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Abstract

This study investigated attractiveness ratings of individual faces and facial prototypes while controlling for symmetry. Symmetry was controlled by comparing symmetric individual faces to prototypes composed of 2, 4, 8, and 16 symmetric faces, morphed together by blending facial features such as eyes, nose, eyebrows, mouth, and outer contour. Adult male and female participants ($N = 139$, M age = 19.12 years) viewed stimuli presented on a computer monitor and rated the attractiveness of each facial stimuli on a 10 point scale, with higher values representing increased attractiveness. Results indicated that attractiveness ratings increased as the number of faces in the prototype increased, $F(4,104) = 145.24, p<.0005$. Since symmetry was controlled in this study, other factors must contribute to a prototype's attractiveness.

The Perceived Attractiveness of Adult Facial Prototypes

Clearly, facial attractiveness maintains an importance influence in society. Attractiveness factors into mate selection, first impressions, judging other's personality, and even job selection and judgments of competence (Eagly, Ashmore, Makhijani, & Longo, 1991). What aspects of faces account for the scientific basis underlying attraction? In light of the awareness of the importance of facial attractiveness, researchers are attempting to determine what makes a face attractive, approaching the problem from different theoretical orientations. Some researchers explore how prototypical faces may appear more attractive (Langlois & Roggman, 1990). Other theories investigate the symmetry of faces and its relation to perceived attractiveness (Perrett, Burt, Penton-Voak, Lee, Rowland, & Edwards, 1999; Grammer & Thornhill, 1994). Yet another line of research crosses over into the biological implications of attractiveness and choosing a mate to produce strong offspring (Barber, 1995; Kalick, Zebrowitz, Langlois, & Johnson, 1998). Regardless of the underlying mechanisms emphasized by each theoretical orientation, these approaches share a common theme: uncovering the variables which contribute to a universal standard of beauty.

Despite the various approaches, thus far researchers have not integrated the study of prototype formation, symmetry, and attractiveness into a well-defined approach. For example, Langlois and Roggman (1990) investigated attractiveness ratings of facial prototypes without controlling for symmetry. This study focuses on the cognitive processes involved in determining facial attractiveness, specifically cognitive processes used in prototype formation. As defined in this study, a *prototype* is a facial image created from individual faces that have been combined together through a morphing process. The morphing process imitates the cognitive processes of naturally creating prototypes, since individuals are believed to mentally create prototypes of commonly viewed patterns, such as the adult face (Posner & Keele, 1968). Pattern matching integrates the most common features that are perceived to be similar. In the present study, images were morphed to create prototypes by matching facial features and contours: lips to lips, nose to nose, eyes to eyes, eyebrows to eyebrows, and facial outline to facial outline. In repeated studies participants rated prototypical faces as more attractive than individual faces (Rhodes, et al., 2001).

As faces are morphed together to create prototypical faces, the images of individual faces that normally embody varying degrees of asymmetry gradually form a more symmetric composite of faces. Particularly, Langlois and Roggman's (1990) study showed higher mean ratings of attractiveness for composites using higher numbers of faces. In the past, research investigating facial prototypes commonly critiqued that symmetry confounds the comparison of the attractiveness of individual faces versus prototypical faces (Alley & Cunningham, 1991). Some progress was made to eliminate the confounding variable and to improve upon other methodologies, again showing that participants rated prototypical composites of faces higher in attractiveness than individual faces (Rhodes, et al., 2001).

Facial Prototypes

Individuals see a face and cognitively process their opinions in terms of the preference for the face, and ultimately, the face's attractiveness. As individuals see more and more faces, a stereotyped idea of what a face should look like forms from the faces each individual has seen. Kagan (1985) described the creation of this face as a schema:

> The schema is a representation of experience that bears a relation to an original event....The schema cannot be an exact copy of reality, for the mind cannot register every feature of an event, even one as meaningful as a mother's face. Further, succeeding exposures to an event are never identical; because the mind related the second experience to the first, and the third to the second, while recognizing the subtle variations, it probably creates a composite of all experiences. The composite, called a schematic prototype, is not identical with any single prior experience and therefore, is the mind's construction. (pp. 35-36).

This cognitive approach furthermore implies that the formation of prototypes using general information-processing mechanisms seems to be the reason for the social preference of attractiveness (Rubenstein, Kalakanis, & Langlois, 1999).

In short, people prefer to look at faces that resemble the prototypical face that they have cognitively created, perhaps because they are easier to classify. Kagan (1985) explained that the mind creates a *schematic prototype* or an idealized "average" from all previous exposures to a certain class of stimuli. Research found that when individuals classify sets of patterns that are distortions of a prototype, they can classify the previously unseen prototype more easily than the other patterns (Posner & Keele, 1968). Franks and Bransford (1971) composed patterns that varied in degree (in terms of feature characteristics) away from a prototype, and presented them to participants. They found that confidence ratings in the recognition of patterns were inversely related to the distance from the prototype, with the prototype receiving the highest confidence recognition rating. Solso and McCarthy (1981) found that recognition memory for a never-before-seen prototypical face made up of features contained in faces presented to participants was judged as previously seen with more confidence than faces that had actually been seen. This tendency was found to last six weeks.

Prototypical faces are perceived as generalizations of previously observed objects, but how fast does this process happen? Walton and Bower (1993) found that newborns created prototypes in less than 1 minute with a limited number of faces. Despite the finding that prototypes can be formed quickly, researchers still cannot conclude when the prototype is formed. Posner and Keele (1968) discussed whether the visual information involved in recognizing the schema or prototype is cognitively processed during the viewing of the original patterns (faces in everyday life) or during the presentation of the schema (when a prototypical face is viewed). All of these findings supported that acquired memory representations work in terms of a schema composed of a prototype and transformations (Franks & Bransford, 1971). Kagan (1985) simplified the mental processes by giving an explanation of three simultaneous assessments. The mind determines the frequency of similar features, their physical salience, and the relative uniqueness as compared to other classifications. Using these three criterias, the mind creates a schema. It still remains unclear when this schema develops.

Regardless of when the facial schemas are developed, researchers used an array of methods to create facial prototypes. Various research studies conducted in the past used some form of multiple composite faces to determine that prototypical faces are rated higher in attractiveness. Participants perceived high attractiveness for a face when the whole face was close to the average of a population of faces (Langlois, Roggman, & Musselman, 1994). If individuals develop prototypes that are used to stereotype based on attractiveness, then it should follow that composites of combined faces will rate higher in attractiveness than most individual faces. Research using different methodologies for creating prototypes supported this hypothesis (Langois & Roggman, 1990; Rhodes, Harwood, Yoshikawa, Nishitani, & McLean, 2002; Rubenstein, Langlois, & Roggman, 2002).

