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Female face preference in 4-month-olds: The importance of hairline

Anne Hillairet de Boisferon [a], Lesley Uttley [b], Paul C. Quinn [c], Kang Lee [d], Olivier Pascalis [a,*]

[a] LPNC (CNRS UMR 5105) – Université Grenoble Alpes, Grenoble, France
[b] Department of Psychology, University of Sheffield, Sheffield, UK
[c] Department of Psychological and Brain Sciences, University of Delaware, Delaware, USA
[d] Institute of Child Study, University of Toronto, Toronto, Canada

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ABSTRACT

At 3–4 months of age, infants respond to gender information in human faces. Specifically, young infants display a visual preference toward female over male faces. In three experiments, using a visual preference task, we investigated the role of hairline information in this bias. In Experiment 1, we presented male and female composite faces with similar hairstyles to 4-month-olds and observed a preference for female faces. In Experiment 2, the faces were presented, but in this instance, without hairline cues, and the preference was eliminated. In Experiment 3, using the same cropping to eliminate hairline cues, but with feminized female faces and masculinized male faces, infants' preference toward female faces was still not in evidence. The findings show that hairline information is important in young infants' preferential orientation toward female faces.

1. Introduction

Young infants respond to the social attribute of gender in faces. In particular, they respond preferentially to female over male faces (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002; Quinn et al., 2008). The preference for female faces is thought to arise because infants interact at greater frequencies with female than male caregivers, in combination with exposure to other adult female faces relative to other adult male faces, in their everyday environment (Rennels & Davis, 2008).

Asymmetrical learning of female versus male faces based on differential experience may lead to different representations for female versus male faces (Quinn et al., 2002; Ramsey-Rennels & Langlois, 2006; Ramsey, Langlois, & Marti, 2005; Younger & Fearing, 1999). Quinn et al. (2002) has reported that 3- to 4-month-old infants presented with a set of female faces are able to recognize those as individuals, whereas when same-aged infants are presented with a set of male faces, those faces are recognized only at the summary category level of male. On this basis, Quinn et al. (2002) has argued that infants may be female face experts, encoding individual exemplars around a summary representation for female faces (consistent with a more expertise-based representation), whereas for male faces, infants may only have the summary representation (consistent with a more novice representation).

* Corresponding author at: Laboratoire de Psychologie et NeuroCognition, Université de Grenoble Alpes, BP 47 38040 Grenoble Cedex 9, France. Tel.: +33 4 76 82 78 31; fax: +33 4 76 82 78 31.
E-mail address: olivier.pascalis@upmf-grenoble.fr (O. Pascalis).

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Despite the consensus that differences in infant processing of female and male faces reflect recurrent exposure differences between the categories, there has been less research into the physical cues in the faces which allow infants to represent one category as female and the other category as male. In the anthropological literature, Enlow (1982) pointed out that male and female faces differ in their global facial shape characteristics (e.g., length and roundness), as well as in their facial feature characteristics (e.g., size of the nose). Among those various characteristics possibly responsible for sexual dimorphism, the internal features of faces have been a particular focus of research in adults. This research indicates that the nose (Chronicle et al., 1995), eyebrows, and facial outline (Yamaguchi, Hirukawa, & Kanazawa, 1995), play a role to determine the gender of a face. In addition, Brown and Perrett (1993) have reported that the brows, eyes, jaw, chin, nose, mouth, and their configural relationships, all carry information about gender. Nevertheless, in the face recognition literature, existing data suggest that although young infants appear not to integrate internal feature information (i.e., eyes, nose, mouth) when recognizing familiar individuals until approximately 4 months of age (Bartrip, Morton, & de Schonen, 2001; Pascalis, de Schonen, Morton, Deruelle, & Fabre-Grenet, 1995), young infants' recognition of unfamiliar faces from the time frame between birth and 4 months of age is led more by external features (i.e., hairline, chin, and ears) than internal features (i.e., eyes, nose, and mouth) (Rose, Jankowski, & Feldman, 2008; Turati, Macchi Cassia, Simion, & Leo, 2006). It is thus possible that external features play a role in providing infants with a basis to separate the two genders. With regard to the external cues, it has been shown that the single cue of hair length, resulting in higher external contrast information in female faces, does not influence infants' preference for female faces. Nevertheless, in both Quinn et al. (2002, 2008), although preference for female faces by infants was observed without hairstyle or hair length cues, hairline information was visible in both sets of stimuli. It could be that hairline may provide an important cue to differentiation of faces based on gender. Hairline is often higher in males and tends to have an "M" or block shape, whereas it tends to be more oval in shape in females (Naini, 2011). In young infants with less experience and therefore less expertise with faces, hairline cues might be salient and potent cues to gender, but this has not been investigated in existing research. The present studies were therefore aimed at investigating the role of hairline information in the visual attraction that young infants display toward female faces.

