Vocal and Facial Attractiveness Judgments of Children, Adolescents and Adults: the Ontogeny of Mate Choice

Tamsin K. Saxton*, Peter G. Caryl† & S. Craig Roberts*

* School of Biological Sciences, University of Liverpool, Liverpool, UK
† Department of Psychology, PPLS, University of Edinburgh, Edinburgh, UK

Correspondence
Tamsin K. Saxton, School of Biological Sciences, University of Liverpool, Biosciences Building, Crown Street, Liverpool L69 7ZB, UK.
E-mail: tamsin.saxton@liverpool.ac.uk

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Abstract

Physical traits are thought to be used as indicators of mate quality, allowing individuals to select mates most likely to help them bear the fittest offspring. As the capacity for human sexual behaviour emerges at puberty, we investigated whether adult-like judgments of the relative attractiveness of opposite-sex individuals also arise at puberty. Following previous research, we focussed on facial and vocal attractiveness, which are known to be used in human mate choice and to carry concordant information regarding mate quality. Here we show that males with more attractive faces have more attractive voices as judged by female adults and adolescents, but not by female children. This suggests that cues of facial and vocal attractiveness provide similar information, but that awareness of these cues does not develop fully until reproductive capability, when mate choice judgments become relevant. Adolescents' judgments also mirrored those of adults in that, like adults, they preferred lower-pitched male voices, and as a group made concordant judgments about facial attractiveness. However, they did not make similarly concordant judgments about vocal attractiveness, suggesting that a further period of maturation and learning is required to fully develop optimal judgments for mate choice.

Introduction

The theory that human physical attraction enables adaptive mate choice behaviour is now well-established (for reviews see Grammer et al. 2003; Rhodes 2006). Amongst other ideas, two important themes have emerged. First, attractiveness is to an extent objective: people tend to agree on the relative attractiveness of different body shapes (Singh & Luis 1995; Furnham et al. 1997), body odours (Rikowski & Grammer 1999; Thornhill & Gangestad 1999), voices (Feinberg et al. 2005a), and faces (Langlois et al. 2000; Little & Perrett 2002; Roberts et al. 2005a). Secondly, different traits provide concordant information even across different modalities, suggesting that common elements underpin the various indicators of mate quality. For example, we find correlations between body scent and facial attractiveness in both sexes (Thornhill & Gangestad 1999), and between facial and bodily attractiveness in females (Thornhill & Grammer 1999). Indeed, research in many different animal species has found that concordant signals may be sent through a range of modalities and lead to better signal decoding (Møller & Pomiankowski 1993; Rowe 1999).

This study is concerned with judgments of male facial and vocal attractiveness, both of which correlate with mating success as measured by number of sexual partners (Hughes et al. 2004; Rhodes et al. 2005). Cross-modal signal concordance involving vocal attractiveness has previously been demonstrated, and predicts body attractiveness in both sexes (Hughes et al. 2004) and facial attractiveness in females (Collins & Missing 2003). In males, concordance between facial and vocal characteristics could be mediated by underlying levels of testosterone,

which are often attractive to females (Penton-Voak et al. 1999; Johnston et al. 2001). Testosterone markers may constitute honest signals of immunocompetence and hence denote genetic quality (Zahavi 1975; Folstad & Karter 1992) or correlate with dominance (Mazur & Booth 1998), which in turn give rise to both direct and indirect benefits to the female and her offspring. Testosterone indicators in the face include broad chins and heavy brows; in the voice, pitch deepens under the influence of testosterone on the growth of the vocal folds in later stages of puberty (review in Feinberg et al. 2005b), and a deeper pitch correlates with higher current testosterone levels (Dabbs & Mallinger 1999). Low voice pitch is a secondary sexual character cueing mate value (Feinberg et al. 2005b), and adult females prefer lower-pitched voices (Collins 2000; Feinberg et al. 2005b).

