
The role of facial attractiveness and facial masculinity/femininity in sex classification of faces

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Abstract. We tested whether adults (experiment 1) and 4–5-year-old children (experiment 2) identify the sex of highly attractive faces faster and more accurately than not very attractive faces in a reaction-time task. We also assessed whether facial masculinity/femininity facilitated identification of sex. Results showed that attractiveness facilitated adults' sex classification of both female and male faces and children's sex classification of female, but not male, faces. Moreover, attractiveness affected the speed and accuracy of sex classification independently of masculinity/femininity. High masculinity in male faces, but not high femininity in female faces, also facilitated sex classification for both adults and children. These findings provide important new data on how the facial cues of attractiveness and masculinity/femininity contribute to the task of sex classification and provide evidence for developmental differences in how adults and children use these cues. Additionally, these findings provide support for Langlois and Roggman's (1990 *Psychological Science* 1 115–121) averageness theory of attractiveness.

1 Introduction

How do we identify the sex of faces? Although anthropological and experimental research shows that adult male and female faces clearly differ on many characteristics including eyes, nose size and shape, brow prominence, face shape, skin texture, and hair length, no one of these features can be used to discriminate reliably between females and males (Brown and Perrett 1993; Bruce et al 1993; Enlow 1982; Intons-Peterson 1988; Roberts and Bruce 1988; Yamaguchi et al 1995). Rather, the entire pattern or configuration of the face seems to be more important than individual features alone in the identification of sex (Brown and Perrett 1993; Burton et al 1993; Campanella et al 2001; Wild et al 2000).

What information might aid in the identification of faces in general and sex of face in particular? One possibility is how attractive a face appears. Even young infants look longer at attractive than at unattractive Caucasian female faces, and these visual preferences generalize to female faces of other ethnic groups and infant faces, although evidence for visual preferences for male faces is mixed (Langlois et al 1987, 1991, 2000; Ramsey 2003; Samuels and Ewy 1985). Averageness theory proposes that attractive faces represent the central tendency of the population from which they are drawn: they are average in facial configuration (although not in attractiveness), they are prototypic, and, therefore, they are better examples of faces and thus preferred (Langlois and Roggman 1990; Langlois et al 1994; Rhodes and Tremewan 1996; Rhodes et al 1999, 2003; Rubenstein et al 2002). Other theories of attractiveness posit that faces that are symmetrical or that include large features (eg large eyes and lips for females) are the most attractive (eg Grammer and Thornhill 1994; Perrett et al 1994); these theories, however, are based on studies with significant methodological shortcomings and, unlike averageness, are neither necessary nor sufficient to explain attractiveness (Langlois et al 1994; Rhodes et al 1999; Rhodes and Tremewan 1996; Rubenstein et al 2002).

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If attractive faces are prototypic, they should be easier than unattractive faces to recognize and classify as being faces, because they can be compared with a prototype quickly and efficiently (Johnston and Ellis 1995). By the same logic, attractive faces should be easier than unattractive faces to classify as being male or female. Indeed, O'Toole et al (1998) found that facial attractiveness information facilitates adults' sex classification in that adults rated faces that previously had their respective sex identified quickly as more attractive than faces which had their respective sex identified more slowly.

Several lines of evidence suggest that attractive faces are treated as prototypes. Adults rate attractive faces as more typical in appearance and classify typical faces as faces more quickly than atypical or distinctive faces in face processing tasks (eg Light et al 1981; Valentine and Bruce 1986; Vokey and Read 1992). Infants look longer at averaged female faces (composite faces made by averaging together 32 individual faces) than at unattractive female faces and can abstract a prototype female face from exposure to exemplar female faces (Rubenstein et al 1999). Furthermore, infants treat a prototype (averaged) female face as familiar even though they have not seen it prior to testing (de Haan et al 2001; Rubenstein et al 1999; Walton and Bower 1993). Because averageness theory predicts that attractive faces are better examples of faces, a crucial test of the usefulness of averageness theory for social categorization would be to determine whether attractive, or prototypical, faces are more quickly and accurately classified as male or female than unattractive faces. If so, then the importance of averageness theory could be extended: attractive faces are not only liked because they are better examples of face categories in general, but also because they are better examples of male and female face categories specifically and, therefore, require less processing time in a sex classification task. The primary purpose of the following studies was to investigate the hypothesis that facial attractiveness facilitates quick and accurate identification of sex.

Facial information other than attractiveness also may be important for sex classification of faces. One type of facial information likely to facilitate sex classification is masculinity or femininity of facial appearance (Bruce et al 1987; O'Toole et al 1998). It is important to examine the influence of facial masculinity and femininity on sex classification independently of the influence of facial attractiveness for several reasons. First, attractive male faces are not always perceived as being highly masculine, whereas attractive female faces generally are perceived as being highly feminine (O'Toole et al 1998; Perrett et al 1998; Rhodes et al 2000). Bronstad et al (2002) found that, with repeated random sampling of 147 female faces and 150 male faces, the correlation between attractiveness and femininity in female faces was relatively high and consistent (average $r = 0.70$), whereas the correlation between attractiveness and masculinity in males was more moderate and inconsistent (average $r = 0.36$). Also, Bronstad et al determined that the correlation between rated attractiveness and rated femininity for female faces was always positive, but the correlation between rated attractiveness and rated masculinity for male faces was sometimes positive and sometimes negative. Taken together, these findings are similar to O'Toole et al's (1998) study in which they found a correlation of 0.88 for female attractiveness and femininity, and a correlation of 0.23 for male attractiveness and masculinity. Given that masculinity and attractiveness may be capturing unique information in male faces, we predict that masculinity in male faces, but not femininity in female faces, may influence the speed and accuracy of sex classification independently of attractiveness.

Although O'Toole et al (1998) previously found that faces classified more quickly as their respective sex tended to be more feminine and more attractive if female, and more masculine if male, the same group of raters judged both the attractiveness and masculinity/femininity of the face stimuli. Because having the same people provide ratings on correlated variables can produce a 'halo effect' that exaggerates the ratings

(eg Hoyt 2000; Saal et al 1980; Thorndike 1920), our study addresses this potential source of bias by having different groups of people rate faces on either attractiveness or facial masculinity/femininity. In addition, O'Toole et al did not select their facial stimuli to reflect significantly different levels of facial attractiveness and masculinity/femininity (rather, they investigated the relationship between speed of sex classification and attractiveness and masculinity/femininity after collecting the reaction time and rating data). Our study remedies this weakness by pre-selecting face stimuli from two levels of facial attractiveness and two levels of facial masculinity/femininity, thus allowing comparison of effects and interactions for low and high levels of attractiveness and masculinity/femininity.

In the following studies, we made separate predictions for how the cues of attractiveness and masculinity/femininity would facilitate adults' and children's sex classification of female and male faces. For female faces, we predicted that highly attractive, very feminine faces should be identified the most rapidly and accurately as female by both children and adults. For male faces, we predicted that highly attractive, very masculine male faces also should be identified the most rapidly and accurately as male by adults, but not by children. Instead, because young children typically have less experience with adult male versus adult female and children's faces (eg Harrison and Magill-Evans 1996; Russell and Radojevic 1992; Wille 1995), they may have a general facial prototype that is more female-like in representation, or they may have a better-formed female versus male facial prototype if they have separate prototypes for female and male faces. Although there is insufficient evidence to determine empirically whether young children have a general prototype for all types of faces or separate prototypes for the two sexes, either possibility suggests children may perceive attractive female faces as prototypic, but may not yet perceive attractive male faces as prototypic. Thus, we predicted that masculinity cues might have equal or greater importance than attractiveness for children's sex classification of male faces.