To understand how prototypical facial images differ from averaged images, distinctions must be made. Averaged images represent truly *mathematical* averages; this method creates prototypes using the gray values of the pixels from the original black and white images, and averages the pixel values together to create the new, averaged image (Langlois and Roggman, 1990; Langlois, Roggman, & Musselman, 1994).

Pittenger (1991) criticized the methodology of Langlois and Roggman's (1990) study because computing averages with gray levels in a set matrix does not take into consideration positions of features. See Figure 1 for examples of pixel-averaged faces used in Langlois and Roggman's (1990) study. Langlois and Roggman (1990) report having to smooth double edges. Pittenger (1991) stated that this occurs because some traits are bimodally distributed, for example people either have large eyes or small eyes. So if eyelids do not match up in location, the averaged image will then produce two eyelid lines. Rhodes (2004), and Rhodes, Harwood, et al. (2002) utilized feature matching techniques, not pixel averaging, to research prototypical face perception cross-culturally.

The statement, "beauty is in the eye of the beholder," is unsupported in the literature because there are many consistencies in what people of different cultures find attractive. Past research demonstrated that participants rated morphed faces as more attractive than most individual faces, even in non-Western cultures (Rhodes, 2004).

Other researchers (Rhodes, Harwood, et al., 2002) showed that both Chinese and non-Chinese individuals rated composites of black and white Chinese faces as higher in attractiveness as the number of component faces increased. This study not only showed support for prototype preferences in other cultures, but also agreement in ratings of attractiveness cross-culturally. In a second phase of Rhodes, Harwood, et al.'s (2002) research, Japanese individuals also found that average, own-race, color composites gained in attractiveness ratings as the number of faces in the composite increased. The overall conclusions indicated that there was no preference for own-race averaged composites over other-race or mixed-race composites. No one has yet published a study examining the differences in attractiveness ratings between an individual face of the participants' culture and a composite face from a different culture.

Furthermore, research in preference of facial prototypes is extended to other ages. Langlois and Roggman (1990) found that adults perceived prototypes (composites) of faces as more attractive and preferable than individual faces based on rating scales of attractiveness. They also found that infants looked longer at the same prototypical faces that adults rated as more attractive than individual faces, indicating that infants preferred the same prototypical faces that adults found attractive. Rhodes, Geddes, Jeffery, Dziurawiec, and Clark (2002) also found that 5- to 8-month-old infants showed sensitivity to differences in averageness and symmetry as measured by how much time infants look at the faces; however, results were not significant. Langlois and Roggman (1990) explained that infants prefer prototypical faces since they are easier to classify as a face than individual faces, given that a combined image closely resembles what an infant may already identify as a face. Preferences for attractive faces are relatively standard across ages and cultures, so Langlois et al. (1994) concluded that attractiveness may be innate or acquired very early.

Even though evidence exists that conceptions of attractiveness are present early in life, the specific factors contributing to attractiveness remain unknown. Attractiveness could depend on the perception of the face as a whole or the individual features. An important distinction remains between features of the face and the configuration of the face as a whole. In studying prototypes, the attractiveness of prototypical faces is not optimal, but participants perceive them as attractive. Some extreme traits remain more attractive than average traits, but average configurations appear more attractive than most faces (Rhodes, 2004). Through the process of morphing faces to create facial prototypes, the configuration of the face becomes more and more average as the number of faces in the prototype increases. Perhaps, an ideal configuration of the human face even exists.

One concept originating with the ancient Greeks is adaptable to the human face. Many naturally occurring objects, such as the spiral of shells and the petals of flowers, follow the "Golden Proportion" or phi, which is a ratio of 1:1.61803… (*Plan to add figure of DaVinci's drawing from book to demonstrate concept, waiting for approval for use). In creating objects, architects and artists utilize the golden ratio to make the object more visually appealing (Hemenway, 2005). The Greeks used it in constructing the Parthenon and DaVinci adapted the Golden Proportion into his works of art. DaVinci even used the ratio in placing features in his painting of human faces (Rubenstein, Langlois, & Roggman, 2002). Could this natural proportion be the key to unlocking why prototypical faces appear more attractive? Participants rated prototypes as more attractive than individual faces repeatedly (Langlois & Roggman, 1990; Rhodes, Harwood, et al., 2002; Rubenstein et al., 2002), but what makes these prototypical faces more attractive? Despite the fact that researchers recognize the phi ratio, examining faces according to the Golden Proportion escaped mainstream psychological analysis.

Social Factors and Gender in Facial Attractiveness

Attractiveness puts children and adults at a significant social advantage in almost every judgment, treatment, and behavior examined (Langlois et al., 2000). In a meta-analysis Eagly et al. (1991) concluded that studies revealed more favorable personality traits and more successful life outcomes to attractive people. The results are particularly significant for studies regarding social competence. Adults and children who are attractive were judged and treated more favorably, even by those individuals that knew them. In addition, attractive children and adults exhibited more positive behaviors than unattractive individuals (Langlois et al., 2000).

Ratings of facial attractiveness showed consistencies across cultures and ages, but not always across genders. Certain types of individual features are preferred in terms of attractiveness, but differ based on gender. Examples of this include the attractiveness of a small nose in women and a large chin in men (Cunningham, Barbee, & Philhower, 2002). The distance between eyebrows is proportionally smaller in males and the brows are usually heavier. A pronounced jaw-line positively impacts attractiveness of males (Barber, 1995). Brown & Perrett (1993) found more importance to gender identification in the vertical, rather than the horizontal, dimension of a male's jaw. In males, prominent cheek bones advertise social dominance; but large eyes and large smile indicate sociability. In females, a small nose and chin, but large lips and short eye-chin distance advertise sexual maturity. Large eyes and a large smile, as well as high eyebrows, indicate perceived sociability in females (Barber, 1995).

Size and shape of men and women's faces differ (Brown & Perrett, 1993). When isolating features or pairs of features and placing them on a prototypical male or female face, Brown and Perrett (1993) found that the jaw, brows and eyes, and chin all held information about the perceived gender of the face. In fact, every feature seemed to hold such information, except the nose. Single feature perception may also give information on attractiveness, which supports a connection to Brown and Perrett's (1993) findings that showed feminine features as attractive in females. Gender characteristics and specific features appear to be linked to perceived attractiveness, but do not account for all facets of attractiveness. Data supported the contention that facial symmetry is positively related to perceived attractiveness (Grammer & Thornhill, 1994).

Symmetry

When creating a prototype, the facial image becomes more symmetric as more faces are morphed together. If the left eye is lower than the right on one facial image and the right eye lower than the left on another, then these types of asymmetries begin to average out and the prototypical image becomes more symmetric, both vertically and horizontally. Since these images become so unusually symmetric, Alley and Cunningham (1991) criticize prototypical facial research. They believe that symmetry, not averageness influenced the high attractiveness ratings (Alley & Cunningham, 1991). In general, individuals prefer symmetry, especially vertical symmetry, to asymmetry (Rock & Leaman, 1963), and facial symmetry is measured about the vertical axis. Langlois et al. (1994) instructed participants to rate female facial stimuli for symmetry, including original faces, attractive faces, unattractive faces, a 32-face averaged image, and two mirror-image faces. They found that the raters agreed with each other about the degree of symmetry of each of the images. Also, participants rated the mirror image faces as significantly more symmetric than the individual faces. Yet, there was no significant relationship between the symmetry ratings and attractiveness ratings. This showed that the participants perceived the symmetry of the faces consistently, but there was no direct connection to the attractiveness ratings.