During maturation, if children are to develop adult-like judgments to enable them to select suitable mates, then not only must any heritable predisposition begin to affect actual mate choice behaviour, but they must also develop the ability to ascribe appropriate weightings to all relevant indicators. As processing of mate-choice information in two different modalities requires a certain degree of sophistication, the investigation of face-voice attractiveness judgments seems appropriate to begin to examine the ontogeny of mate preferences.

Connolly et al. (2004) outlined three distinct ontogenetic models for the development of adult-type reactions to stimuli associated with sexual behaviour. The finding of one or another of these models has the potential to inform us on the extent to which physical attraction relates solely to mate choice, and on the interaction between the ontogenetic program and the learning process. First, adult-like preferences might be apparent (and, by necessity, influence behaviour) from an early age. In this regard, neonates and infants spend longer looking at faces which adults gauge to be more attractive (Langlois et al. 1991). If there is no difference between attractiveness judgments made by adults and those made by pre-reproductive children, theories which relate physical attraction solely to mating behaviours would need to be viewed with caution. A more general interpretation of physical attraction, for instance, suggests that it could be adaptive to identify fitness indicators in others in order to identify social allies or sexual competitors (Thornhill & Grammer 1999).

A second ontogenetic model is that the ability to make adult-like judgments arises gradually during childhood and adolescence, not reaching completion until adulthood. This finding would highlight the importance of a renewed focus on the role of learning in adult-like mate choice behaviour. Finally, a third developmental model is that of punctuated development, where adult-like preferences emerge at a particular developmental stage, such as puberty, coincident with the sexual dimorphisms which provoke sexual attraction. Sexual attraction appears to be mediated by changing levels of hormones, and so sufferers of precocious puberty exhibit mature sexual responses from a very early age (Thamdrup 1961; Ehrhardt & Meyer-Bahlburg 1994). Even if children have some awareness of relative attractiveness, we might expect preferences to shift at puberty as mate choice factors enter into play. Certainly, the variation in female preference that coincides with the menstrual cycle (Gangestad & Thornhill 1998; Penton-Voak et al. 1999; Havlicek et al. 2005; Feinberg et al. 2006) cannot be manifest in pre-menarchal children. Temporal coincidence of sexual ability and sexual attraction would be indicative of the adaptationist theory that preferences have been designed primarily to gauge potential mates.

In this study, female children, adolescents and adults were asked to rate the relative attractiveness of the faces and voices of various males. We used adult judgments as a baseline to compare with the younger age groups in three different comparisons. First, we measured the extent to which each of the age groups exhibited concordant preferences (i.e. inter-rater reliability) for faces and voices. Secondly, we examined cross-modal concordancy by examining the correlations between facial and vocal attractiveness of each male, for each age group. Finally, we assessed the degree to which vocal attractiveness ratings in each group correlated with voice pitch.

Methods

Male Stimuli

Twelve Caucasian males, all native English speakers aged 23 yr 8 mo to 28 yr 2 mo (mean age 26 yr 2 mo) were recruited from social contacts. Each was photographed head-on, with a neutral expression, using a Canon PowerShot A95 digital camera (Canon, Tokyo, Japan). No subject wore visible jewellery or spectacles, or possessed extensive facial hair or other unusual features. Subjects were also recorded counting from one to five on a Sony (Sony, Tokyo, Japan) MZ-N710 portable mini disc player using a Sony ECM-MS907 microphone held approx.

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30 cm from the speaker's mouth while he was standing (Sony, Tokyo, Japan). No subject smoked more than 10 cigarettes per week, or had colds or other conditions which could affect his voice. Body mass index (BMI) was calculated from self-reported height and mass, varying between 20.4 and 26.1 ($\bar{x} = 23.3$; 'ideal' or just 'overweight' according to current World Health Organization recommendations). Each subject provided full and informed consent to experimental use of his photograph and voice recording.