2 Experiment 1

To investigate whether the facial cues of attractiveness and masculinity/femininity interactively or independently influence adults' identification of sex, we asked adults to perform a reaction-time task in which they classified, as quickly as possible, the sex of male and female faces.

2.1 Method

2.1.1 *Participants.* We recruited 33 adults (17 female, mean age = 25.5 years) from the Austin community, who volunteered to participate in the study. This sample included participants of Caucasian (79%), Hispanic (15%), and Asian-Pacific-Island (3%) descent. The remaining participants (3%) were either mixed race or 'other'. The data from 5 adults were excluded from analyses for the following reasons: experimenter error (2), voice activation errors on multiple trials (ie not speaking loudly enough; 2), and missing data (ie having two incorrect responses for a particular type of face; 1). The final sample included data from 28 adults (14 female) ranging in age from 18 to 39 years ($M = 26.43$ years, $SD = 5.77$ years).

2.1.2 *Stimuli.* We randomly chose 200 images of adult male ($N = 100$) and female ($N = 100$) Caucasian faces from an existing database of highly attractive and not very attractive images of faces of undergraduate students. Within each sex category of faces, half the faces were highly attractive and half the faces were not very attractive. The faces had been rated previously for attractiveness by at least 40 undergraduates (20 female) on a 5-point Likert scale (1 = very unattractive, 5 = very attractive); the ratings were highly reliable (for all $\alpha = 0.90$ or higher). The selected faces represented the range of attractiveness found within the population of healthy, normal,

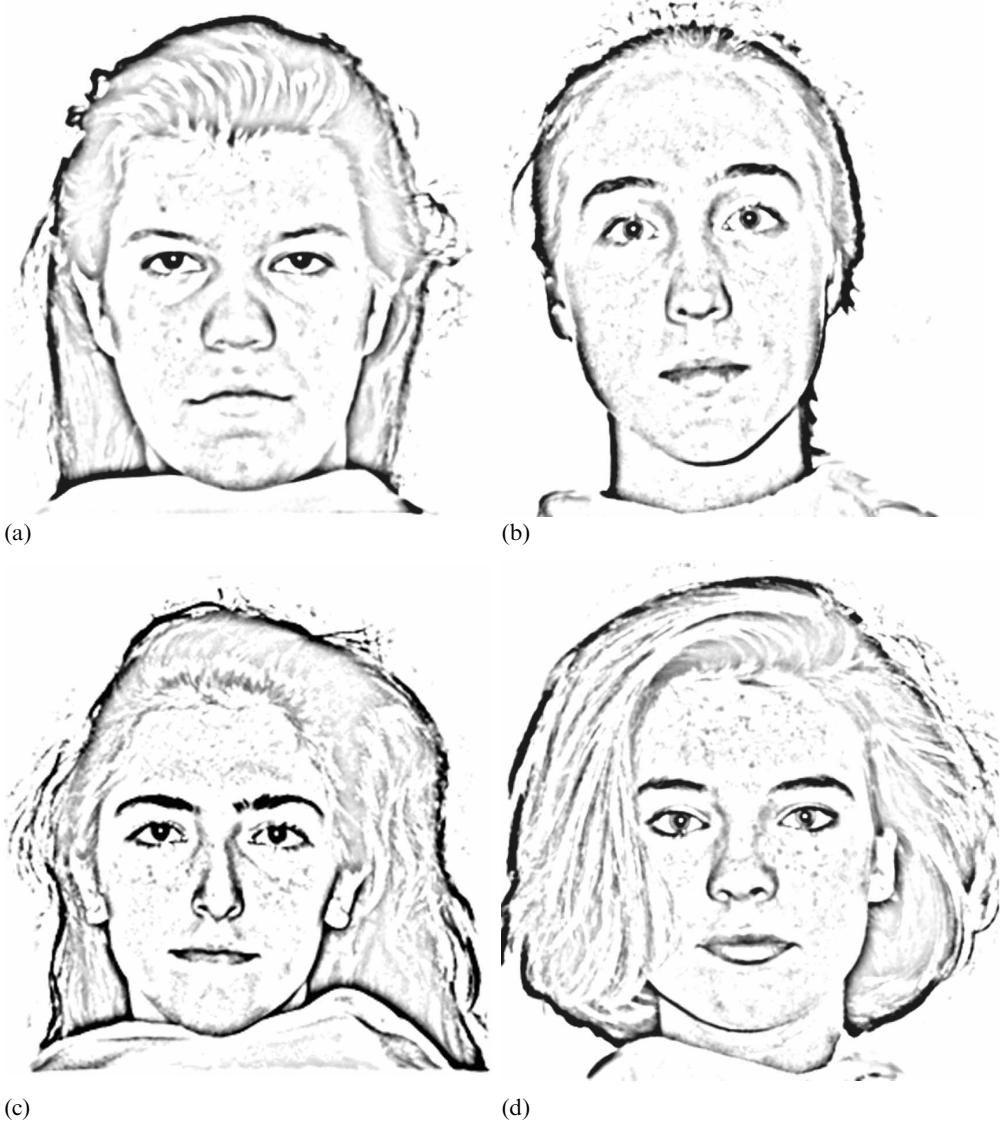


Figure 1. Illustrations created from examples of each type of stimulus face. (a) A not very attractive, not very feminine female face; (b) a not very attractive, very feminine female face; (c) a very attractive, not very feminine female face; (d) a highly attractive, very feminine female face; (e) a not very attractive, not very masculine male face; (f) a not very attractive, very masculine male face; (g) a highly attractive, not very masculine male face; (h) a highly attractive, very masculine male face.

young adult faces; none was a movie star and none was deformed. An independent group of at least 40 undergraduates (20 female) rated these faces for masculinity or femininity on a 5-point Likert scale (1 = not very feminine, 5 = very feminine for female faces; 1 = not very masculine, 5 = very masculine for male faces). The masculinity and femininity ratings were highly reliable ($\alpha = 0.97$) and correlated positively with the attractiveness ratings ($r = 0.40$ for male faces, $r = 0.80$ for female faces). Although male faces were rated for masculinity only and female faces were rated for femininity only, we refer to these variables together as masculinity/femininity for ease of communication; henceforth, when we refer to the variable of masculinity/femininity, we mean masculinity for male faces and femininity for female faces.