Symmetry often links to higher perceived attractiveness of facial images. Perrett et al.'s (1999) study showed that participants chose symmetric faces as a preference more often than chance. However, in their debriefing sessions, the majority of participants stated that they did not notice a manipulation of symmetry, even though results indicated a preference for symmetric faces. In a study by Grammer and Thornhill (1994), participants rated composite female faces (produced by using a pixel blending technique) as more symmetric and attractive than individual female faces. When using a partial correlation analysis, facial symmetry was still a predictor of facial attractiveness, but removing symmetry eliminated the significant relationship between facial averageness and ratings of attractiveness.

The following studies showed evidence for a preference for symmetry in faces. Gangestad, Thornhill, and Yeo (1993) reported that asymmetry may fluctuate over time, and as an individual ages, more asymmetries may accrue. Facial attractiveness was found to be negatively correlated with fluctuating asymmetry (Gangestad et al., 1993). Moreover, findings showed that there is a preference for perfect facial symmetry over faces with normal levels of asymmetry (Perrett et al., 1999).

Consistent with facial prototype research, studies across age groups discovered a preference for symmetry in faces. Evidence suggested that facial symmetry had a positive impact on human mate selection in adults (Perrett et al., 1999). Even infants showed a looking preference for perfectly-symmetric faces compared to low-symmetry faces (Rhodes, Geddes, et al., 2002).

The preference for symmetric faces has a biological basis. Rhodes et al. (2001) concluded that a preference for symmetry, and even averageness, may have evolved to demonstrate health, developmental stability, and other traits of mate quality. Symmetry may not only demonstrate a sign of genetic quality, but also influence mate selection (Perrett et al., 1999). Furthermore, faces that are more symmetric may indicate better immunocompetence and parasite resistance than those faces with asymmetries (Gangestad et al., 1994). Some studies even indicated that facial averageness is a reliable indicator of health (Rhodes, Harwood, et al., 2002). However, another study concluded that although facial appearance was an indicator of health in adolescence, in further statistical analysis the variable of attractiveness suppressed the correlation between attractiveness and health (Kalick et al., 1998).

Theories about the implications of health only support one side of the debate about whether or not symmetric or asymmetric faces are perceived as more attractive. Some research indicated that asymmetric faces were more attractive than symmetric faces due to their distinctiveness and dominant traits, especially in the case of males (Perrett, May, & Yoshikawa, 1994). But, research indicated more support for the opposing view; symmetric faces were indicative of good health and attractiveness (Gangestad et al., 1994).

The Present Study

The present study investigated the hypothesis that facial prototypes are more attractive than individual faces, while controlling for symmetry. Human faces provide us with an overabundance of important information necessary for social interactions (O'Toole et al., 1998). Facial attractiveness research illustrates implications in the media, sexual relationships, and social acceptance. Preferences for facial averageness and symmetry may be evolved, biologically based standards of beauty (Rhodes et al., 2001).

Past methodologies using mathematical averaging are no longer the standard procedure for creating prototypical faces. Instead, methodologies that morph features rather than overlapping pixels remove many of the discrepancies between individual and prototypical faces, such as irregularities in complexion and ghostlike double images. Perceptually, symmetry consistently confounds past research. By controlling for symmetry, one can draw firmer conclusions regarding the attractiveness of individual and prototypical faces to clarify variables important in perceiving attractiveness.

Matching the shape and locations of facial features better supports the cognitive processes in mental prototype formation, since one's mind would not combine faces as a whole with out matching features. Posner and Keele (1968) found that prototypes share the most common properties with a set of patterns; facial features would be these properties. Individuals were also found to generalize what they had seen from previous experiences (Posner & Keele, 1968), providing further evidence that the mind creates prototypes or schemas.

Despite the importance of facial prototype theories in cognitive research, not much research has explored subpopulations of faces, such as gender (O'Toole et al., 1998). To lend additional insight into gender in the present study, attractiveness ratings of prototypes of males were compared to prototypes of females, as well as symmetric individual faces of both genders.

To further study the implications of facial symmetry on perceived attractiveness, this study used Gryphon's Morph Program (Burns, 1994) instead of Langlois et al. (1987, 1994) and Langlois and Roggman's (1990) pixel averaging technique to create symmetric individual and prototypical faces. Gryphon's Morph Program matches the shapes and locations of anatomical features using a spatially warped, cross-fade technique, which does not create the criticized double lines of pixel averaging. This removes ghost-like shadows, as seen in Langlois et al.'s (1994) research that may distract the participants from properly rating the images for attractiveness. It is also capable of creating colored images. Rhodes, Harwood, et al. (2002) did not utilize the ability to create composites using color photographs when using Gryphon's Morph program.

The present study improved the methodology of Langlois et al. (1987, 1994) and Langlois and Roggman (1990) by controlling symmetry as a confounding variable. Critics often state that asymmetric variations between individual faces and composites confound much of the research on facial prototypes (Alley & Cunningham, 1991; Langlois et al., 1994); however, until now there has not been an attempt to compare attractiveness ratings between symmetric individual faces and prototypical faces made up of symmetrical individual faces. It is predicted that as more images are added to create a facial prototype, the more attractive the prototype will appear.

Hypotheses

In the current study, several outcomes are expected, but the results are not hypothesized to be as strong as some of the previous studies' results in symmetry and averageness of facial perception. For the *first prediction*, symmetric individual faces are expected to receive higher ratings in attractiveness than the individual faces. However, since symmetric, mirror-image faces are usually rated higher in attractiveness than individual faces (Rhodes et al., 2001), and prototypical faces are also rated higher in attractiveness than individual faces (Langlois et al., 1994), the difference between the ratings of symmetric faces and prototypes of symmetric faces is expected to be smaller due to the control of symmetry adapted in this study.

For the *second prediction*, participants are expected to rate prototypes higher in attractiveness than the symmetric individual faces. The 16-face composites of each male faces and female faces will rate highest in attractiveness and probably will be the only prototype that will yield significant results. Langlois and Roggman (1990) only found significant differences between 32- and 16- face male and female composites when compared to individual faces. From there, the average ratings of attractiveness of the prototypes are expected to decrease; 8-face, 4-face, and 2-face composites, respectively.

