline association between age group and health preferences,  $F(2,170) = 2.43$ ,  $p = .09$ , all other  $F$ s  $< 2.8$ , all  $p > .1$ . It was therefore considered appropriate to leave age out of the puberty analyses completely; thus the following section reports ANOVAs using only puberty group and sex of child as IVs. Mean scores and confidence intervals for all tests are shown in Fig. 6.

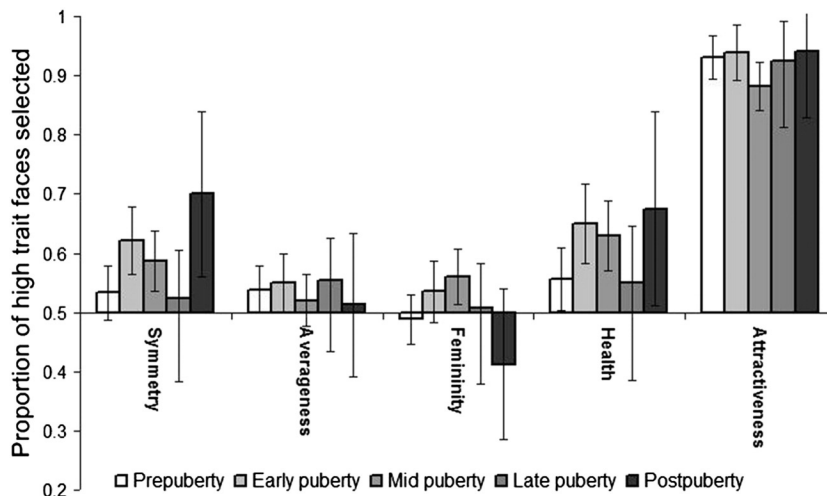


Fig. 6. Puberty-related changes in the proportion of trials in which high-trait faces were selected.

### 3.3.1. Attractiveness and averageness

Relations between puberty stage and attractiveness/averageness preferences were investigated in separate child gender  $\times$  puberty stage ANOVAs. There were no main effects and no interaction (all  $F$ s  $< 1.1$ ,  $p$ s  $> .1$ ).

### 3.3.2. Symmetry

Relations between puberty stage and symmetry preference were investigated in a child gender  $\times$  puberty stage ANOVA. As the means in Fig. 6 demonstrate, there was a main effect of puberty on symmetry preferences,  $F(4, 139) = 2.59$ ,  $p < .05$ ,  $\eta^2 = .07$ , such that pre-pubertal children had marginally weaker symmetry preferences compared with early-pubertal children (Tukey's  $p = .098$ ). There was no effect of child gender on preferences for symmetry in this analysis and no interaction (both  $F$ s  $< 2.7$ ,  $p$ s  $> 0.1$ ).

### 3.3.3. Femininity

Relations between puberty stage and femininity preference were investigated in a child gender  $\times$  puberty stage ANOVA. There was a trend for a main effect of pubertal stage on femininity preferences,  $F(4, 139) = 2.25$ ,  $p = .07$ ,  $\eta^2 = .06$ . Although post-hoc tests could not identify which groups differed from each other, observation of the means and confidence intervals (see Fig. 6) would suggest that the main effect was driven by the mid-puberty children having stronger preferences for feminine faces than the pre-pubertal or post-pubertal children. There was no effect of child gender on preferences and no interaction (both  $F$ s  $< 1.2$ ,  $p$ s  $> 0.1$ ).

### 3.3.4. Health

Relations between puberty stage and health preference were investigated in a child gender  $\times$  puberty stage ANOVA. Girls preferred healthy looking faces more than did boys,  $F(1, 139) = 4.63$ ,  $p = .015$ ,  $\eta^2 = 0.03$ , but there was no effect of puberty stage on preferences and no interaction (both  $F$ s  $< 1.8$ ,  $p$ s  $> 0.1$ ).

## 4. Discussion

The present study aimed to describe the emergence across childhood of preferences for specific facial traits associated with attractiveness (symmetry, averageness, femininity, health), and to examine whether puberty was a potential causal factor in the development of preferences for these facial traits.

