

# Sussex Research

## Facial aesthetics: babies prefer attractiveness to symmetry

CA Samuels, G Butterworth, T Roberts, Ludmila Graupner, Graham Hole

### Publication date

01-01-1994

### Licence

This work is made available under the **Copyright not evaluated** licence and should only be used in accordance with that licence. For more information on the specific terms, consult the repository record for this item.

### Document Version

Published version

### Citation for this work (American Psychological Association 7th edition)

Samuels, C., Butterworth, G., Roberts, T., Graupner, L., & Hole, G. (1994). *Facial aesthetics: babies prefer attractiveness to symmetry* (Version 1). University of Sussex. <https://hdl.handle.net/10779/uos.23325605.v1>

### Published in

Perception

### Copyright and reuse:

This work was downloaded from Sussex Research Open (SRO). This document is made available in line with publisher policy and may differ from the published version. Please cite the published version where possible. Copyright and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners unless otherwise stated. For more information on this work, SRO or to report an issue, you can contact the repository administrators at [sro@sussex.ac.uk](mailto:sro@sussex.ac.uk). Discover more of the University's research at <https://sussex.figshare.com/>

---

## Facial aesthetics: babies prefer attractiveness to symmetry

---

Curtis A Samuels, George Butterworth †, Tony Roberts #, Lida Graupner †, Graham Hole †  
Department of Psychology, University of New England, Armidale, New South Wales 2351, Australia;  
† Division of Psychology, University of Sussex, Brighton BN1 9QU, UK; # Department of Psychology,  
University of Southampton, Southampton, UK  
Received 19 July 1993, in revised form 10 March 1994

---

**Abstract.** The visual preferences of human infants for faces that varied in their attractiveness and in their symmetry about the midline were explored. The aim was to establish whether infants' visual preference for attractive faces may be mediated by the vertical symmetry of the face. Chimeric faces, made from photographs of attractive and unattractive female faces, were produced by computer graphics. Babies looked longer at normal and at chimeric attractive faces than at normal and at chimeric unattractive faces. There were no developmental differences between the younger and older infants: all preferred to look at the attractive faces. Infants as young as 4 months showed similarity with adults in the 'aesthetic perception' of attractiveness and this preference was not based on the vertical symmetry of the face.

### 1 Introduction

Results from various laboratories support the suggestion that infants prefer to visually attend to faces which adults rate as attractive, rather than to faces which adults rate as unattractive (Samuels and Ewy 1985; Langlois et al 1987; Shapiro et al 1987). This is evident at least as early as 2 to 3 months of age and is revealed both in visual and in behavioural preferences for attractive faces (Langlois 1986; Langlois et al 1990). Recently, Langlois et al (1991) found that 6-month-old Caucasian infants showed a consistent preference for attractive faces across the race, gender, and age of the persons photographed, a finding which suggests that a very broad range of attractive faces will elicit preferential looking. The stimuli were photographs of white males and females, black female adults and white female adults, and faces of 3-month-old Caucasian male and female infants.

Of course, the infants' preference for attractive faces may have been learned in the first few weeks of life but it is possible that the preferential looking of babies reveals a universal unlearned aesthetic criterion for facial attractiveness. Whatever the ultimate origin of the preference, it remains to be resolved how infants makes these judgments of facial attractiveness. Does the human visual system have prewired sensitivities to specific physical parameters of facial stimuli? There may be an innate facial schema, as has been suggested by many theorists following Lorenz (1943), which serves the purpose of species recognition. Morton and Johnson (1991) suggested that infants are born with some information about the structure of faces, (the 'CONSPEC' mechanism), which may serve for species recognition and to underpin learning about the particular facial characteristics of significant other persons (through a 'CONLEARN' mechanism). Whether and how such mechanisms are involved in perceiving facial attractiveness has not been specifically addressed.

One approach would be to ask what is the facial quality that affords the description 'attractive'? Possible candidates would include higher proportions of curves rather than angles in the face, larger quantities of high-contrast contours in the face, specific types of features (such as large eyes or long and thin lips), fine rather than coarse features, or the extent of facial symmetry (see eg Eibl-Eibesfeldt 1988). An alternative is that higher order, more holistic, perceptual evaluations could yield a perceptual

judgment of attractiveness. Candidates for what makes a face attractive to an adult might include similarity to a 'baby-face prototype' (Lorenz 1943; Hildebrandt and Fitzgerald 1979), resemblance to mother or to another familiar face (Moreland and Zajonc 1982), similarity to one's own face (Sappenfield and Balogh 1970; Samuels 1986), or similarity to a 'stereotypical' or average face (Langlois and Roggman 1990). Some of these factors might also apply to babies.