In addition to the comparison of prototypical, symmetric individual, and asymmetric individual faces, an expectation exists in relation to the participants. Often in studies involving ratings of attractiveness, female participants rate male and female faces higher than male participants (Grammer & Thornhill, 1994). This *third prediction* is expected to be the case in this study as well. Regardless of the sex of the stimuli, it is hypothesized that on average females will give higher attractiveness ratings to faces than males.

Method

Participants

One-hundred thirty-nine undergraduate students (57 males and 82 females, mean age = 19.12 years, 86.2% white, 7.3% black, 1.8% Hispanic, 0.9% Asian/Pacific Islander, and 3.7% other) at a small, Midwestern liberal arts university volunteered to participate in a study of face perception. Students enrolled in General Psychology received a research credit in order to fulfill a course requirement.

Stimuli

Sixteen male and 16 female caucasian college students were photographed (Kodak EasyShare DX7440) with a neutral facial expression against a white background. All pictures were taken in the same lighting conditions. Only pictures of males without facial hair were used. Females were asked to wear no makeup and pull their hair back. Adobe Photoshop was used to crop the photos so that only the portion of the face from the middle of the forehead to below the chin remained. To assure that each photo had the same dimensions, the resolution of each photograph was 640 X 480 pixels. Prior to morphing images, blemishes or irregularities in complexion were also eliminated using Adobe Photoshop, since morphing photographs tends to produce smoother textures.

Gryphon's Morph Software (Burns, 1994) was used to create stimuli. This program creates a morphed image by combining two other images. The morphing process has the advantage of spatially morphing features. Asymmetry normally exists in individual faces; asymmetry can be eliminated by the morphing process. Gryphon's

Software morphs features using a spatially warped, cross-fade, an advantage over software that mathematically averages pixels, creating ghost-like images. It also allows for pattern matching of specific features, including the outline of the eyes, pupils, eyebrows, nose, nostrils, outer contour of each lip, and outer contour of the facial shape. Gryphon's Morph Program has been used by other researchers investigating face perception and is an accepted standard (Swaddle & Cuthill, 1995; Rhodes, Harwood, et al., 2002).

First, symmetric versions of each individual face were produced by morphing a face with its mirror image to conserve face and trait sizes and placements. Each individual symmetric face was given a random identification number. These faces were then randomly assigned to prototypes, assuring that within the same prototype set, the only repetition of individual faces would be in the composite comprised of all 16 faces. Two separate sets of prototypes were created, with different faces comprising the prototypes of each set (except for the 16-face prototypes). This provided additional assurance that the random placement of individual faces in the prototypes does not result in the most attractive faces comprising the 2-, 4-, and 8-face prototypes. Since two faces were not used in each set of prototypes (2-, 4-, and 8-face), those two faces were in 2-, 4- or 8-face composites in the other set. During this process only identification numbers were used; the faces could not be seen to ensure that the experimenter did not visually bias the placement of faces into a prototype.

Then research assistants morphed symmetric individual facial images into male and female prototypical facial composites. Eight male and eight female composites were created, composed of the following number of faces: 2 faces, 4 faces, 8 faces, and 16 faces. Three computer files were created for presentation. The first file consisted of the 32 individual asymmetric faces. The second and third files each consisted of the 32 symmetric individual faces and one example of each of the level of the prototypes for both genders. Between the two groups each face was used in at least one composite, besides the 16-face composite. Within each file, the faces were randomly assigned positions in a slide show.

Design and Procedure

The procedure consisted of two phases, using different slide show presentations. Participants in phase 1 did not participate in phase 2, to assure that familiarity with the faces would not confound the attractiveness ratings. The participants in phase 1 saw 32 asymmetric individual faces. The participants in phase 2 saw 32 symmetric individual faces and 8 prototypical faces. Phase 1 was conducted to test the first prediction that symmetric individual faces in phase 2 would receive higher attractiveness ratings than asymmetric individual faces in phase 1.

Phase 1: Thirty participants reported to a psychology classroom at a designated time. Participants were not permitted to see other participant's ratings. After informed consent was obtained, participants were given an example of the task to make sure that they understood the rating process. Participants were instructed to rate individual faces with respect to perceived attractiveness. Participants were asked to rate each face on a ten-point scale, with 1 being "very unattractive" and 10 being "highly attractive." Each face was projected on a screen for 10 seconds, followed by a blank screen for 5 seconds using Microsoft PowerPoint. While the blank screen was displayed, participants responded by writing their attractiveness rating on paper before being shown the next face. Participants were shown a total of 16 male faces and 16 female faces; they were not familiar with any of the faces.

Phase 2: One-hundred nine participants reported to a psychology lab at a designated time in small groups of 16 or less. After informed consent was obtained, participants were assigned to a computer. The faces for each presentation were loaded into MediaLab (Empirisoft, 2002) for controlled appearance and timing. One 4 in. X 6 in. color facial image was presented per slide on a 15 in. computer monitor. After the presentation of each facial image, a question appeared asking the participant to rate the previous face in terms of perceived attractiveness, using the same scale described in phase 1. Stimuli in phase 2 consisted of symmetric individual faces and 8 prototypical faces. Prototypical faces were composed of 2 faces, 4 faces, 8 faces, or 16 faces. This set was repeated for both male and female faces. All together each participant viewed 20 male faces and 20 female faces, for a total of 40 faces (32 individual, morphed symmetric faces and 8 prototype faces). There were two groups for this phase, using different faces in the prototypes (except for the 16-face prototype).

Results

Seven attractiveness ratings identified as extreme outliers (defined as values greater than 3 box lengths in the SPSS box plot), were removed from the data set because they were assumed to be typing errors. One participant's data was completely eliminated due to a lack of variability in the scoring. An alpha level of .05 was used in all statistical analyses.

Contrary to the first hypothesis that participants would rate symmetric individual faces higher in attractiveness than individual faces, the overall mean ratings for individual faces ($M = 4.65$, $SD = .69$) was significantly higher than the overall mean ratings of the symmetric individual faces ($M = 4.48$, $SD = .92$), $t(1) = 53.71$, $p<.01$.

The second hypothesis predicted that participants would rate prototypical faces with more faces higher in attractiveness than symmetric individual faces. The differences in attractiveness scores between symmetric individual faces and the number of faces in the prototype were evaluated using a repeated measures analysis of variance (repeated measures ANOVA) with sex of the rater as the between-subjects factor and the number of faces in the stimuli (5 levels: individual symmetric faces, 2-face prototype, 4-face prototype, 8-face prototype, 16-face prototype) as the within-subjects factor (see Table 1). As predicted, the effect of the number of faces in the stimuli was highly significant, Wilke's Lambda = .152, $F(4,104) = 145.24$, $p<.0005$, multivariate eta squared = .85. No interaction was found.