2. Experiment 1

In Experiment 1, 4-month-old infants were administered the Quinn et al. (2008) female versus male face preference task. It will provide an internal baseline level of female face preference against which performance in Experiments 2 and 3, where hairline manipulations are introduced, can be judged.

2.1. Participants

The final sample consisted of 18 4-month-old infants (*M* age = 139 days; *SD* = 5.2; 11 males, 7 females). Twelve additional infants participated in the study but their data were excluded due to side biases. A side bias was considered to be in effect when infants looked in one direction more than 95% of the time for either of the two different presented pairings of faces. Infants were typically developing, healthy infants recruited from the maternity ward in Jessop's Hospital in Sheffield, UK. Infants were Caucasian, and had their mother as primary caregiver.

2.2. Stimuli

Stimuli were obtained from Lisa DeBruine's and Ben Jones's face laboratory at the University of Aberdeen (www.Facelab.org). The stimuli were comprised of color images of three male and three female faces that were composites of four individual faces each. Composite faces were chosen to remove the facial irregularities typical of real faces and were homogenized in terms of shape and skin color/texture. Averaging faces also has the advantage of establishing consistent differences in the internal features of faces that could be of importance in gender discrimination. The 24 individual faces (12 males, 12 females) used to create the composite faces were all Caucasians and aged 21–24. Faces were photographed under the same lighting conditions, full-front views, and neutral facial expression. The shape of individual faces was defined manually by marking 189 feature points on salient facial landmarks (e.g., center of the eyes, nose-tip). The average female and male face shapes were then defined by averaging the positions of the feature landmarks for the entire sample. Each individual face image was then morphed to the shape of the corresponding average face. Resultant reshaped face images were then blended together by averaging color and intensity of corresponding pixels to create each composite face. Composite female and male faces were cropped to reveal the hairline, but not hairstyle (see Fig. 1 for an example pairing). Images were adjusted for brightness and contrast and mounted onto a black background.

2.3. Procedure

The infants were tested in a quiet room where they were seated on their parents' lap approximately 60 cm away from a screen onto which the images were projected. All parents were instructed to fixate centrally above the screen and to remain quiet during testing. Eye movements were recorded and the film was then digitized so that it could be analyzed frame by frame by two independent observers on a computer using specialized software.

Fig. 1. Examples of composite female (left) and male (right) faces.

When projected onto the screen, all images measured 10 cm wide × 15 cm high and were positioned side-by-side separated with a 12 cm gap. Each pair of images was displayed until 10 s of fixation time had elapsed. Between each image pairing, a blank screen was presented for 5 s or until the infant moved their eyes from the final point of fixation from the previous trial. Each infant was presented with two female–male face pairings for a total of two 10-s trials. The particular male and female faces for each pairing were randomly selected for each infant from among six possible pairings. Left–right positioning of gender was counterbalanced across infants on the first trial and reversed on the successive trial.

2.4. Results

The inter-observer reliability score was 0.97. Summed looking time (in milliseconds) to the female faces was divided by summed looking time to the female and male faces and converted to a percentage score by multiplying by 100. The preference for female faces was significantly different from chance, $M = 55.47\%$, $SD = 10.14$, $t(17) = 2.29$, $p < .05$, two-tailed, Cohen's $d = 0.54$. At the individual level, 14 of the 18 infants looked longer at the female face (binomial test, $p < .05$).