In our study we focussed on vertical symmetry as a possible basis for perception of facial attractiveness. The idea that symmetry is intrinsic to beauty is widespread. It can be found in the ancient Greek philosophy of Plato and Aristotle, although it was not necessarily assumed to be an adequate explanation of beauty (see Baldwin 1905). Further reasons for the possible importance of facial symmetry in determining attractiveness come from sociobiology. Moller (1992) has suggested that developmental stressors may result in marked asymmetries in structures, such as the peacock's tail, which serve an important role as markers of 'fitness' for long-term reproductive success. There are also arguments against the importance of facial symmetry in beauty. Secord and Muthard (1955) reported that adults have difficulty in making perceptual judgments of facial symmetry in normal faces. Peck and Peck (1970) examined a set of pictures of famous women who were renowned for their beauty and found notable asymmetry in many of the faces. In fact, few if any people have perfect facial symmetry (Shore 1960).

Photographs of faces used in previous studies with babies did not control for the vertical symmetry of the differentially attractive faces. In fact, faces are not perfectly vertically symmetrical in their structure and so it is possible that the attractive facial photographs were systematically more (or less) symmetrical than the less attractive faces, and this could have been responsible for the observed infant preference for more-attractive faces. Fisher et al (1981) and Bornstein et al (1981) argued that a preference for vertically symmetrical (over horizontally symmetrical or asymmetrical abstract patterns) may develop between 4 and 12 months of age. Bornstein et al actually suggested that the preference for vertically symmetrical abstract patterns may be derived from experience of the vertical symmetry of the human face (Bornstein et al 1981, page 86). Recently, Walton and Bower (1992) have shown that newborns can use vertical facial symmetry to differentiate between faces, so it is possible that symmetry could play an important part, whether innate or acquired, in determining infants' preferences for attractive faces.

It is not clear, therefore, whether facial symmetry contributes to judgments of attractiveness, either in adults or in babies. The purpose in this experiment was to establish whether vertical symmetry of the face may account for the continuity between adults' and infants' visual preferences for attractive faces.

## **2 Method**

### **2.1 Subjects**

The sample consisted of twenty-five infants, ranging from 4 to 15 months of age (mean 7.94 months), thirteen males and twelve females. Infants were chosen to span the age range within which a preference for vertically symmetrical abstract stimuli had been demonstrated in previous research (Bornstein et al 1981). An additional eight infants were omitted from the analyses; four because the infants failed to cooperate during the procedure and did not complete the viewing session or became inattentive to the photographs, and four due to a bias to the left or right side in the infant's looking. A side bias was scored if the infant looked to one side, thus excluding the other side, on at least half of the 24 trials, or if the infant showed a consistent preference for either the right or the left side across all 8 trials within a trial block.

In either of these cases, the side bias must predominate over any stimulus-driven comparison and therefore data from these infants were omitted.

## 2.2 Stimuli

A total of 16 black-and-white photographs of women's faces were selected from a set of 97 pictures. A panel of six adult raters (three males and three females) evaluated the attractiveness of each of the pictures on a 10 point scale where 10 was 'highly attractive' and 1 was 'very unattractive'.<sup>(1)</sup> The overall level of agreement between the six raters was reasonably high (the average interrater correlation was 0.79). The 8 highest with a mean rating (out of 10) 7.1 and lowest exemplars (mean rating 2.4) were selected for inclusion in this study (group average 4.68).

The faces were all of Caucasian females<sup>(2)</sup> aged between 18 and 23 years. They were photographed full face, none wore spectacles, and they were either smiling or had a neutral facial expression (for the 8 attractive faces: 3 were smiling with lips closed, 3 smiling showing teeth, and 2 with neutral expression; for the 8 unattractive faces the numbers were 3, 4, and 1, respectively). Thus the facial expressions were generally comparable between the attractive and unattractive groups. The photographs showed the faces from the crown of the head to the neckline below the jaw (with one exception where a small proportion of the hairline was omitted), and they usually showed the full width of the hair (ie the faces were all framed by the hair). Both the normal full-face presentation and a computer-manipulated chimeric (vertically symmetrical) version of each face were employed in the paired-comparison procedure.