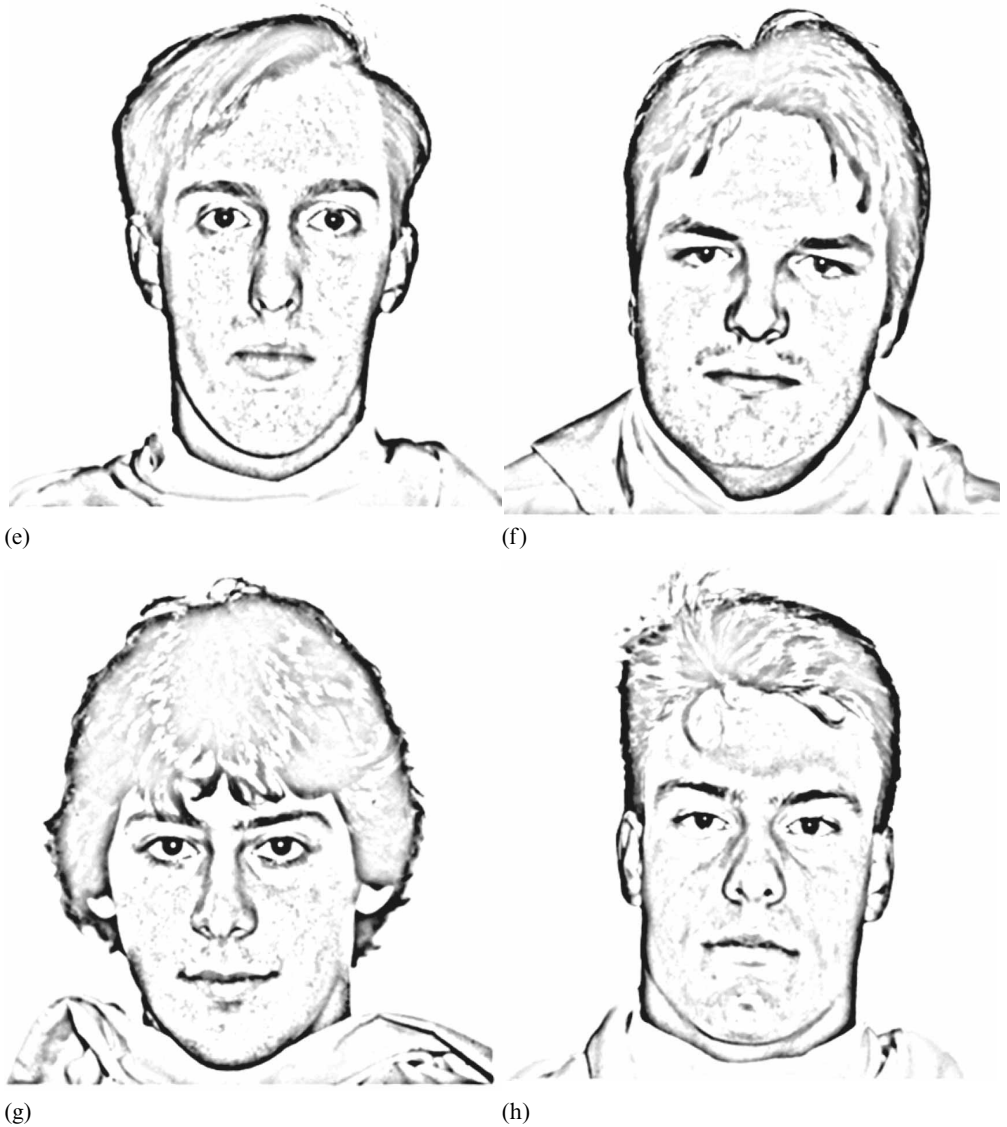


Figure 1 (continued)

From the initial pool of 200 facial images, we selected 12 for each sex including 3 each of the following face types for both female and male faces: not very attractive, not very masculine/feminine; not very attractive, very masculine/feminine; highly attractive, not very masculine/feminine; and highly attractive, very masculine/feminine. Because of the high positive correlation between attractiveness and femininity for the female faces, we were unable to choose more than a few examples from certain face types (eg highly attractive, not very feminine female faces). Therefore, we limited the number of examples of all face types to 3 examples each for a total of 12 faces of each sex (see figures 1a–1h for illustrations created from examples of each type of stimulus face). Within face types, examples were chosen based on having the highest or lowest attractiveness and masculinity/femininity scores with the constraint that characteristics such as hair color were equally represented across categories.

To determine whether mean group attractiveness scores were significantly different across attractiveness and masculinity/femininity levels but not within attractiveness

and masculinity/femininity, we conducted several *t*-test comparisons. The ratings of the faces in the not very and highly attractive conditions were significantly different from one another ($p < 0.0001$ for both the female and male faces). There were also significant differences between the two levels of femininity within each of the two levels of attractiveness for the female faces and between the two levels of masculinity within each of the two levels of attractiveness for the male faces (for all, $p < 0.05$). For the female faces, the ratings for the six not very attractive faces ranged from 1.69 to 1.84 ($M = 1.81$) and the ratings for the six highly attractive faces ranged from 3.17 to 4.19 ($M = 3.50$). Also, the ratings for the six not very feminine faces ranged from 2.32 to 3.52 ($M = 2.80$), and the ratings for the six very feminine faces ranged from 3.66 to 4.55 ($M = 4.13$). For the male faces, the ratings for the six not very attractive faces ranged from 1.18 to 1.55 ($M = 1.46$), and the ratings for the six highly attractive faces ranged from 3.09 to 3.54 ($M = 3.31$). Additionally, the ratings for the not very masculine faces ranged from 1.80 to 2.87 ($M = 2.54$), and the ratings for the very masculine faces ranged from 4.07 to 4.65 ($M = 4.31$).

To make the task manageable for younger participants (see experiment 2), all participants viewed only 2 of the 3 examples of every combination. We also selected 6 children's faces (3 girls, 3 boys) of similar attractiveness to be used in a practice portion of the study. Children's faces were selected in order to introduce participants to the task without sensitizing them to variations in facial attractiveness or masculinity/femininity. All faces were standardized for size, color, brightness, and contrast with Adobe Photoshop[™]. Additionally, all faces had neutral expressions, and all clothing cues were masked.

2.1.3 Procedure. Participants sat in front of a computer screen, which displayed the facial images. The images appeared one at a time on the computer screen for a maximum of 3000 ms via Superlab[™]. The on-screen size of each facial image was 700 by 700 pixels, just slightly smaller than life-size. To make our task more manageable for our child participants (experiment 2), we employed a verbal response methodology rather than a manual response methodology. We reasoned that a verbal task, in which participants responded with one of two words, would be less confusing and time-consuming to children than a manual-search task, in which participants needed to look for and press one of two computer keys (which would be difficult to clearly label for children who cannot yet read). In accordance with our verbal methodology, we asked the adults to respond to the faces verbally by saying either 'boy' or 'girl' as soon as they knew the sex of the face. We chose the words 'boy' and 'girl' because pilot testing demonstrated that they were both easy to pronounce and familiar to young children. A microphone centered at the bottom of the computer screen recorded the onset of each verbal response and was set at a low threshold in order to register low-volume responses. Once participants made a response or reached the maximum time allotted (3000 ms) for that trial, the face disappeared. To control for any visual aftereffects and to give participants a brief break between each face, a white screen appeared for 2000 ms and then a black dot, centered on a white screen, appeared for 750 ms prior to the presentation of each face.

Before viewing the adult stimulus faces, the participants first viewed and responded to the 6 children's faces to provide practice with the general method of the study. Once they understood the task, they viewed the series of adult faces in two blocks so that a break in presentation separating each of the blocks allowed a brief rest period. Each participant viewed and responded to 16 of 24 possible faces in 1 of 12 random orders, and the orders were counterbalanced across participants so that all faces were shown an equal number of times overall.