Two groups of 2-, 4-, and 8-face prototypes were constructed to ensure that differences between the means of the prototypes were not due to the selection of the faces comprising each prototype. Post hoc pairwise comparisons were used to determine that there were no significant differences between the means of the two-face prototypes or four-face prototypes presented. Although a significant difference was found between the eight-face prototypes, $t(107) = 3.44$, $p = .001$, the means were in the direction of the prediction; both means fell between the means of the 4- and 16-face prototypes. Furthermore, only one male symmetric individual face was rated higher than the prototype in which it was included. No female symmetric individual faces were rated higher than a composite that contained it.

The second hypothesis predicted that the 16-face prototypes would be the only prototypes significantly higher than the symmetric individual faces; however, a significant difference was found between the means of the different number of faces for all levels of the stimuli except the 8-face and 16-face prototypes for both male and female faces (see Table 1). Since there was a significant difference in the same direction for each level in order, no other paired comparisons are necessary. This reduced the chances of a Type I error.

The third hypothesis addressed an expected difference between female and male ratings. This hypothesis was supported by using an analysis of variance (ANOVA) with sex of the rater as the between-subjects factor and the number of the face in the stimuli (5 levels) as the within-subjects factor. A main effect was found for the sex of the rater on the attractiveness ratings, $F(1,107) = 5.60, p = .02$ (see Table 2 and Figure 2). Females rated faces significantly higher than males at all levels of the stimuli, as expected. There was no interaction between sex and level of the prototype.

Discussion

Although the mean differences are small, the results did not support the first hypothesis because participants rated individual asymmetric faces significantly higher in attractiveness than symmetric individual faces. The large difference in sample size between the two groups and the sex of the rater offer explanation for this unexpected finding. This explanation is especially relevant since those rating the individual faces were mostly female, and the literature showed that female participants consistently rated faces higher in attractiveness than males. Another factor could contribute to the lower ratings of the symmetric individual faces. Since the participants in the second phase of the experiment were presented with symmetric individual faces and symmetric prototypes, it is probable that the symmetric individual faces appeared less attractive due to an anchoring effect. Tversky & Kahneman (1974) described the process of anchoring as an adjustment from a starting point. Since the stimuli appeared randomly, a prototype was the first stimulus for some participants, who most likely made judgments based on this first view of attractiveness. The anchoring effect presumably resulted in participants rating symmetric individual faces lower than otherwise expected. A solution includes showing all of the faces to the same participants in the same slide show. This method controls for participant group and sample size, but is not a viable solution because attractiveness ratings increase with longer exposure to faces. Past research showed that the probability of recognition effects becomes strong (Moreland & Zajonc, 1982; Shepherd & Ellis, 1973), since the same participant would then see four versions of the same face (an individual face, a symmetric individual face, the 16-face prototype including each face, and a 2-, 4- or 8-face prototype with the face).

Contrary to the expectation of the second hypothesis, that differences between the attractiveness of symmetric individual faces and prototypes would be smaller than the differences between individual asymmetric faces and prototypes, this study exhibited otherwise. This belief was held due to past research demonstrating that participants rate symmetric, mirror-image faces higher in attractiveness than individual faces (Rhodes et al., 2001) and rate prototypical faces higher in attractiveness than individual faces (Langlois et al., 1994). The 16-face prototype was the only prototype expected to show a significantly higher rating of attractiveness. The data in the present study indicated that all levels of prototypes demonstrated a significantly higher rating in attractiveness when compared to the symmetric individual faces. These results showed a greater difference than those previously published by researchers (Langlois & Roggman, 1990; Langlois et al., 1994).

The second hypothesis predicted that prototypes would receive higher attractiveness ratings than individual symmetric faces; results supported this hypothesis. Significant differences were found between the symmetric individual faces and the levels of the prototypes in this study that Langlois and Roggman (1990) did not find. The most plausible explanation comes from improved methodology. The present study used feature matching techniques to create prototypes instead of the criticized pixel averaging techniques used by Langlois and Roggman (1990), Langlois, Ritter, Roggman, and Vaughn (1991), Langlois, Roggman, et al. (1991), and Langlois et al. (1994). The ghost-like images created by pixel averaging most likely distracted participants when rating prototypes based on attractiveness, thus suppressing attractiveness ratings. Specifically, they had awkward ghostly hair, so the present study cropped the hairline from the stimuli. Consequently the improved methodology removed these distractions and positively influenced participants' higher ratings for prototypes with fewer faces.

As expected, ratings by male and female participants differed. Females did in fact rate faces higher in attractiveness than males, which is consistent in face perception research (Grammer & Thornhill, 1994).

Further evidence for the high attractiveness of prototypes lies in the finding that prototypes at all levels (2-faces, 4-faces, 8-faces, and 16-faces) were rated higher in attractiveness than any individual faces that composed the prototype, with one exception. The one male face that was rated higher in attractiveness than its prototypes may be approaching levels of attractiveness that Perrett et al., (1994) refer to as a "high attractive face," which is systematically different in shape from average faces. Attractive composites were found to be more attractive when the shape differences from the averages were exaggerated (Perrett et al., 1994). Baudouin and Tiberghien (2004) also found that a woman's face was perceived as most attractive when it was symmetrical, and close to average with exaggerated features, such as big eyes, a small nose, prominent cheekbones, a small chin, and a thick mouth and upper lip. Perrett et al. (1994) found that average face shape is attractive, but not optimally attractive, and thus concluded that some preferences are directional.

Since differences between levels of the prototypes remained while controlling symmetry, prototypical faces appeared attractive for more reasons than symmetry alone. Pixel-averaging techniques used in the past (Langlois et al., 1990) changed the facial feature shape and placement. The averaging process used in this study, Gryphon's Morph Program (Burns, 1994), used feature matching for already symmetric faces, which improved upon past methodologies, in order to strongly conclude that prototypical faces appear more attractive than individual faces.

In general, the morphing process evens skin tone and mimics biologically healthy qualities in the face. Minor imperfections were removed from the individual faces before morphing, resulting in little difference between symmetric individual faces and the prototypes in terms of skin texture. Past research indicated that skin texture and suntanned skin may also contribute to face preferences. For example, Fink, Grammer, and Thornhill (2001) reported that males found females with homogeneous (smooth) skin the most attractive and those with tan skin preferred. Fink and Neave (2005) concluded that the condition of one's skin surface may indicate the strength of the immune system.

Symmetry was also found to be an indicator of immunocompetence, which is a reason why symmetric faces were often preferred to asymmetric faces (Perrett et al., 1999). Natural selection stabilizes facial features in relation to the means, associating averageness with good phenotypic condition (Thornhill & Gangestad, 1999). This preference could have been due to the combination of averageness and symmetry. Baudouin and Tiberghien (2004) found that symmetry and averageness were significantly and positively correlated. Furthermore, even when symmetry was controlled, Baudouin and Tiberghien (2004) found that averageness and attractiveness were significantly correlated; but when averageness was controlled, there was no longer a strong relationship between symmetry and attractiveness. Similarly, the present study found a relationship between the number of faces in prototypes and attractiveness ratings while controlling symmetry. Since symmetry is not the only factor that makes prototypes attractive, what is responsible for the high attractiveness of prototypes?