The 16 photographs selected were measured for contrast with the aid of a photometer which provided luminosity readings ( $\text{cm m}^{-2}$ ) for the darkest and lightest parts of each image. There was no significant difference in contrast values for the attractive faces and unattractive faces: contrast values for attractive faces were 84.25%, sd 8.25, and for the unattractive faces 89.75%, sd 6.36. Percentage contrast was calculated as  $(L_{\max} - L_{\min}) / (L_{\max} + L_{\min}) \times 100$ .  $t_{14} = 1.49$ ,  $p = 15$ , not significant.

The 16 black-and-white photographs were digitally scanned into the computer and 'half faces' (created by removing one side along the vertical axis) were computer 'mirrored', to create chimeric faces which were symmetrical about the vertical midline axis. This was accomplished by the use of a Macintosh computer and the Adobe Photoshop software, and laser printouts were made. These, in turn, were photographed to produce slides for use in the experiment.

This procedure yielded a set of 24 attractive faces (8 originals, 8 left chimeras, and 8 right chimeras), and, similarly, 24 unattractive faces. These 48 faces were rated by a new panel of three male and three female adults. The new mean rating for the original (normal) attractive faces was 5.73 (sd 2.11), and for the left and right attractive chimeras as a group was 4.84 (sd 2.39). Unattractive normal faces were rated 2.52 (sd 1.41) on average and the unattractive chimeric mean rating was 2.27 (sd 1.29). As would be expected, the new panel rated the previously selected attractive faces as significantly more attractive than the previously selected unattractive faces, both for the normal photographs ( $t_5 = 7.81$ ,  $p < 0.001$ ) and for the chimeric faces

<sup>(1)</sup> Instructions to the adult raters were: "You will be given a number of photographs depicting women's faces. You should judge how attractive each face is and allocate a score from 1 to 10, which reflects your judgment. A low score, for instance 1, means 'not very attractive' and a high score, for instance 10, means 'very attractive'. Your decisions should be made quickly, and should be based on a first impression. Please write your scores on the score sheet in front of you, against the appropriate serial number."

<sup>(2)</sup> We chose only female faces for this study because in our pilot work we had found that judgments of male faces tended to yield lower attractiveness ratings, generally, compared with the female faces. We did not want to have the set of stimuli composed of male and female faces which differed substantially in their level of attractiveness.

( $t_5 = 4.60$ ,  $p < 0.01$ ). Making chimeras of the faces did not significantly change the ratings for the unattractive faces ( $t_5 = 1.40$ ,  $p = 0.22$ ) whereas, for the attractive faces, the normal facial photographs were rated as significantly more attractive than the chimeric versions of the same faces ( $t_5 = 5.22$ ,  $p < 0.005$ ). Thus, making the unattractive faces vertically symmetrical did not render them more attractive, whereas the attractive faces became, on average, less attractive as chimeras. The data support the suggestion that vertical symmetry does not determine the relative attractiveness of the faces for adults.

### 2.3 *Experimental design*

Since infants were to be presented repeatedly with pictures of the same 16 faces, it was essential to control for the familiarity of the stimuli. It is well known that babies in this age range seek out novelty and they recognise familiar faces, and so our experimental design was carefully constructed to ensure that, when confronted with a pair of faces, each exemplar would be equally novel.

Three main types of paired comparisons, each consisting of 8 trials, were devised. In the first type of comparison we paired attractive faces with unattractive faces directly, both for normal faces and for chimeras. The comparisons made on alternating trials were either an attractive with an unattractive normal face or an attractive chimeric face with an unattractive chimeric face. In the second type of comparison we crossed attractiveness and symmetry of the faces within each trial by comparing attractive normal faces with unattractive chimeric (ie symmetrical) faces on alternating trials, and attractive chimeric with unattractive normal faces on the other trials. In the third comparison we used the two versions of the same person's face, with the normal (therefore asymmetrical) photograph of the face paired with a chimeric (therefore symmetrical) version of the same individual's face, using a different face for each of 8 trials. In half the trials the faces were attractive and in the other half unattractive.

Two independent sets of pairs of stimulus faces were made up: series A and B. For series A all the chimera were made from the left half of the photograph and in series B all the chimera were made from the right half of the photograph. For each of the three types of comparisons, the particular faces used as exemplars were of different individuals. The same parameters were manipulated across the two series of faces, attractiveness, and symmetry. This was done to provide an internal replication of data so that any effects obtained could not be artifacts of the particular pairs of faces shown.