Our results showed that there was a main effect of age group on preferences for global attractiveness and the four individual facial traits. The youngest children (aged 4 and 5 years) did not show a

preference for any of the four facial traits studied here, although they did prefer faces that were judged by adults to be globally attractive. These findings thus replicate previous research indicating that preferences for naturally varying faces considered globally attractive by adults exist from an early age (Cavior & Lombardi, 1973; Cross & Cross, 1971; Kissler & Bauml, 2000; Slater et al., 1998); indeed, our results showed that preferences for global attractiveness approached ceiling by age 9. Preferences for facial health first emerged at age 6 to 8, followed by symmetry and averageness preferences at age 9. Preferences for all three of these traits then plateaued or dipped between 10 to 14 years before increasing markedly at age 17. In contrast, preferences for facial femininity were seen only in the oldest age group (17-year-olds) and then specifically in girls (who preferred feminized faces of both sexes, as seen in Perrett et al., 1998).

With reference to facial preferences associated with puberty, the youngest 4- to 5-year-olds (who would be at floor level for all pubertal hormones) did not show preferences for any individual facial trait. By 9 years of age, a time at which DHEA levels would have increased substantially, children were showing preferences for three of the four individual facial traits (symmetry, averageness, health). However, when the sample was restricted to children likely to be experiencing puberty (amongst whom age did not affect preferences), and puberty stage was used as the independent variable, the findings were considerably more equivocal. There was a main effect of puberty stage only on children's symmetry preferences, with pre-pubertal children showing marginally weaker symmetry preferences compared with post-pubertal children. The only other finding in relation to pubertal development was a marginally significant main effect of puberty stage on children's femininity preferences, but for this effect, the late puberty and post-puberty groups did not show the characteristic preference for feminized faces seen in adults (see Fig. 6), with femininity preferences peaking in the mid-puberty group. These findings partially replicate those of Saxton et al. (2010), who reported that pubertal development related to children's symmetry preferences but not to their preferences for averageness or femininity, in a sample of children with a narrower age range.

With regard to our hypothesis that facial preferences may exhibit disruption around mid puberty, although the puberty analyses did not show any significant group differences, the pattern of means is consistent with a mid/late puberty dip for symmetry and health preferences in particular. Moreover, the age group analyses show clear evidence of a plateau or dip in preferences around the ages of 10- to 14-years which is consistent with the evidence regarding the developmental dip in face recognition performance. As such, our age-based analyses are compatible with the proposition that specific facial preferences are part of a suite of mating-related cognitions which are perhaps facilitated by early pubertal hormone release, but then disrupted and constrained during the main period of pubertal change when, as Scherf et al. (2012) suggest, the brain is experiencing significant recalibration of reproductively relevant networks.

Of course, a definitive understanding of the relation between pubertal development and facial preferences can only be obtained by directly assessing hormonal levels. The next step is thus to assay hormones such as DHEA, testosterone, and oestrogen and investigate how actual hormonal production relates to children's preferences for specific facial traits. Future research should also assess children's own experience of sexual attractions, and use facial stimuli created from faces of peers rather than adults (as in Saxton et al., 2010) in order to investigate whether the emergence of facial preferences is linked to the onset of interest in potential sexual relationships. It would also be interesting to include assessments of children's general face recognition and face processing abilities to explore their relations with facial preferences. Such studies would provide a rigorous test of the evolutionary account and enable potential mediating and moderating effects of pubertal development on children's facial processing to be explored. Furthermore, it must be acknowledged that all our stimuli

were adult faces and as such (except for our 17-year-olds) even those participants who were starting to feel sexual attraction were unlikely to consider our stimuli faces as potential romantic partners. While we felt it was essential to keep stimuli the same across all participants, and indeed changing the stimuli to match the participant age group has produced partial confounds in other studies (see Saxton et al., 2010), our results only pertain to how children develop preferences for traits in adult faces. Further research to investigate age-related changes in preferences for traits associated with attractiveness in both adult and peer faces would thus be worthwhile.

A final point worthy of further discussion is the fact that a femininity preference emerged only in our late adolescence/adult group, and was observed only in girls. To account for its late emergence, future research could explore whether detecting femininity variations is more difficult than identifying differences in other facial traits.

In summary, the results of the present study show that preferences for specific facial traits that adults deem attractive are not present in early childhood and develop in an apparently non-linear manner which is consistent with the proposition that early adrenal hormones may facilitate the activation of specific facial preferences.

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