Evidence most strongly points to averageness as an explanation for prototypes' attractiveness. Morphing increasing numbers of faces produces prototypical faces that are closer to the average size and placement of facial features. The natural variability of asymmetric placement and size of features is diminished. Researchers largely agree that averageness contributes to much of what individuals perceive as attractive in faces (Alley & Cunningham, 1991; Baudouin & Tiberghien, 2004; Fink & Neave, 2005; Rhodes, Sumich, & Byatt, 1999; Thornhill & Gangestad, 1999).

The results of the present study lend support to the contention that the mind creates mental prototypes through pattern matching (Posner & Keele, 1968). As individuals match the patterns of common facial features, each individual's mind forms a symmetric facial prototype. The creation of mental prototypes results in a schematic prototype that is more attractive than asymmetric individual faces. This study found strong evidence that symmetric prototypes are more attractive than individual symmetric faces. Individuals prefer faces that closely match these mental constructions, perhaps because they are easier to classify (Kagan, 1985). If this is the case, then participants may rate prototypes that they have never seen before as more attractive because they resemble their own mental constructions of a prototype. Theoretically speaking, as more faces are encountered, they are averaged into the mental prototype and an ideal average face results. If all human faces could be averaged together, then all individuals' conceptions of the ideal face would be the same. Perhaps this is why much consistency exists in attractiveness ratings across cultures.

Future research directions include cross-cultural studies with caucasian faces controlled for symmetry, as well as studies using symmetric faces of different cultures, similar to Rhodes et al. (2001), Rhodes, Geddes, et al. (2002), and Rhodes, Harwood, et al. (2002). In the future, researchers can conduct studies attempting to control for skin textures and other factors affecting facial attractiveness to further limit confounding variables and determine other factors that influence facial attractiveness. Baudouin and Tiberghien (2004) explored the weights of a variety of factors indicative of attractiveness by using factorial analysis and a multiple regression model, and found that averageness contributed the most to attractiveness ratings; however, they also concluded that attractive faces must contain factors other than just averageness. In using further studies such as those proposed, we will come closer to determining all of the aspects that make faces attractive. Researchers are beginning to explore the possibility of a universal attractive face (Fink & Neave, 2005). Specifically, researchers in the field of cosmetology and dentistry use golden mean proportions as their basis for the ideal male and female face. Psychological research (Green, 1995) may explore the concept of ideal proportions further in the future.

References

Alley, T.R., & Cunningham, M.R. (1991). Averaged faces are attractive, but very attractive faces are not average. *Psychological Science, 2*(2), 123-125.

Barber, N. (1995). The evolutionary psychology of physical attractiveness: Sexual selection and human morphology. *Ethology and Sociobiology, 16*(5), 395-424.

Baudouin, J., & Tiberghien, G. (2004). Symmetry, averageness, and feature size in the facial attractiveness of women. *Acta Psychologica, 117*, 313-332.

Benson, P.J., & Perrett, D.I. (1993a). Extracting prototypical facial images from exemplars. *Perception, 22*(3), 257-262.

Brown, E., & Perrett, D.I. (1993b). What gives a face its gender? *Perception, 22*(7), 829-840.

Brown, T.A., Cash, T.F., & Noles, S.W. (1986). Perceptions of physical attractiveness among college students: Selected determinants and methodological matters. *The Journal of Social Psychology, 126*(3), 305-316.

Burns, P.J. (1994). Gryphon's Morph Software (Version 1.5) [Computer Software]. Reading, MA: Addison-Wesley Publishing Company.

Cunningham, M.R., Barbee, A.P., & Philhower, C.L. (2002). Dimensions of facial physical attractiveness: The intersection of biology and culture. In G. Rhodes, & L.A. Zebrowitz (Eds.), *Facial attractiveness: Evolutionary, cognitive, and social perspectives* (pp. 193-238). Westport, CT: Ablex Publishing.

Eagly, A.H., Ashmore, R.D., Makhijani, M.G., & Longo, L.C. (1991). What is beautiful is good, but . . .: A meta-analytic review of research on the physical attractiveness stereotype. *Psychological Bulletin, 110*(1), 109-128.

Empirisoft. (2002). MediaLab2002 Research Software [Computer Software]. New York, NY: Empirisoft Corporation.

Fink, B., Grammer, K., & Thornhill, R. (2001). Human (homo sapiens) facial attractiveness in relation to skin texture and color. *Journal of Comparative Psychology, 115,* 92-99.

Fink, B., Manning, J.T., Neave, N., & Grammer, K. (2004). Second to fourth digit ratio and facial asymmetry. *Evolution and Human Behavior, 25*(2), 125-132.

Fink, B., & Neave, N. (2005). The biology of facial beauty. *International Journal of Cosmetic Science, 27*, 317-325.

Franks, J.J., & Bransford, J.D. (1971). Abstraction of visual patterns. *Journal of Experimental Psychology, 90*(1), 65-74.

Gangestad, S. W., Thornhill, R., & Yeo, R. A. (1994). Facial attractiveness, developmental stability, and fluctuating asymmetry. *Ethology and Sociobiology, 15*(2), 73-85.

Grammer, K., & Thornhill, R. (1994). Human (homo sapiens) facial attractiveness and sexual selection: The role of symmetry and averageness. *Journal of Comparative Psychology, 108*(3), 233-242.

Green, C. D. (1995). All that glitters: A review of psychological research on the aesthetics of the golden section. *Perception, 24*, 937-968.

Hemenway, P. (2005). *Divine proportion phi: In art, nature, and science*. New York, NY: Sterling Publishing.

Kagan, J. (1985). *The nature of the child.* Cambridge, MA: Harverd University Press.

Kalick, S.M., Zebrowitz, L.A., Langlois, J.H., & Johnson, R.M. (1998). Does human facial attractiveness honestly advertise health? Longitudinal data on an evolutionary question. *Psychological Science, 9*(1), 8-13.

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*(3), 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*(1), 79-84.

Langlois, J.H., & Roggman, L.A. (1990). Attractive faces are only average. *Psychological Science, 1*(2), 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*(3), 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*(4), 214-220.

Langlois, J.H., Roggman, L.A., Musselman, L., & Acton, S. (1991). A picture is worth a thousand words: Reply to "on the difficulty of averaging faces." *Psychological Science, 2*(5), 354-357.

Mervis, C.B., & Rosch, E. (1981). Categorization of natural objects. *Annual Review of Psychology, 32*, 89-115.

Moreland, R.L., & Zajonc, R.B. (1982). Exposure effects in person perception: Familiarity, similarity, and attraction. *Journal of Experimental Social Psychology, 18*, 395-415.

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*(1), 146-160.