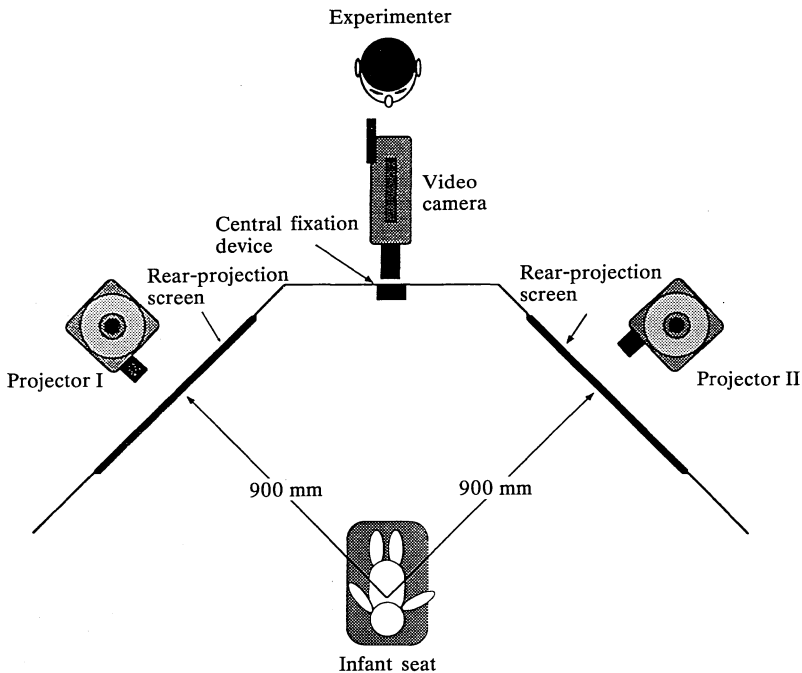
### 2.4 *Procedure*

Mothers brought their infants into our laboratory at the University of Sussex. Infants were placed into an infant seat in front of a rear-projection apparatus at a viewing distance of 90 cm (figure 1). Two Kodak carousel projectors, equipped with electronic shutters, presented the pairs of slides in synchrony. Slide-presentation onset and offset were controlled by the laboratory computer such that the presentation time for each slide pair was exactly 10 s (measured from the time of the infant's first fixation). In previous research it had been suggested that 10 s viewing time is sufficient for infants to reveal a preference for attractive faces (Samuels and Ewy 1985). Length of the intertrial interval was determined by the infant's own visual behaviour. After each trial the infant's attention was attracted to the midline by a small red light, located centrally between the two screens, accompanied by a gentle tone. Fixation was monitored by the experimenter and once the infant had fixated the light for at least 1.5 s the computer was given the command to present the next pair of slides. Infants had 10 s to fixate one (or both) of the paired slides before the computer would end the trial and commence the next interstimulus interval. The stimulus set comprised 24 pairs of slides, subdivided into three blocks of 8 trials each.

The experimental session lasted from 4.6 min to 8 min in total. Several controls were introduced into the procedure. Position (left versus right), order (forward versus reversed)<sup>(3)</sup>, and slide set (series A versus series B) were each counterbalanced as between-group factors.

Before starting the experimental session, the mother withdrew from the infant's visual field and sat centrally 1.5 m behind the infant. The experimenter went to the back of the projection apparatus to observe the baby's visual fixations through a small centrally located peephole. The experimenter could not see the position of the particular slides within each pair, and did not know which stimuli were being presented to the infants, because the computer was programmed to control the actual stimulus presentation. The experimenter knew which of the two stimulus arrays (series A or B) the infant was viewing, whether the infant was viewing the paired slides in the standard or left-right reversed orientations, and also whether the infant was seeing the paired slide sequences in forward or reversed order. Although the experimenter placed the carousel trays onto the slide projectors to enable these control manipulations for forward/reverse order, left/right stimulus position, and exemplar series A/B, the experimenter did not know which particular slides would appear in what order for any given baby, and therefore observations could not be biased.