2.5. Discussion

When composite faces of males and females with similar hairstyles but intact hairlines are presented to 4-month-old infants reared by female caregivers, the preference for female faces over male faces is still present, thereby replicating the data from Quinn et al. (2008). This result provides another demonstration that hairstyle or length does not influence infants' interest in female faces (see also Quinn et al., 2002).

3. Experiment 2

Experiment 1 still leaves open the question of what physical cues in the stimulus images allow infants to separate the two categories and prefer the females over the males. One can ask, in particular, if infants' preference toward female faces was guided by facial characteristics and not influenced by other non-facial cues. By homogenizing the shape of the hairstyle between males and females, we took care to remove one of the non-face cues that could affect preference. As noted, Quinn et al. (2002) also reported that the female preference was preserved when hair length cues were removed, but hairline information was preserved. Both sets of experiments leave open the role that hairline information may play in driving the preference for female faces. Hairline is thought to be a salient and relevant cue to gender classification: It is often higher in males and tends to have an "M" or block shape, whereas it tends to be more oval in shape in females (Naini, 2011). Therefore, in Experiment 2, we used the same pictures as in Experiment 1, but with hairline information removed.

3.1. Participants

The final sample consisted of 19 4-month-old infants (Mean age = 142 days; $SD = 3.4$; 11 males, 8 females). Seventeen additional infants participated in the study but their data were excluded due to side biases.

Fig. 2. Examples of cropped composite female (left) and male (right) faces with hairline cues removed.

3.2. Stimuli

The three female and three male images of Caucasian composite faces, used in Experiment 1, were cropped so that hairline cues were removed, but otherwise the natural shape of the face (in the lower half of the face) remained intact (see Fig. 2 for an example pairing).

3.3. Procedure

The apparatus and procedure were identical to Experiment 1.

3.4. Results

The inter-observer reliability score was 0.91. Summed looking time (in milliseconds) to the female faces was divided by summed looking time to the female and male faces and converted to a percentage score by multiplying by 100. The preference for female faces was not significantly different from chance ($M = 48.20\%$, $SD = 15.30$, $t(18) = -0.53$, $p = .60$). At the individual level, only 11 of the 19 infants looked longer at the female face (binomial test, $p > .05$).

3.5. Discussion

The failure to observe the female face preference for the composite stimuli without hairline information has implications for our current understanding of the female face preference. First, the fact that 4-month-old infants did not prefer to look at female faces over male faces suggests that cues that are more external relative to the classic internal features (i.e., eyes, nose, mouth) can influence infants' orientation toward faces. More specifically, this finding suggests that hairline information may be a diagnostic cue used by infants for gender classification. This evidence is consistent with the finding in adults that the presence versus absence of hairline information affects the perceived femininity versus masculinity of faces (DeBruine, Jones, Smith, & Little, 2010): perceived masculinity of faces is higher in faces with hair than in faces without hair.

4. Experiment 3

In Experiment 3, we used the same pictures as in Experiment 2, such that hairline information was unavailable as a gender-diagnostic cue; however, we feminized and masculinized the faces in order to increase sexual dimorphism as a distinguishing cue for gender. This manipulation allowed us to determine whether increasing the sexual dimorphism of the faces could bring back the female face preference, in spite of the hairline cue being absent.

4.1. Participants

The final sample consisted of 18 4-month-old infants (Mean age = 140 days; $SD = 6.6$; 10 males, 8 females). Nineteen additional infants participated in the study but their data were excluded due to side biases ($n = 16$), parental interference ($n = 1$), or experimenter error ($n = 2$).

Fig. 3. Examples of cropped composite female (left) and male (right) faces polarized in femininity for female and in masculinity for male.