Perrett, D.I., Burt, D.M., Penton-Voak, I.S., Lee, K.J., Rowland, D.A., & Edwards, R. (1999). Symmetry and human facial attractiveness. *Evolution and Human Behavior, 20*(5), 295-307.

Perrett, D.I., May, K.A., & Yoshikawa, S. (1994). Facial shape and judgements of female attractiveness. *Nature, 368*(6468), 239-242.

Pittenger, J. B. (1991). On the difficulty of averaging faces: Comments on Langlois and Roggman. *Psychological Science, 2*(5), 351-353.

Posner, M.I., & Keele, S.W. (1968). On the genesis of abstract ideas. *Journal of Experimental Psychology, 77*(3, PT. 1), 353-363.

Rhodes, G. (2004). Facial attractiveness: The role of evolutionary mechanisms and experience. *Journal of Cultural and Evolutionary Psychology, 2*(1-2), 81-92.

Rhodes, G., Geddes, K., Jeffery, L., Dziurawiec, S., & Clark, A. (2002). Are average and symmetric faces attractive to infants? Discrimination and looking preferences. *Perception, 31*(3), 315-321.

Rhodes, G., Harwood, K., Yoshikawa, S., Nishitani, M., & McLean, I. (2002). The attractiveness of average faces: Cross-cultural evidence and possible biological basis. In G. Rhodes & L.A. Zebrowitz (Eds.), *Facial attractiveness: Evolutionary, cognitive, and social perspectives.* (pp. 35-58). Westport, CT: Ablex Publishing.

Rhodes, G., Sumich, A., & Byatt, G. (1999). Are average facial configurations attractive only because of their symmetry? *Psychological Science, 10*(1), 52-58.

Rhodes, G., Yoshikawa, S., Clark, S., Lee, K., McKay, R., & Akamatsu, S. (2001). Attractiveness of facial averageness and symmetry in non-western cultures: In search of biologically based standards of beauty. *Perception, 30*(5), 611-625.

Rock, I., & Leaman, R. (1963). An experimental analysis of visual symmetry. *Acta Psychologica, 21*, 171-183.

Rubenstein, A.J., Kalakanis, L., & Langlois, J.H. (1999). Infant preferences for attractive faces: A cognitive explanation. *Developmental Psychology, 35*(3), 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 G. Rhodes & L.A. Zebrowitz (Eds.), *Facial attractiveness: Evolutionary, cognitive, and social perspectives* (pp. 1-33). Westport, CT: Ablex Publishing.

Shepherd, J.W., & Ellis, H.D. (1973). The effect of attractiveness on recognition memory for faces. *American Journal of Psychology, 86*(3), 627-633.

Solso, R., & McCarthy, J.E. (1981). Prototype formation of faces: A case of pseudo memory. *British Journal of Psychology, 72*(4), 499-503.

Swaddle, J.P., & Cuthill, J.C. (1995). Asymmetry and human facial attractiveness: Symmetry may not always be beautiful. *Procedings of the Royal Society of London, 261*, 111-116.

Thornhill, R., & Gangestad, S. W. (1993). Human facial beauty: Averageness, symmetry, and parasite resistance. *Human Nature, 4*(3), 237-269.

Thornhill, R., & Gangestad, S. W. (1994). Human fluctuating asymmetry and sexual behavior. *Psychological Science, 5*(5), 297-302.

Thornhill, R., & Gangestad, S. W. (1999). Facial attractiveness. *Trends in Cognitive Sciences, 3*(12), 452-460.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*(4157), 1124-1131.

Walton, G.E., & Bower, T.G.R. (1993). Newborns form "prototypes" in less than 1 minute. *Psychological Science, 4*(3), 203-205.

Zhou, G., Fu, X., Hayward, W.G., Locke, V., & Peillicano, E. (2005). Cultural difference in the application of the diagnosticity principle to schematic faces. *Journal of Cognition and Culture, 5*(1-2), 240-247.

Table 1

Mean Attractiveness Ratings of Symmetric Individual and Prototypical Faces

	Faces				
Sex	Individual	2	4	8	16
Male Faces					
M	4.23	4.88	5.36	6.17	6.39
SD	1.06	1.57	1.53	1.48	1.34
t (df)		-5.69(108)**$_a$	-2.92(108)*$_b$	-5.34(108)**$_c$	--
Female Faces					
M	4.73	4.86	7.00	7.58	7.66
SD	0.93	1.53	1.33	1.43	1.42
t (df)		-2.97(108)*$_a$	-12.45(107)**$_b$	-5.00(107)**$_c$	--

Note. * $p < .004$, two-tailed. ** $p < .0005$, two-tailed.

$_a$ Comparing the means of symmetric individual faces to 2-face prototypes. $_b$ Comparing the means of 2-face prototypes to 4-face prototypes. $_c$ Comparing the means of 4-face prototypes to 8-face prototypes.

Table 2

Male and Female Participants Mean Attractiveness Ratings of Facial Stimuli at Each Level

	Faces				
Sex	Individual	2	4	8	16
Male					
M	4.22	4.68	5.95	6.63	6.88
SD	0.84	1.14	1.15	1.00	1.01
Female					
M	4.70	5.03	6.36	7.08	7.14
SD	0.94	1.30	1.11	1.30	120

Figure Caption

Figure 1. Examples of pixel-averaged morphs. From "Attractive Faces are Only Average," by J.H. Langlois and L.A. Roggman, 1990, *Psychological Science, 1*, 2. Copyright 1990 by American Psychological Society. Adapted with permission of the publisher.