The left and right visual fixations of the infants were recorded by the observer and stored on the laboratory computer for analysis. Additionally, a videotape record was made of each infant's behaviour during the session so that a measure of interrater



**Figure 1.** A schematic of the paired-comparison rear-projection situation.

<sup>(3)</sup> Only the stimulus sets for the first and second types of comparison were reversed in the control procedures, with the third comparison type (stimulus set 3, which included the same person's face presented both as a chimeric face and as a normal face) always placed after the other two comparison types. This was necessary to control for the familiarity of each face, so that differential novelty or recognition of the faces would not become an additional (and confounding) factor.

reliability could be obtained. In this study, interobserver reliabilities were computed by correlation, trial-by-trial, the total-left and total-right visual fixation times for two observers across all 24 trials for a randomly selected 25% of our sample, yielding a reliability coefficient of 0.92.

### 3 Results

In table 1 the mean fixation times for the three types of comparison involved in the separate phases of the experiment are shown. A repeated-measures ANOVA was conducted with total fixation time as the dependent measure, attractiveness and symmetry as within-subject factors, and sex of the infant, left/right presentation, forward/reverse order of presentation, and stimulus set A/B as between-subject factors. A significant main effect for attractiveness was obtained ( $F_{1,23} = 24.01, p < 0.001$ ), whereas symmetry was not significant ( $F_{1,23} = 1.22, p = 0.28$ ). The sex of the infant and other control variables did not have significant main effects, nor did they yield significant interactions with any of the other factors. The lack of any effect of stimulus set A/B, where the chimeras were based either on the left or on the right side of the photographs, suggests that the side the chimera was based on did not significantly influence preferential looking.

Each of the three blocks of 8 trials was also analysed separately, with looking time as the dependent variable. For this analysis infants were divided into three groups according to age (4 to 6 months, 6.1 to 9.9 months, and 10–15 months).

A three-way ANOVA, attractiveness (2) by symmetry (2) by age of infant (3), was conducted for each trial block, collapsing across the three control variables (forward/reverse order, left/right presentation arrangement, and stimulus set A/B) to yield larger subject numbers in each cell.

In the first type of comparison we used 8 pairs of slides to compare attractive with unattractive faces, separately for the normal faces and for the chimeric faces. The sequence of slides consisted of alternating pairs where a whole attractive face was compared with a whole unattractive face, or a chimeric attractive face was compared with a chimeric unattractive face. Results with this subset of stimuli showed the same trend as for the data as a whole, although the contrast between attractive and unattractive faces did not quite reach statistical significance. Infants tended to prefer attractive over unattractive faces, but there was no difference in looking time between normal and chimeric faces. Summing across whole and chimeric stimuli, the attractive faces recruited an average of 3.67 s (sd 0.92 s) whereas the unattractive faces recruited an average of 3.33 s (sd 0.91 s) looking time ( $F_{1,22} = 3.04, p = 0.095$ ). Summing across attractive and unattractive faces, there were no significant differences between the normal and chimeric faces in the overall amount of visual attention recruited (3.46 versus 3.63 s), respectively (sd 0.69 and 0.89 s) ( $F_{1,22} = 1.04, p = 0.32$ ). There was no

**Table 1.** Infants' mean fixation times (in seconds) for normal, chimeric, attractive, and unattractive faces across the three phases of the experiment; see text for details of comparisons.

Stimulus type	Type 1 comparisons	Type 2 comparisons	Type 3 comparisons
Normal attractive	3.79	4.09	3.04
normal unattractive	3.14	–	–
chimeric attractive	–	4.29	2.81
Chimeric unattractive	3.53	3.1	2.64
chimeric attractive	3.74	–	–
normal unattractive	–	2.66	2.75

main effect for age ( $F_{2,22} = 0.78, p = 0.47$ ), nor were there any significant two-way or three-way interactions between attractiveness, symmetry, or age.

In the second type of comparison we used 8 pairs of slides to cross the attractive/unattractive contrast with the normal/chimeric contrast. The sequence of slides consisted of alternating pairs where a normal attractive face was compared with a chimeric unattractive face, or a chimeric attractive face was compared with a normal unattractive face. This contrast produced the clearest evidence for the importance of attractiveness independently of symmetry. Summing across whole and chimeric stimuli, the attractive faces received significantly more visual attention than did the unattractive faces: 4.19 s and 2.88 s, respectively ( $F_{1,22} = 23.55, p < 0.001$ ). However, summing across attractive and unattractive faces, the normal and chimeric faces did not differ significantly in their ability to attract the infants' attention (3.37 and 3.69 s, respectively,  $F_{1,22} = 1.17, p = 0.29$ ). Again, there was no main effect for age of the infant, nor were there any significant 2-way or 3-way interactions of age with attractiveness and symmetry. These results are in agreement with the suggestion that the preference for attractive faces is present throughout the age range: it cannot be a consequence of development of a preference for vertically symmetrical stimuli during the first year of life.