2.2 Results and discussion

2.2.1 Reaction times. To analyze reaction times for identifying faces as female and male, we first averaged the reaction times (in ms) for each of the 8 face types (see table 1). Adult participants made few errors, but if they made an error to one example of a face type (eg the first not very attractive, not very masculine male face), then only the reaction time to the other face of that type (eg the second not very attractive, not very masculine male face) was used for data analysis. Errors included either misidentifying a face (eg identifying a female face as a 'boy') or making a voice activation error (eg not talking loud enough during a stimulus presentation).

Table 1. Adults' reaction times to all face types (standard deviation in parentheses).

	Mean reaction time/ms	
	female faces	male faces
Highly attractive, very masculine/feminine faces	614.43 (143.16)	601.64 (134.56)
Highly attractive, not very masculine/feminine faces	598.48 (152.86)	748.66 (276.95)
Not very attractive, very masculine/feminine faces	653.27 (135.79)	628.84 (138.21)
Not very attractive, not very masculine/feminine faces	672.11 (157.88)	835.79 (319.18)

To determine the independent versus interactive effects of facial attractiveness and masculinity/femininity on how quickly adults identified sex, we initially analyzed the data with a 2 (participant sex) \times 2 (facial attractiveness) \times 2 (facial masculinity/femininity) \times 2 (sex of face) repeated-measures ANOVA. The between-participants variable was participant sex; within-participants variables were the facial attractiveness, facial masculinity/femininity, and sex of face. Because this analysis showed no effect of participant sex, we collapsed the data across this variable and analyzed the three within-participants variables.

Results showed a main effect of facial attractiveness that was not qualified by any higher order interaction: as predicted, adults identified the sex of the highly attractive faces ($M = 640.80$, $SD = 151.29$) significantly faster than that of the not very attractive faces ($M = 697.50$, $SD = 167.27$) ($F_{1,27} = 7.22$, $p < 0.05$). Results also demonstrated a significant two-way interaction between facial masculinity/femininity and sex of face ($F_{1,27} = 35.30$, $p < 0.001$). In interpreting this interaction, we controlled for Type-1 error across multiple comparisons by using Bonferroni corrections. Paired comparison t -tests showed that adults identified the sex of the very masculine male faces ($M = 615.24$, $SD = 131.10$) significantly more quickly than that of the not very masculine male faces ($M = 792.22$, $SD = 249.22$) ($t_{27} = 5.89$, $p < 0.001$); adults, however, evidenced no difference in how quickly they identified the sex of the very feminine female faces ($M = 633.85$, $SD = 128.20$) versus that of the not very feminine female faces ($M = 635.30$, $SD = 137.35$; $t_{27} = 0.138$, ns; see figure 2). There were no other significant interactions.

High levels of facial attractiveness for all faces and facial masculinity for male faces facilitated the speed of adults' classification of sex in experiment 1. These results were similar to those found by O'Toole et al (1998), except that highly attractive, very feminine female faces were not identified more quickly than their not very attractive, not very feminine counterparts in our study. Instead, highly attractive faces of both sexes were identified as their respective sex faster than not very attractive faces regardless of their facial masculinity/femininity. Independently of facial attractiveness, level of facial masculinity/femininity facilitated rapid sex classification of male, but not female, faces. By pre-selecting stimuli that ranged in attractiveness and masculinity/femininity, our results more precisely demonstrated that the cue of attractiveness (or averageness) aids adults' identification of sex independently of masculinity/femininity and whether a face is male or female.

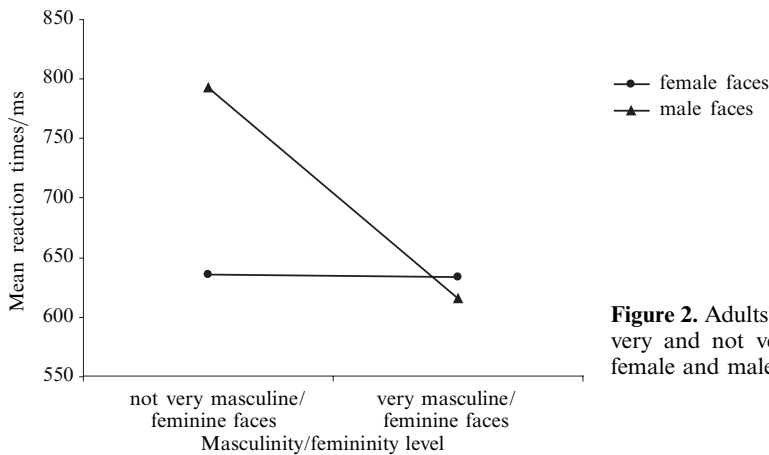


Figure 2. Adults' mean reaction times to very and not very masculine/feminine female and male faces.

2.2.2 Errors in sex classification. Although adult participants made some incorrect responses (3% of all responses were errors), the total number of incorrect responses ($N = 14$) was too small for statistical analysis. Descriptively, though, adults made errors most often on not very attractive, not very masculine male faces (12). There was also one error each for highly attractive, not very masculine male faces and not very attractive, not very feminine female faces. Hence, if adults made mistakes in classifying sex, they were most likely to err on male than on female faces and especially on male faces lower in both attractiveness and masculinity. This finding fits with our prediction that participants should be less accurate in identifying the sex of not very attractive and not very masculine/feminine faces and suggests that not very attractive, not very masculine male faces were sometimes perceived as female.

3 Experiment 2

After determining that facial attractiveness facilitates sex classification independently of facial masculinity/femininity for adults, we wanted to assess if and how the cues of facial attractiveness and facial masculinity/femininity affect sex classifications for children. Similar to our results with adults, we expected that attractiveness (or averageness) should be more important than femininity for identifying the sex of female faces. Conversely, because children may have a female-like general facial prototype or better-formed prototypes for adult-female versus adult-male faces (if they have sex-specific prototypes), we expected that masculinity information might be more important than attractiveness for classifying the sex of male faces. We tested 4–5-year-olds because, although previous research has shown that children as young as 5 years of age more rapidly identify prototypical faces than distinctive faces as being faces (Johnston and Ellis 1995), no-one to our knowledge has tested this age group of children using a reaction-time task for the identification of sex of face.

3.1 Method

3.1.1 Participants. We recruited 245 4–5-year-old children (124 girls, mean age = 4.8 years), including children of Caucasian (76%), Hispanic (12%), Asian-Pacific-Island (2%), and African-American (2%) descent. The remaining participants (8%) were either mixed race or 'other'. Published birth announcements in a local newspaper provided the initial source of participant names. The names provided by birth announcements were entered into a database; we contacted parents of all potential 4–5-year-old participants with a letter explaining the experiment and followed up with a telephone call to schedule an appointment.

The data from 102 children were excluded from data analyses for the following reasons: participant refusal to either begin or complete the task (40); voice-activation errors on multiple trials [ie not talking loud enough, talking or laughing at the start of a response, using responses other than ‘boy’ or ‘girl’, and responding before the photograph fully appeared on screen (36)]; missing data (22); experimenter error (3); and equipment error (1).