Photographs were cropped to an oval shape which retained information about hairline, chin and ears while concealing most of the hairstyle and clothing, and rotated and resized such that the pupils were horizontal and 310 pixels apart using Paint Shop Pro (Corel Corporation, Ottawa, Canada). Voice recordings were manipulated using Cool Edit Pro (Adobe Systems Incorporated, San Jose, CA, USA), such that numbers were recited at a rate of one per second, and normalized for amplitude using ch_wave audio file manipulation (Edinburgh Speech Tools Library, http://www.cstr.inf.ed.ac.uk/projects/speech_tools/manual-1.2.0/x444.htm) in PRAAT (version 4.1.9, P. Boersma & D. Weenick, http://www.praat.org). Each vocal stimulus consisted of the counting set from one to four; 'five' was excluded to avoid list-final intonation. An approximate index of the pitch of each sample was determined by gauging the average fundamental frequency of the vowel sound of the spoken word 'two' with the automatic measurement function of the speech analysis and synthesis program PRAAT. The word 'two' was chosen as it was pronounced with consistent intonation in all samples, and avoided any list-initial intonation. The pitches we measured ranged from 105 to 155 Hz; typical male voice pitch ranges from 110–130 Hz, although a pitch falling somewhere within the range 85–155 Hz is not abnormal.

Ratings by Females

Female raters were recruited from amongst visitors to the Museum of Scotland, members of two Hampshire-based packs of Girl Guides, and via social contacts. Either informed or parental consent was obtained, as appropriate. The male photographs and voice recordings were presented in pairs in a PowerPoint presentation (Microsoft Corporation). Each face was presented in a pair with every other face, such that the faces were presented in an approximately even distribution either twice on the left (and three times on the right), or vice versa. Voices were presented in the same way. We used this pairwise comparison system rather than rating individual stimuli to facilitate the task for the younger participants. The female raters (i) indicated which was the more attractive of each pair, and (ii) stated whether it was 'Only a tiny bit more attractive', 'A little bit more attractive', 'More attractive' or 'Much more attractive'. In order to avoid overtaxing the youngest raters, females rated one of two stimulus sets ('set 1' and 'set 2'), each of which included six male faces and voices. The female raters were told that they would be asked to rate the attractiveness of a series of male faces and voices, but not that the faces and voices belonged to the same set of men. They were instructed to complete a paper-based rating sheet as they followed the presentation, and to withdraw from the task if they recognized any male.

Female raters were divided into three age groups on the basis of normal physical and hormonal developmental stages. A previous survey of over 1000 girls of predominantly European ethnicity found that average age of menarche is 12 yr 11 mo with a small standard deviation: menarche had taken place by the 10th birthday for 0.8% of girls, by the 11th birthday for 3.6%, and by the 12th birthday for 21.7% (Whincup et al. 2001). However, first sexual attraction may arise prior to menarche at adrenarche, some time after the 10th birthday (see McClintock & Herdt 1996 for overview). Consequently, those aged 7–10 were allocated to the 'child' age group (set 1: $\bar{x} = 8$ yr 4 mo, $\sigma = 1$ yr 1 mo; set 2: $\bar{x} = 8$ yr 11 mo, $\sigma = 1$ yr 2 mo); those aged 12–15, the 'adolescent' group (set 1: $\bar{x} = 13$ yr 8 mo, $\sigma = 1$ yr 2 mo; set 2: $\bar{x} = 13$ yr 8 mo, $\sigma = 1$ yr 3 mo); those aged 20–34, the 'adult' group (set 1: $\bar{x} = 26$ yr 2 mo, $\sigma = 3$ yr 9 mo; set 2: $\bar{x} = 25$ yr 7 mo, $\sigma = 3$ yr 10 mo).

Before the task began, participants rated pairs of cartoon faces as practice and to confirm that they had correctly understood the task. These cartoons had been selected so we could reliably predict which should normally be chosen as more attractive (40 of 44 adults agreed on both pairs). Any female (including the four adults) who did not make these judgments was excluded. Data collection continued until results from 120 females (40 children, 40 adolescents and 40 adults), following these exclusions, had been obtained. For each age group, 20 females rated stimulus set 1, and 20 rated set 2.