In the third type of comparison we used 8 pairs of slides to compare the two versions of the same person's face directly (the normal photograph and the chimeric version of that same face). These 8 trials were always presented last because the subset of the faces would be being seen by the infants for the second time in the same experiment. Although the pairs of faces were equally familiar to the babies, they were no-longer novel. Another difference, over the previous sets, was that identity of the face was also introduced into the comparison for the first time. This set was the only one not to yield any evidence of a preference for attractiveness. Summing across normal and chimeric stimuli, the average looking times to the attractive (2.92 s) and unattractive (2.69 s) stimuli did not yield a preference for the attractive stimuli ( $F_{1,22} = 1.65, p = 0.21$ ). Summing across attractive and unattractive faces neither the normal face nor the chimeric face was significantly preferred to the other (2.89 versus 2.73 s, respectively) ( $F_{1,22} = 0.39, p = 0.53$ ). There was no significant effect for age of the infants, either as a main effect or in interaction.

The average looking time per stimulus for the final block of 8 trials (2.8 s) was rather lower than the average for the counterbalanced first and second blocks (3.5 and 3.5 s, respectively) and so there may have been some effect of fatigue which might have eliminated the preference for attractive faces. A variety of other explanations also seems possible. For example, differences in visual inspection time for attractive faces may only be revealed for unfamiliar faces [Langlois et al (1990) have independently suggested this]. Alternatively, since the identical face was presented in normal and chimeric forms, there may have been little to choose in attractiveness between the two versions of the same face. Perception of the identity of the face within each trial may have eliminated any need for a comparison between faces on the basis of attractiveness, across trials.

#### 4 Discussion

Our results lead us to suggest that the attractiveness of the face is not determined for infants (or adults) solely by symmetry around the vertical midline. Human infants were found to look longer at photographs of faces which adults rated as very attractive than at photographs which adults had rated as unattractive. This was a robust effect which held both for normal photographic representations of faces and for computer-constructed facial chimera. It is clear that differences in infants' visual inspection times for attractive faces cannot have been due to the vertical symmetry of



the faces. In each of three paired comparisons the vertical symmetry of the face did not recruit any more visual attention from the infants than was elicited by normal faces. To reiterate, although facial attractiveness, as rated by adults, was significantly able to attract and hold infants' visual attention, facial symmetry did not differentially attract the infants' visual attention. Thus, although we cannot positively define from this study what ultimately determines facial attractiveness for babies, we can say that it is not simply vertical symmetry about the midline.

How might the preference for attractive faces arise? The results obtained in this and in prior research (Samuels and Ewy 1985; Langlois et al 1987; Shapiro et al 1987) show that infants, even as young as 2 or 3 months of age, show a visual preference for attractive over unattractive faces even when the faces are of different races and cultures. This makes it unlikely that perception of facial attractiveness is merely a matter of learning a particular cultural convention. Of course, this would not preclude the possibility that a general preference for attractive faces is learned through specific experiences in the first 2 or 3 months of life.

Recent evidence that superimposition of faces by computer renders the averaged face more attractive than the individual constituents has been used to argue for a 'prototype theory' of facial attractiveness (Langlois and Roggman 1990). In real life, a prototypical facial schema may correspond to an 'ideal type' derived from experience of real faces. For this argument to be plausible developmentally, much would depend on how many different faces the young infant would need to see to extract a prototype. An alternative is that the preference is based on an 'archetype' to which particular faces are assimilated. An archetype is defined as the facial structure of an individual at a given age that would be produced as a function of optimal growth, ie a face that has not undergone stressful deformation (Carello et al 1989, page 231; or see Alley 1988). This hypothesis is based on the assumption that the face carries evidence of its own growth process and that optimal growth is an index of maximal attractiveness. This hypothesis seems equally plausible to the prototype theory on the available evidence. However, a further problem with explaining the origins of facial attractiveness, whether in terms of prototypes or archetypes, is that neither theory actually explains why the ideal type of face should be perceived as attractive.