The final sample included data from 143 children (77 girls) ranging in age from 3.99 to 5.72 years ($M = 4.86$ years, $SD = 0.51$ years). Although similar in age to the original sample, the final sample was significantly different in race and sex from the original sample in that it had proportionally fewer Caucasian children and boys than the original sample.

3.1.2 Stimuli and procedure. The stimuli and procedure were identical to those of experiment 1 except that if children had difficulty with the practice portion of the task, they practiced with the children’s faces until they demonstrated comprehension of the procedure. Also, as with the adults, we presented the faces in two blocks for the children closer to 5 years of age; for children closer to 4 years of age, however, we presented the faces in four blocks because pilot testing suggested the younger children needed more breaks to successfully complete the task.

3.2 Results and discussion

3.2.1 Reaction times. As with the adult data in experiment 1, we first averaged the reaction times (in ms) for each of the eight types of faces in order to analyze children’s reaction times for identifying faces as female or male (see table 2). Again, if children either misidentified a face or made a voice-activation error on one example of a face type, only the reaction time to the other example of that face type was included in the data analysis. Because data can be correlated within a participant in a repeated-measures design (Hays 1994), we could not find an appropriate method for analyzing partially missing data and, therefore, we could not analyze data for any children who made voice-activation errors or who misidentified a face during both examples of a face type (eg both not very attractive, not very masculine male faces).

Table 2. Children’s reaction times to all face types (standard deviation in parentheses).

	Mean reaction time/ms	
	female faces	male faces
Highly attractive, very masculine/feminine faces	909.92 (259.16)	884.76 (297.61)
Highly attractive, not very masculine/feminine faces	906.24 (265.87)	943.49 (342.08)
Not very attractive, very masculine/feminine faces	1103.79 (375.72)	915.70 (289.77)
Not very attractive, not very masculine/feminine faces	1032.55 (396.71)	994.34 (334.25)

To determine the effects of facial attractiveness and masculinity/femininity on how quickly children identified sex, we first analyzed the data with a 2 (participant sex) \times 2 (facial attractiveness) \times 2 (facial masculinity/femininity) \times 2 (sex of face) repeated-measures ANOVA. The between-participants variable was participant sex; within-participants variables were facial attractiveness, facial masculinity/femininity, and sex of face. In addition to significant and predicted main effects and two-way interactions, this analysis resulted in a single significant three-way interaction between participant sex, facial masculinity/femininity, and sex of face ($F_{1,141} = 5.13$, $p < 0.05$). We did not investigate this interaction further for the following reasons: we found no effect of participant sex in experiment 1; there were no main effects or two-way interactions involving participant sex; there is no empirical history of participant sex effects in sex classification studies with children; and there was no theoretical reason to predict such a higher-order interaction.

We, therefore, collapsed data across the variable of participant sex to analyze the data with a 2 (facial attractiveness) \times 2 (facial masculinity/femininity) \times 2 (sex of face) repeated-measures ANOVA.

Results showed significant two-way interactions between facial attractiveness and sex of face ($F_{1,142} = 15.32, p < 0.001$), and facial masculinity/femininity and sex of face ($F_{1,142} = 9.69, p < 0.005$). We conducted paired samples t -tests to interpret the significant interactions. For all comparisons, we controlled for Type-1 errors across multiple comparisons using Bonferroni corrections. As predicted, attractiveness was important for children's sex classification of female faces, but not of male faces: children identified the sex of the highly attractive female faces ($M = 908.08, SD = 206.98$) significantly faster than the not very attractive female faces ($M = 1068.17, SD = 296.82; t_{142} = 7.05, p < 0.001$), whereas there was no difference in children's speed of sex classification for the highly attractive male faces ($M = 914.12, SD = 245.85$) versus the not very attractive male faces ($M = 955.02, SD = 244.71; t_{142} = 1.74, ns$; see figure 3a). Also as predicted, masculinity was important for children's sex classification of male faces: children identified the sex of the very masculine male faces ($M = 900.23, SD = 230.52$) significantly faster than that of the not very masculine male faces ($M = 968.91, SD = 259.06; t_{142} = 2.93, p < 0.01$), whereas there was no difference in their speed of sex classification of the highly feminine female faces ($M = 1006.86, SD = 263.81$) versus the not very feminine female faces ($M = 969.39, SD = 254.83; t_{142} = 1.58, ns$; see figure 3b). No other interactions were significant.

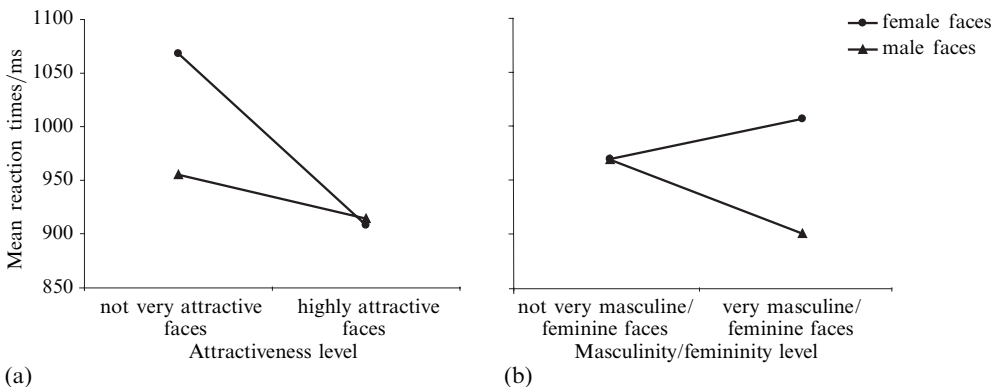


Figure 3. Children's mean reaction times to (a) highly and not very attractive female and male faces, and (b) very and not very masculine/feminine female and male faces.

These results indicate that children as young as preschool-age make use of attractiveness cues when classifying the sex of female faces and make use of masculinity cues when classifying the sex of male faces. As with the adults in experiment 1, attractiveness cues facilitated children's identification of sex independently of femininity cues for female faces: children classified the sex of highly attractive female faces faster than that of not very attractive female faces. Unlike the adults, however, attractiveness cues were not important for the classification of male faces; children identified the sex of highly and not very attractive male faces with equal speed. Like the adults and as predicted, however, high masculinity appeared to facilitate children's identification of males, because children classified the sex of very masculine male faces faster than not very masculine male faces. Also, like the adults, they classified the sex of very and not very feminine faces with equal speed to one another.