Statistical Analyses

The rating scale allowed conversion to a numerical score by allocating four points if a face or voice was

rated 'Much more attractive', three points if 'More attractive', two points if 'A little more attractive' and one point if 'Only a tiny bit more attractive'. Each face was rated five times, once against each of the other five faces, resulting in a 21-point scale ranging from 20 to zero points. To illustrate, a face rated 'More attractive' (three points) for one comparison, and 'Only a tiny bit more attractive' (one point) for the remaining four comparisons, would receive $(3 \times 1) + (1 \times 4) = 7$ points.

Both correlational analysis of voice pitch and attractiveness, and also vocal and facial attractiveness, were one-tailed, as similar correlations have previously been demonstrated in adults (Collins 2000; Collins & Missing 2003; Feinberg et al. 2005b) and as such our primary aim was to compare the development of these correlations across groups, rather than test whether the correlation occurred. All analyses were conducted with SPSS version 12 (SPSS Inc., Chicago, IL, USA) and fulfil the requirements of the statistical tests used.

Results

The data from stimulus sets 1 and 2 were combined for analysis where possible because an independent-samples t-test indicated that there were no significant differences between the mean rating given by each female to each set (faces: $t_{118} = -0.702$, $p = 0.484$; voices: $t_{118} = 1.847$, $p = 0.067$). Initial correlational analysis of mean attractiveness ratings suggested that all age groups tended to select the same sorts of faces as more attractive (adults/adolescents: $r = 0.902$, $p < 0.001$; adults/children: $r = 0.892$, $p < 0.001$). In contrast, while vocal attractiveness ratings of adults correlated significantly with those of adolescents ($r = 0.870$, $p < 0.001$), this pattern was not found in comparing adults with children ($r = -0.234$, $p = 0.463$).

Concordance within Age Group

We examined the extent to which the raters of an age group agreed with the ratings given by the other members of the same group (Table 1). All age groups were significantly concordant in their judgments of facial attractiveness, although the coefficient of concordance increased with age. In contrast, while the coefficient of concordance for voice ratings was significant for all age groups, the child and adolescent age groups showed a similar, and much lower, concordance than the adults.

Table 1: Inter-rater reliability of attractiveness judgments, by age group. Values of *W* (Kendall's coefficient of concordance) denote the extent of agreement between the 20 members of each age group within each stimulus set in rating faces and voices of male stimuli for attractiveness.

		Coefficient of concordance (*W*)	
	n	Faces	Voices
Set 1			
Children	20	0.356**	0.121*
Adolescents	20	0.437**	0.146*
Adults	20	0.661**	0.629**
Set 2			
Children	20	0.274**	0.180**
Adolescents	20	0.424**	0.167**
Adults	20	0.532**	0.406**

*p = < 0.05; **p = < 0.01 [Correction added after publication 10 November 2006: in the preceding footnote, *p = < 0.5; **p = < 0.1 was corrected to *p = < 0.05; **p = < 0.01].

Cross-Modal Concordance

We compared the mean facial attractiveness rating awarded to each male by all members of each age group with his mean vocal attractiveness ratings

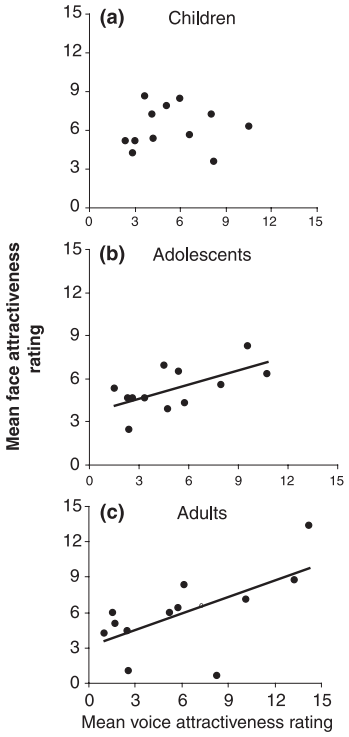

Fig. 1: Relationships between mean voice and face attractiveness ratings awarded by (a) children (b) adolescents and (c) adults. Each data point represents one male and is calculated from the average ratings of 20 female raters. Only the ratings given by the adolescent and adult age groups give rise to a significant correlation