Infant visual-inspection times and adult ratings imply that attractive faces have greater 'positive valence', they attract looking. This aspect of face perception might correspond to what Schneirla (1962) called 'aesthetic perceiving', defined as the capacity for perceiving objects in evaluative terms. Whatever theory proves to be applicable to early-infant data, it still needs to explain the evaluative aspect of face perception, already evident early in development. In this study we have demonstrated that a plausible basis for the evaluative aesthetic aspect of face perception, namely vertical symmetry, is not actually responsible for the perceived attractiveness of the face.

**Acknowledgments.** We should like to acknowledge useful discussions with Dr T Diffey on aesthetics, Dr P Green on sociobiology, and Mr C Crook and Mr T Stubbens for their assistance with the technical aspects of the experiment.

#### References

- Alley T R, 1988 *Social and Applied Aspects of Perceiving Faces* (Hillsdale, NJ: Lawrence Erlbaum Associates)
- Baldwin J M, 1905 *Dictionary of Philosophy and Psychology. Beauty* Volume 1 (London: Macmillan) pp 104-109
- Bornstein M H, Ferdinandsen K, Gross C G, 1981 "Perception of symmetry in infancy" *Developmental Psychology* 17 82-86
- Carello C, Groszofsky A, Shaw R E, Pittenger J B, Mark I S, 1989 "Attractiveness of facial profiles is a function of distance from archetype" *Ecological Psychology* 1 227-251

- 
- Fisher C B, Ferdinandsen K, Bornstein M H, 1981 "The role of symmetry in infant form discrimination" *Child Development* **52** 457-462
- Hildebrandt K A, Fitzgerald H E, 1979 "Facial feature determinants of perceived infant attractiveness" *Infant Behavior and Development* **2** 329-339
- Langlois J H, 1986 "From the eye of the beholder to behavioral reality: The development of social behaviors and social relations as a function of physical attractiveness", in *Physical Appearance, Stigma, and Social Behavior: The Ontario Symposium* Volume 3, Eds C P Herman, M P Zanna, E T Higgins (Hillsdale, NJ: Lawrence Erlbaum) pp 23-51
- 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, Rieser-Danner L A, 1990 "Infants' differential social responses to attractive and unattractive faces" *Developmental Psychology* **26** 153-159
- Lorenz K, 1943 "Die angeborenen Formen möglicher Erfahrung (Innate forms of possible experience)" *Zeitschrift für Tierpsychologie* **5** 233-409
- Moller A P, 1992 "Female swallow preferences for symmetrical male sexual ornaments" *Nature (London)* **357** 63 75 238-240
- Moreland R L, Zajonc R B, 1982 "Exposure effects in person perception: Familiarity, similarity and attraction" *Journal of Experimental Social Psychology* **18** 395-415
- Morton J, Johnson M H, 1991 "CONSPEC and CONLEARN: A two-process theory of infant face recognition" *Psychological Review* **98** 164-181
- Mothersill M, 1984 *Beauty Restored* (Oxford: Clarendon Press)
- Peck H, Peck S, 1970 "A concept of facial aesthetics" *Angle Orthodontist* **40** 284-317
- Samuels C A, 1986 "Bases for the infant's developing self-awareness" *Human Development* **29** 36-48
- Samuels C A, Ewy R, 1985 "Aesthetic perception of faces during infancy" *British Journal of Developmental Psychology* **3** 221-228
- Sappenfield B R, Balogh B, 1970 "Perceived attractiveness of social stimuli as related to their perceived similarity to self" *Journal of Psychology* **74** 105-111
- Schneirla T C, 1962 "Psychology, comparative", first published in *Encyclopaedia Britannica* Reprinted in 1972 in *Selected Writings of T C Schneirla* Eds L R Aronson, E Tobach, J S Rosenblatt, D Lehrmann (San Francisco, CA: W H Freeman) pp 30-86
- Secord P F, Muthard J E, 1955 "Personalities in faces: IV. A descriptive analysis of the perception of women's faces and the identification of some physiognomic determinants" *Journal of Psychology* **39** 269-278
- Shapiro B, Eppler M, Haith M, Reis H, 1987 "An event analysis of facial attractiveness and expressiveness", paper presented at the Biennial Meeting of the Society for Research in Child Development, Baltimore, MD, April 1987
- Shore I L, 1960 "A cephalometric study of facial symmetry" *American Journal of Orthodontics* **46** 789
- Walton G E, Bower T G R, 1992 "Newborn discrimination of symmetrical faces", paper presented at the International Conference on Infant Studies, Miami, Florida, USA, May 1992