3.2.2 Errors in sex classification. Children's error rate was fairly low (17%) but frequent enough for statistical analysis (see figure 4 for total number of children's errors to all face types). To assess whether any of the stimulus variables (sex of face, facial attractiveness,

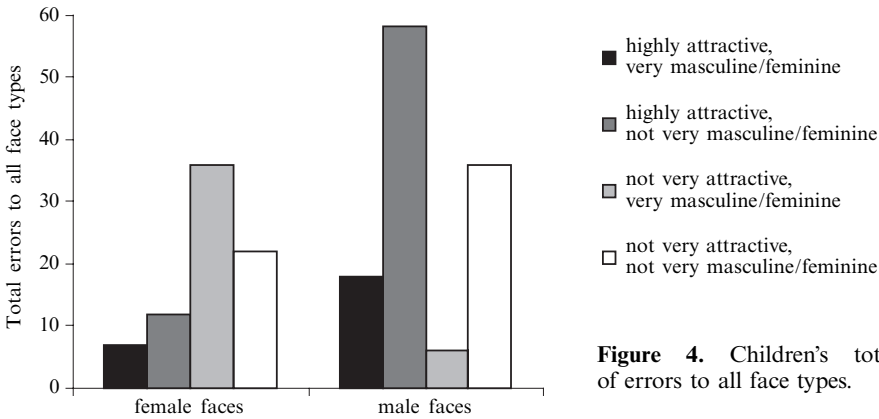


Figure 4. Children's total number of errors to all face types.

and facial masculinity/femininity) predicted the accuracy of sex classification, we first determined how many errors each child made for each of the 8 types of faces. Errors were defined as either no response to a face or an incorrect response to a face (eg identifying a female face as a 'boy'). Errors made because of equipment problems or performing the task incorrectly were not included as errors in sex classification. Because of a priori rules for the analysis of missing data, children could either make no errors or just one error for a face type; therefore, for each of the 8 face types, children received a score of 0 or 1 for the number of errors made on that face type.

Because the data were binary and because errors could have been correlated within participants as a result of the repeated-measures design, the most appropriate way to model the error data and to assess the effects of predictor variables was a generalized linear-modeling procedure. This model applies generalized estimating equations (GEEs) to determine both main effects and interaction effects of predictor variables on categorical responses [see Liang and Zeger (1986) for an explanation of GEEs].

All results of the GEEs analysis are reported as Wald statistics (Wald 1943). After testing the most restricted model (one in which all three predictor variables are included) against less restrictive models (models in which at least one predictor variable was not included), χ^2 statistics showed that the most restrictive model accounted for the most variance in error judgments ($\chi^2_{1140,143} = 1177.04$). This model resulted in an overall three-way interaction between the variables of sex of face, attractiveness, and masculinity/femininity ($\chi^2_{1,143} = 5.75$, $p < 0.05$). To interpret this interaction, we conducted simple-effects analyses between sex of face and attractiveness, and sex of face and masculinity/femininity. For all comparisons, we controlled for Type-1 error across multiple comparisons using Bonferroni corrections.

The simple-effects analyses resulted in significant two-way interactions between sex of face and attractiveness ($\chi^2_{1,143} = 32.52$, $p < 0.0001$), and between sex of face and masculinity/femininity ($\chi^2_{1,143} = 31.24$, $p < 0.001$). Because simple effects do not allow for an interpretation of the direction of effects (see Winer et al 1991), we conducted further simple-effects analyses within sex of face by attractiveness and within sex of face by masculinity/femininity.

In the sex-of-face-by-attractiveness simple-effects analysis, we collapsed the variable of masculinity/femininity across attractiveness levels for both female and male faces. These results showed that, for female faces, the likelihood of a child making a sex classification error increased as the attractiveness of the face decreased ($\beta = 1.22$, $\chi^2_{1,143} = 19.71$, $p < 0.0001$). In contrast, for male faces, the likelihood of a child making a sex classification error increased as the attractiveness of the face increased ($\beta = -0.77$, $\chi^2_{1,143} = 12.82$, $p < 0.001$).

In the sex-of-face-by-masculinity/femininity simple-effects analysis, we collapsed the variable of attractiveness across masculinity/femininity levels for both female and male faces. Results demonstrated that, for male faces, the likelihood of a child making a sex classification error increased as the masculinity of the face decreased ($\beta = 1.72$, $\chi^2_{1,143} = 47.00$, $p < 0.0001$). Level of femininity, however, did not affect the likelihood of errors in children's sex classification of female faces ($\beta = -0.24$, $\chi^2_{1,143} = 0.95$, ns).

The results of children's errors in sex classification correspond to the results of children's reaction times in identifying sex of face. Specifically, children were both slower *and* more likely to make an error in identifying the sex of a not very attractive female face as compared to a highly attractive female face. Additionally, level of femininity did not affect children's errors in sex classification just as it did not affect their speed in reaction times. For male faces, children were both faster *and* less likely to err on a very masculine versus a not very masculine male face. Interestingly, children were more likely to err on highly attractive relative to not very attractive male faces. Although this result does not explain why children identified highly and not very attractive male faces with equal speed, it suggests why high attractiveness did not facilitate the speed of sex classification more than low attractiveness for male faces: because they were more apt to err in their classification of highly attractive versus not very attractive male faces, children likely required more processing time than would be expected to successfully identify the sex of highly attractive versus not very attractive male faces.

4 General discussion

Previous researchers have suggested that facial configuration as a whole is more informative than individual facial features such as mouth or eye shape in helping people to correctly identify sex (eg Bruce et al 1993; Campanella et al 2001; Yamaguchi et al 1995), yet this is the first study to examine if an attractive or masculine/feminine facial configuration facilitates the task of sex classification for both adults and children. The results from our two experiments demonstrate that facial attractiveness helps adults and children to identify sex, although the importance of facial attractiveness for male faces depends on whether the perceiver is an adult or a young child. Whereas facial attractiveness facilitated adults' sex classification of both female and male faces, attractiveness facilitated children's sex classification of female faces only. In contrast, facial masculinity facilitated both children's and adults' sex classification decisions similarly. Here we explore these interesting differences in the sex classification of female versus male faces and also speculate about the implications of our findings for Langlois and Roggman's (1990) averageness theory of attractiveness preferences.

4.1 Sex classification of female faces

Our prediction that high attractiveness combined with high femininity would lead to the fastest and most accurate sex classification of female faces was not supported because the variable of facial attractiveness did not interact with the variable of facial femininity for either adults or children. Instead, for both adults and children, only high attractiveness facilitated sex classification of female faces regardless of high femininity. These results extend O'Toole et al's (1998) findings by showing that, although attractiveness generally correlates with femininity for female faces, high attractiveness appears to be a more influential cue than high femininity in facilitating accurate sex classification when the two variables are manipulated independently. Thus, people may prefer very attractive female faces because such faces are prototypic, good examples of female faces, and easier to process.

4.2 Sex classification of male faces

In our experiments, children relied more on masculinity than attractiveness cues when deciding the sex of a male face, whereas adults relied on both attractiveness and

masculinity cues, though independently of one another, in the same task. All participants' faster and more accurate identification of very masculine relative to not very masculine male faces fits with previous findings with adults that masculinity is an informative cue in the sex classification of male faces (Bruce et al 1987; O'Toole et al 1998). Why is masculinity useful for identifying the sex of male faces, particularly for young children? One possibility is that children's greater experiences with adult female than with adult male faces may solidify the prototypicality of attractive female faces; therefore, children might be using masculinity cues to help identify adult faces that are dissimilar to either their general female-like face prototype or their well-formed sex-specific prototypes for female faces.