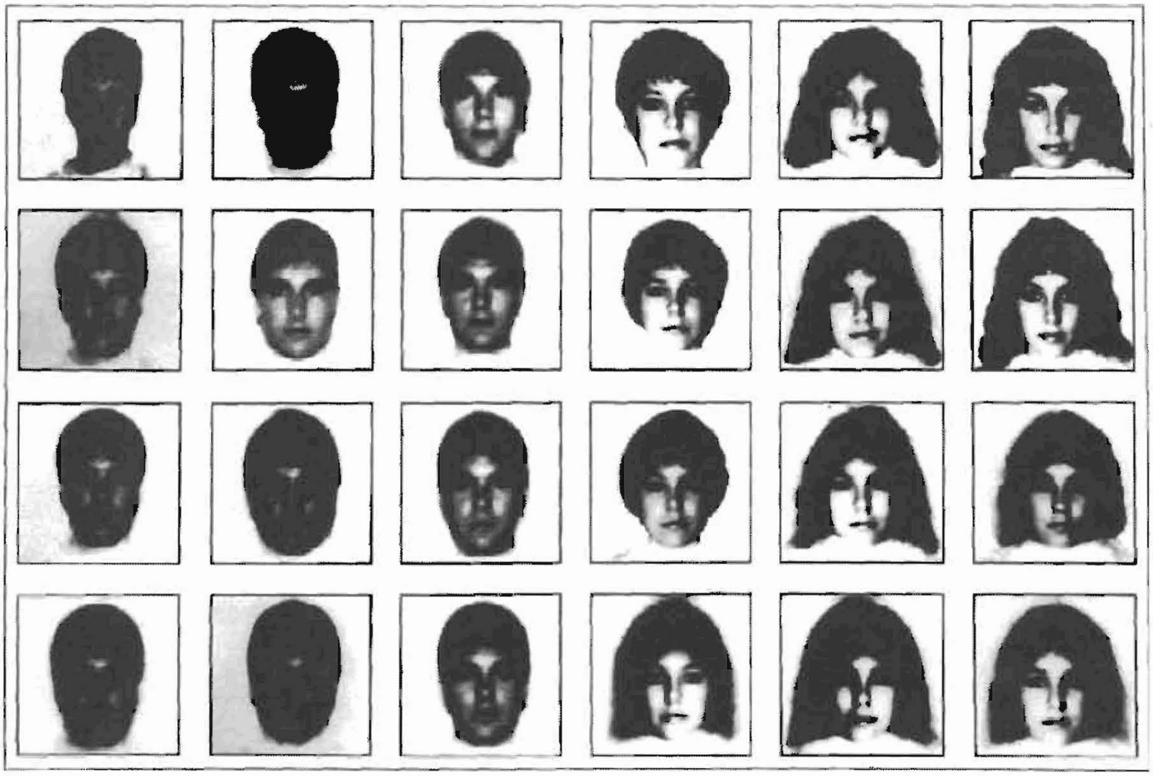


Figure Caption

Figure 2. Mean male and female participants' attractiveness ratings for the individual symmetric faces and all levels of the prototypes.

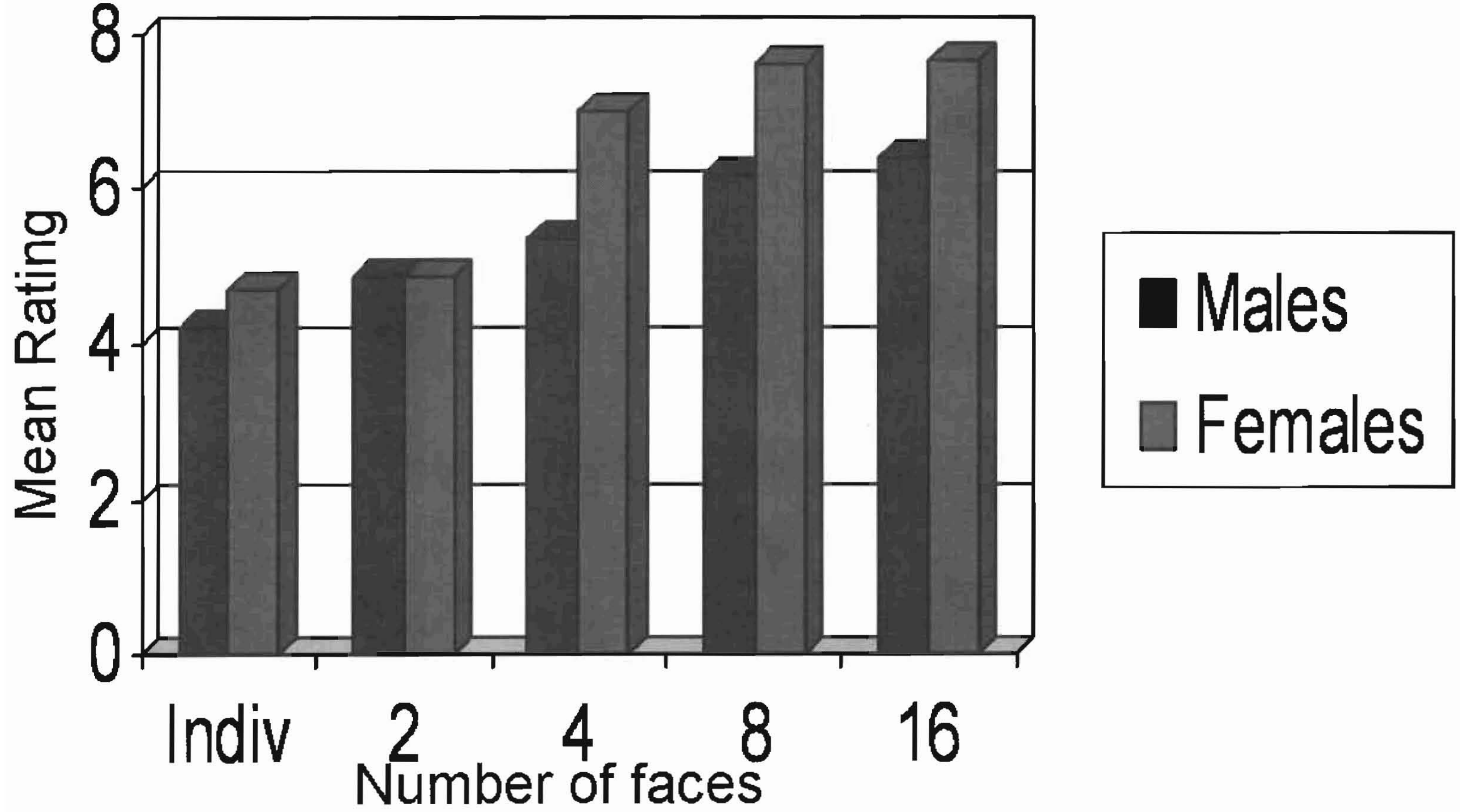

8
6
4
2
0
Mean Rating
Indiv
2
4
8
16
Number of faces
Males
Females

Figure Caption

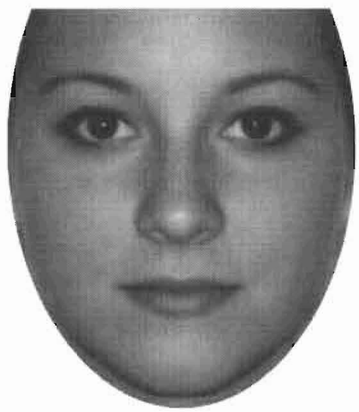
Figure 3. Examples of female stimuli including the individual asymmetric face, the individual symmetric face, and all levels of the prototypes.

Individual Face

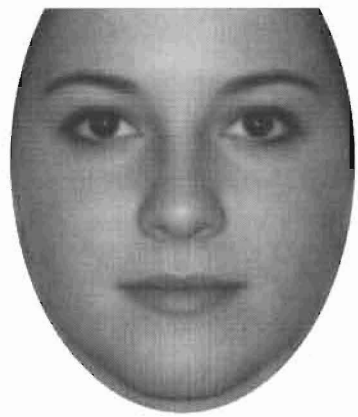
Individual Symmetric Face

2-Face Prototype

4-Face Prototype



8-Face Prototype



16-Face Prototype