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(Fig. 1). The mean attractiveness rating of a male face correlated positively with the mean rating of his voice as judged both by adults ($r = 0.630$, $p = 0.014$, $n = 12$, one-tailed) and adolescents ($r = 0.620$, $p = 0.016$, $n = 12$, one-tailed) but not by children ($r = 0.040$, $p = 0.451$, $n = 12$, one-tailed).

We sought to determine whether there were statistically significant differences between the age groups in terms of their ability to ascribe similar attractiveness judgments across the two modalities of face and voice. To do this, we first calculated the correlation between male facial and vocal attractiveness (Pearson's correlation coefficient) on a participant-by-participant basis, giving 40 correlations per age group (cf. Lorch & Myers 1990, pp. 152–153, for regression equations). Single-sample t-tests showed that these sets of correlations differed reliably from zero in both the adults (mean individual $r = 0.361$, $t_{39} = 6.097$, $p < 0.01$) and adolescents (mean individual $r = 0.284$, $t_{39} = 4.467$, $p < 0.01$), but not in the children (mean individual $r = 0.030$, $t_{39} = 0.394$, $p = 0.696$). We confirmed the differences in correlation between the three age groups using a one-way ANOVA ($F_{2,117} = 6.8$, $p < 0.01$). Planned orthogonal contrasts revealed that the set of correlations derived from the children's ratings differed significantly from adults/adolescents ($t_{117} = -3.595$, $p < 0.01$), while there was no significant difference between adults and adolescents ($t_{117} = 0.823$, $p = 0.412$). In other words, it seems that both adults and adolescents are able to use either face or voice signals to tune into cues of male quality, as their ratings of a male concur. In contrast, children appear not to be able to use face and voice signals equally well to detect underlying male quality, and so the average correlation between a male's face and voice attractiveness does not differ significantly from zero for the children's judgments.

Voice Attractiveness and Pitch

We tested whether lower pitch of voice correlated with enhanced attractiveness ratings in the judgments of each age group. We found that lower pitched voices were judged significantly more attractive by the adults ($r = -0.569$, $p = 0.027$, $n = 12$, one-tailed) and adolescents ($r = -0.627$, $p = 0.015$, $n = 12$, one-tailed) but not the children, who showed a non-significant tendency to prefer higher-pitched voices ($r = 0.210$, $p = 0.257$, $n = 12$, one-tailed). We again tested directly for differences between age groups by comparing sets of correlation coefficients (Pearson's r, $n = 40$ per age group) for vocal attractiveness and pitch. One-way ANOVA revealed significant differences between the age groups ($F_{2,117} = 15.327$, $p < 0.001$), and single-sample t-tests showed that the adults' and adolescents' ratings, but not those of the children, differed significantly from zero (children: $t_{39} = 1.307$, $p = 0.199$; adolescents: $t_{39} = -3.057$, $p < 0.01$; adults: $t_{39} = -10.48$, $p < 0.001$). Planned orthogonal contrasts revealed that the set of correlation coefficients derived from the children's ratings were significantly lower than those of the adults/adolescents ($t_{64.7} = -4.879$, $p < 0.01$) and also that the adults showed a stronger preference of marginal significance for lower-pitched voices compared with the adolescents ($t_{57.9} = -2.023$, $p = 0.048$).

Discussion

Our results on adult female judgments are consistent with findings from previous studies (eg Collins 2000; Langlois et al. 2000; Collins & Missing 2003; Feinberg et al. 2005a,b; see Introduction for full discussion). Specifically, we found that adults as a group were strongly concordant in their judgments of the relative attractiveness of specific male faces and voices (Langlois et al. 2000), their judgments revealed cross-modal correlations between vocal and facial attractiveness (Collins & Missing 2003; Feinberg et al. 2005a), and they demonstrated a preference for lower-pitched male voices (Collins 2000; Feinberg et al. 2005b). As these findings appear robust and representative, we proceeded to compare them with judgments of children and adolescents.