If attractive female faces are more prototypical than attractive male faces to children, then attractive female faces would fall nearer to the center of their geometric, multi-dimensional 'face space' than attractive male faces. Face space is a metaphorical framework for understanding the mental representation of faces in which faces are stored within locations in a multidimensional space, and the dimensions of the space correspond to ways in which faces can vary and be encoded (Valentine 1991). If attractive female faces are at the center of face space, then less-attractive and less female-like faces should be farther away from the center of face space. Because not very attractive, very masculine male faces are conceivably the least 'female-like' and, therefore, the farthest faces away from the center of face space, these faces should be easily identified as being 'not female'. Support for this hypothesis comes from our finding that children were least likely to make mistakes on not very attractive, very masculine male faces than on any other type of face.

A second, related possibility is that children's extensive experience with peers might lead them to form a neotenous general face prototype. Consequently, adult female faces may be more similar than adult male faces to this prototype given that female faces evidence fewer physical changes than male faces following puberty (Enlow 1990). Again, masculinity would be a useful cue to differentiate male faces from such a prototype. Either possibility fits with our predictions and results because adult male faces are likely the most different from any face prototypes that children have. Unfortunately, though, our data do not allow us to determine whether children are using general or sex-specific face prototypes, or adult or child-like face prototypes, when making sex classification decisions.

4.3 *The importance of sex classification*

Earlier researchers have found that infants and adults evidence visual preferences for attractive faces and perceive them as more face-like, perhaps because they are more average (in facial configuration) or prototypical (Langlois et al 1987; Langlois and Roggman 1990; Light et al 1981; Rubenstein et al 1999). In this study, we found that adults identify the sex of highly attractive female and male faces faster than their not very attractive counterparts and that children identify the sex of highly attractive female faces faster and more accurately than their not very attractive counterparts. That highly attractive faces are identified as their respective sex faster than not very attractive faces provides an additional explanation why attractive faces are appealing to young children and adults. Specifically, more attractive faces are not just average in facial appearance and therefore more prototypical and face-like, but are also prototypical of sex appearance and therefore more 'female-like' and 'male-like'.

Most participants in our task correctly identified the sex of the faces within the allotted time frame, suggesting that sex classification is an automated task. Indeed, identifying sex is a crucial social action that must occur almost instantaneously for social-interaction purposes. Our results show that an especially attractive appearance for female targets (and male targets when adults are the perceivers) and an especially

masculine appearance for male targets facilitate sex classification, which likely has useful social consequences. On the other hand, rapid sex categorization in modern society could also be disadvantageous for targets in that categorization often precedes stereotype formation. Specifically, faces that are easily identified as male or female may be perceived as being more sex-typed than other male and female faces. Indeed, research shows that both children and adults perceive females with highly attractive faces as being more likely to have feminine traits and as being more likely to engage in feminine activities and occupations than females with not very attractive faces (Gillen 1981; Hoss and Langlois 2003).

5 Directions for future research

Although our findings are in accord with those of O'Toole et al (1998), who found that adults quickly identify the sex of faces that are highly attractive and the sex of male faces that are highly masculine in appearance, we were able to draw more precise conclusions about how independent levels of facial attractiveness and masculinity/femininity affect the speed and accuracy of sex classification. By independently varying levels of both attractiveness and masculinity/femininity in our experiments, we were able to determine whether the two types of cues interacted or made independent contributions to the sex classification of faces. One limitation to our studies is that, because of the attentional limitations of the children we tested, we showed only 24 adult faces as stimuli, which may limit the generalization of our findings to other stimulus sets of different races or ages. Other stimuli should be employed in similar studies to bolster our findings. Child faces as stimuli could result in particularly interesting findings in that sex-typical appearance cues (eg high masculinity for male faces) are less prominent in prepubescent children's faces than in adults' faces (Enlow 1982), which would suggest that attractiveness might be more important than masculinity/femininity in the sex classification of young children's faces. Recent research, though, has shown that adults detect a range of facial masculinity and femininity in children as young as 3 years of age and even make sex-typed attributions to children based on differences in facial masculinity/femininity when attractiveness is held constant (Rogers and Ritter 2002). Because it is unclear how attractiveness and masculinity/femininity would affect the sex classification of children's faces, studies employing stimulus faces of varying ages are needed.

Finally, although our pilot work for this study showed that 4-year-olds are the youngest age group that can reliably perform the sex classification task we designed, future research should assess how facial cues such as attractiveness and masculinity/femininity aid children younger than 4 years in sex classification using other age-appropriate methodology. Sex categorization of target faces is an important social task that is believed to develop in infancy; in existing research on the development of sex categorization in infancy, however, facial stimuli have been used that are highly attractive and sex-typical in appearance rather than facial stimuli that range in attractiveness and typicality (eg Leinbach and Fagot 1993). Given our findings that attractiveness and sex-typical cues facilitate faster and more accurate sex categorization for children and adults, the findings from infant sex-categorization studies are limited because they do not clearly show that infants can easily categorize the sex of faces that are not very attractive or not very masculine/feminine in facial appearance. Indeed, recent research suggests that infants have difficulty categorizing sex at 11 months of age and younger if the faces are atypical in appearance (Newell and Strauss 2002; Newell et al 2003).

6 Conclusions

In support of our predictions, we found that a highly attractive face facilitates quick and accurate sex classification but that facial attractiveness information is more useful for identifying female faces than male faces during childhood and equally useful for identifying both female and male faces during adulthood. Perhaps attractiveness becomes

a more important cue for the sex classification of male faces sometime during the early adolescent years, when identifying another's sex might be especially important for social interaction and dating. Additionally, we found that masculinity in male faces, but not femininity in female faces, independently aids both children and adults in sex classification tasks; moreover, the importance of masculinity cues does not appear to differ between early childhood and adulthood. These results taken together suggest that facial attractiveness and facial masculinity information both play an important, yet independent, role in facilitating even young children's quick and accurate sex classification.