4.2. Stimuli

The same cropped composite images of faces as in Experiment 2 were used, but the three females were polarized in femininity and the three males were polarized in masculinity (see Fig. 3 for an example pairing). The average male and female faces were computed in the same way as in Experiment 1, except the vector difference between corresponding feature points on both average shape faces was increased by 50% to create feminized and masculinized shapes. The composite face images were then morphed into these new face shapes. This manipulation aimed to increase the perceptual difference between the images by making the female faces seem more stereotypically feminine and the male faces more stereotypically masculine. To ascertain whether the faces were indeed polarized in femininity and masculinity, we asked adults to rate our stimuli. Thirty-six independent adult observers (18 males; *M* age = 30.5, *SD* = 4.6) were asked to rate both the male and female pictures used in each experiment on a 7-point scale in terms of how stereotypically masculine the male faces were and how feminine the female faces were. The degree of agreement between observers was high, as revealed by the intra-class correlation coefficient of 0.91 (95% confidence interval 0.84–0.96). Overall, the femininity/masculinity scores were significantly higher for the polarized faces ($M = 5.7$, $SD = 0.6$) than the cropped faces used in Experiment 1 ($M = 5.1$, $SD = 0.7$), $t(35) = 5.8$, $p < .001$, two-tailed, Cohen's $d = 0.69$, and in Experiment 2 ($M = 5.2$, $SD = 0.7$), $t(35) = 8.5$, $p < .001$, two-tailed, Cohen's $d = 0.57$.

4.3. Results

Inter-observer reliability score was 0.95. Summed looking time (in milliseconds) to the female faces was divided by summed looking time to the female and male faces and converted to a percentage score by multiplying by 100. The preference for female was not significantly different from chance, $M = 48.29\%$, $SD = 7.26$, $t(17) = -1.00$; $p = .33$. At the individual level, only 9 of the 18 infants looked longer at the female face (binomial test, $p > .05$).

4.4. Discussion

Consistent with the results of Experiment 2, the faces with increased sexual dimorphism, but without hairline, failed to elicit a female face preference in 4-month-old infants. The composite faces used in Experiments 2 and 3 were cropped so that only the natural face shape (along the lower half of the face) and internal features remained, but no hairline was visible. Under such conditions, even if the female faces were feminized and the male faces were masculinized, infants' preference toward the female faces was no longer in evidence. The null results from Experiments 2 and 3, in combination with the positive results from Experiment 1 where hairline information was present, suggest that hairline may be an eliciting cue for the female face preference manifested by young infants.

5. General discussion

In Experiment 1, we replicated 4-month-old infants' preference for female faces over male faces with averaged faces (Quinn et al., 2008), and with faces that were controlled in terms of hairstyle. Despite the possible dilution of cues to gender from the removal of hairstyle and hair length information, the preference for female faces was not taken away in the current experiment, consistent with the findings of Quinn et al. (2002) with individual faces.

As noted, the greater responsiveness to female faces is thought to arise due to the stronger, more-expert representation infants have for female faces relative to male faces based on differential experience (Rennels & Davis, 2008), but there must be some diagnostic cues in the face images that infants detect which allow them to distinguish between the categories of greater and lesser experience. In Experiment 2, with the removal of the hairline cues from the stimuli, infants no longer preferred to look at the female faces. Hairline has been acknowledged in the facial esthetics literature as a diagnostic cue to gender (Naini, 2011), and the composite faces used in Experiment 2 were cropped so that only the natural face shape (in the lower half of the face) and the internal features remained, but information about the hairline was not available. By removing hairline information, young infants' ability to discriminate faces based on gender was impacted and their preference for female faces was blocked. This finding is consistent with research showing that 4-month-old infants spend more than one-third of their time exploring external features of a face (Gallay, Baudouin, Durand, Lemoine, & Lécuyer, 2006), and their recognition of faces is disrupted by removing this information (Rose et al., 2008; Turati et al., 2006).

In Experiment 3, we observed the potency of the hairline cue. When the infants were presented with faces marked by increased sexual dimorphism (i.e., more feminized female faces and more masculinized male faces) to increase the distinctiveness of the gender contrast, we again failed to observe a preference for female faces. The pattern of responding across experiments indicates that infant's interest in female faces may be significantly impacted by hairline information.

An issue of interest is whether the cues used by infants will change as they gain more expertise, with hairline becoming less relevant. Indeed, a shift in reliance from external to internal facial features has been attributed to the familiarity of the faces in face processing during childhood (Ge et al., 2008). Future research should investigate the direct benefit of hairline information in infants' ability to discriminate gender of a face through development.

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