The children, like the older age groups, tended to agree with each other about which faces were the most attractive (although within-group concordance was not as strong as in adolescents or adults), and their average rating of each face correlated with those of the adults. The within-group concordance of their facial attractiveness judgments is perhaps not surprising, as facial attractiveness may correspond with traits other than mate value, and appears to influence many aspects of social interaction; even in childhood, attractive children are treated and behave differently (overview in Langlois et al. 2000). The concordance of facial attractiveness judgments also indicates that the task was not prohibitively difficult for child participants. In contrast, unlike adults, children did not pick out the voices and faces of the same men as being the most attractive. They showed lower concordance in vocal attractiveness judgments relative to the other age groups, did not select the same voices as adults as the most

attractive, and did not prefer lower pitch in voices. Together, these results suggest that female children of pre-reproductive years have some form of accessible internal scale for adult male facial attractiveness, but a more rudimentary scale in relation to adult male vocal attractiveness, and that they are not especially attuned to cues of mate value.

In comparison, the adolescents appeared more adult-like in their judgments. Adolescents' judgments of facial attractiveness were more concordant than those of the children (although not as concordant as the adults), and their ratings of the male faces correlated with those given by the adults. The main difference between adolescent and adult judgments was that adolescents showed a lower within-group concordance on vocal attractiveness ratings, of an order similar to the children, although adolescent ratings of male vocal attractiveness correlated significantly with those of adults. In common with the adults, adolescents tended to prefer the voices of the men whose faces they rated more highly. This is consistent with the idea that both vocal and facial attractiveness derive from the same underlying 'quality' and contain similar sorts of cues (Collins & Missing 2003), and that these cues can be recognized by both adolescents and adults. Again, like the adult age group, adolescents preferred the lower-pitched voices (although to a lesser extent than the adults), replicating previous research on female preference for low pitch (Collins 2000; Feinberg et al. 2005b). Taken together, the discrepancies between the adolescents' and the adults' judgments imply that a period of maturation and learning may be required subsequent to the main hormonal changes of development (adrenarche and menarche) in order to fully develop optimal judgments for mate choice.

Whereas previous studies on vocal attractiveness have used vowel sounds alone to form the vocal stimuli, the current study used a series of numbers, so as not to bewilder the younger participants. As our vocal stimuli contained a wider range of phonemes than vowel sounds, they may have presented more information about individual variation in intonation, articulation or accent, information which is unavoidable in the ethological context. Thus, it appears that pitch of voice remains a predictor of attractiveness within a 'noisier' signal. If, as hypothesized, low voice pitch is a sexually selected character (Collins 2000), then it necessarily must be salient even within such a noisy signal.

One potential confounding factor within this study was the variation in similarity between age of rater and age of male stimuli, which was greatest for the adult age group and decreased progressively for the adolescents and children. Individuals might be better equipped to interpret attractiveness cues from their age-matched peers. A similar study on the ability to recognize the specific cues identified as bearing on attractiveness while using age-matched stimuli would address this. Further research is also required to determine what information can be derived by the evaluation of facial and vocal attractiveness, and whether it can indicate different aspects of mate value or forms a set of redundant signals; female ratings of male facial attractiveness have been found to interact with both absolute and relative aspects of their genetic make-up (Roberts et al. 2005a,b).

Our results suggest that adult-like attractiveness judgments (and especially vocal attractiveness judgments) are not apparent in children, and thus do not support the first model of development described by Connolly et al. (2004). Their survey of preferences of 6- to 17-yr-olds for different waist-to-hip ratios and BMI found some evidence for punctuated development, but preferred to conclude by supporting a linear development model. We are not aware of any other research to distinguish between these models. Further work to better clarify the ontogeny of mate choice and distinguish between punctuated or linear development is therefore recommended.

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