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References

- Bronstad P M, Ramsey J L, Langlois J H, 2002 "Sample size explains the discrepancies in facial attractiveness research: Masculine male faces are more attractive (*formerly* Femininity = attractiveness but masculinity and attractiveness merely share variance)", poster presented at 14th Annual Meeting of the American Psychological Society, New Orleans, LA, June
- Brown E, Perrett D I, 1993 "What gives a face its gender?" *Perception* **22** 829–840
- Bruce V, Burton A M, Hanna E, Healey P, Mason O, Coombes A, Fright R, Linney A, 1993 "Sex discrimination: how do we tell the difference between male and female faces?" *Perception* **22** 131–152
- Bruce V, Ellis H, Gibling F, Young A, 1987 "Parallel processing of the sex and familiarity of faces" *Canadian Journal of Psychology* **41** 510–520
- Burton A M, Bruce V, Dench N, 1993 "What's the difference between men and women? Evidence from facial measurement" *Perception* **22** 153–176
- Campanella S, Chrysochoos A, Bruyer R, 2001 "Categorical perception of facial gender information: Behavioural evidence and the face-space metaphor" *Vision Cognition* **8** 237–262
- de Haan M, Johnson M H, Maurer D, Perrett D I, 2001 "Recognition of individual faces and average face prototypes by 1- and 3-month-old infants" *Cognitive Development* **16** 659–678
- Enlow D, 1982 *Handbook of Facial Growth* (Philadelphia, PA: W B Saunders)
- Enlow D H, 1990 *Facial Growth* (Philadelphia, PA: W B Saunders)
- Gillen B, 1981 "Physical attractiveness: A determinant of two types of goodness" *Personality and Social Psychology Bulletin* **7** 277–281
- Grammer K, Thornhill R, 1994 "Human (*Homo sapiens*) facial attractiveness and sexual selection: The role of symmetry and averageness" *Journal of Comparative Psychology* **108** 233–242
- Harrison M J, Magill-Evans J, 1996 "Mother and father interactions over the first year with term and preterm infants" *Research in Nursing & Health* **19** 451–459
- Hays W L, 1994 *Statistics* 5th edition (Fort Worth, TX: Harcourt Brace)
- Hoss R A, Langlois J H, 2003 "Children's attributions of gender stereotypes to faces varying in attractiveness", poster presented at the 15th Annual Meeting of the American Psychological Society, Atlanta, GA, May
- Hoyt W T, 2000 "Rater bias in psychological research: When is it a problem and what we can do about it?" *Psychological Methods* **5** 64–86
- Intons-Peterson M, 1988 *Children's Concepts of Gender* (Norwood, NJ: Ablex)
- Johnston R A, Ellis H D, 1995 "Age effects in the processing of typical and distinctive faces" *Quarterly Journal of Experimental Psychology Section A* **48** 447–465
- Langlois J H, Kalakanis L, Rubenstein A J, Larson A, Hallam M, Smoot M, 2000 "Maxims or myths of beauty? A meta-analytic and theoretical review" *Psychological Bulletin* **126** 390–423
- Langlois J H, Ritter J M, Roggman L A, Vaughn L S, 1991 "Facial diversity and infant preferences for attractive faces" *Developmental Psychology* **27** 79–84
- Langlois J H, Roggman L A, 1990 "Attractive faces are only average" *Psychological Science* **1** 115–121
- Langlois J H, Roggman L A, Casey R J, Ritter J M, Rieser-Danner L A, Jenkins V Y, 1987 "Infant preferences for attractive faces: Rudiments of a stereotype?" *Developmental Psychology* **23** 363–369
- Langlois J H, Roggman L A, Musselman L, 1994 "What is average and what is not average about attractive faces?" *Psychological Science* **5** 214–220
- Leinbach M D, Fagot B I, 1993 "Categorical habituation to male and female faces: Sex schematic processing in infancy" *Infant Behavior and Development* **16** 317–332
- Liang K-Y, Zeger S L, 1986 "Longitudinal analysis using generalized linear models" *Biometrika* **73** 13–22
- Light L L, Hollander S, Kayra-Stuart F, 1981 "Why attractive people are harder to remember" *Personality and Social Psychology Bulletin* **7** 269–276

- Newell L C, Strauss M S, 2002 "Infants' ability to discriminate gender using internal facial features", poster presented at the Biennial Meeting of the International Conference on Infant Studies, Toronto, Ontario, April
- Newell L C, Strauss M S, Best C A, 2003 "Gender categorization during infancy: The effects of typicality and hair", poster presented at the Biennial Meeting of the Society for Research in Child Development, Tampa, FL, April
- O'Toole A J, Deffenbacher K A, Valentin D, McKee K, Huff D, Abdi H, 1998 "The perception of face gender: The role of stimulus structure in recognition and classification" *Memory & Cognition* **26** 146–160
- Perrett D I, Lee K J, Penton-Voak I, Rowland D, Yoshikawa S, Burt D M, Henzi S P, Castles D L, Akamatsu S, 1998 "Effects of sexual dimorphism on facial attractiveness" *Nature* **394** 884–887
- Perrett D I, May K A, Yoshikawa S, 1994 "Facial shape and judgments of female attractiveness" *Nature* **368** 239–242
- Ramsey J L, 2003 *Infant Attention to Male Faces* Doctoral dissertation, University of Texas at Austin, Austin, TX, USA
- Rhodes G, Hickford C, Jeffery L, 2000 "Sex-typicality and attractiveness: Are supermale and superfemale faces super attractive?" *British Journal of Psychology* **91** 125–140
- Rhodes G, Jeffery L, Watson T L, Clifford C W G, Nakayama K, 2003 "Fitting the mind to the world: Face adaptation and attractiveness aftereffects" *Psychological Science* **14** 558–566
- Rhodes G, Sumich A, Byatt G, 1999 "Are average facial configurations attractive only because of their symmetry?" *Psychological Science* **10** 52–58
- Rhodes G, Tremewan T, 1996 "Averageness, exaggeration, and facial attractiveness" *Psychological Science* **7** 105–110
- Roberts T, Bruce V, 1988 "Feature saliency in judging the sex and familiarity of faces" *Perception* **17** 475–481
- Rogers C M, Ritter J M, 2002 "The power of perception: Children's appearance as a factor in adults' predictions of gender-typical behavior" *Social Development* **11** 409–426
- Rubenstein A J, Kalakanis L, Langlois J H, 1999 "Infant preferences for attractive faces: A cognitive explanation" *Developmental Psychology* **35** 848–855
- Rubenstein A J, Langlois J H, Roggman L A, 2002 "What makes a face attractive and why: The role of averageness in defining facial beauty", in *Facial Attractiveness: Evolutionary, Cognitive, and Social Perspectives. Advances in Visual Cognition* volume 1, Eds G Rhodes, L A Zebrowitz (Westport, CT: Ablex) pp 1–33
- Russell G, Radojevic M, 1992 "The changing role of fathers? Current understandings and future directions for research and practice" *Infant Mental Health Journal* **13** 296–311
- Saal F E, Downey R G, Lahey M A, 1980 "Rating the ratings: Assessing the psychometric quality of rating data" *Psychological Bulletin* **88** 413–428
- Samuels C A, Ewy R, 1985 "Aesthetic perception of faces during infancy" *British Journal of Developmental Psychology* **3** 221–228
- Thorndike L, 1920 "A constant error in psychological findings" *Journal of Applied Psychology* **4** 25–29
- Valentine T, 1991 "A unified account of the effects of distinctiveness, inversion, and race on face recognition" *Quarterly Journal of Experimental Psychology Section A* **43** 161–204
- Valentine T, Bruce V, 1986 "Recognizing familiar faces: The role of distinctiveness and familiarity" *Canadian Journal of Psychology* **40** 300–305
- Vokey J R, Read J D, 1992 "Familiarity, memorability, and the effect of typicality on the recognition of faces" *Memory & Cognition* **20** 291–302
- Wald A, 1943 "Tests of statistical hypothesis concerning several parameters when the number of observations is large" *Transactions of the American Mathematical Society* **54** 426–482
- Walton G E, Bower T G R, 1993 "Newborns form 'prototypes' in less than 1 minute" *Psychological Science* **4** 203–205
- Wild H A, Barrett S E, Spence M J, O'Toole A J, Cheng Y D, Brooke J, 2000 "Recognition and sex categorization of adults' and children's faces: Examining performance in the absence of sex-stereotyped cues" *Journal of Experimental Child Psychology* **77** 269–291
- Wille D E, 1995 "The 1990s: Gender differences in parenting roles" *Sex Roles* **33** 803–817
- Winer B J, Brown D R, Michels K M, 1991 *Statistical Principles in Experimental Design* (New York: McGraw-Hill)
- Yamaguchi M K, Hirukawa T, Kanazawa S, 1995 "Judgment of gender through facial parts" *Perception* **24** 563–575