Intern. J. Neuroscience, 117: 423 - 431, 2007
Copyright © 2007 Informa Healthcare
ISSN: 0020-7454 / 1543-5245 online
DOI: 10.1080/00207450600581928

informa
healthcare

ATTRACTIVENESS OF NATURAL FACES COMPARED TO COMPUTER CONSTRUCTED PERFECTLY SYMMETRICAL FACES

DAHLIA W. ZAIDEL

Department of Psychology
University of California, Los Angeles
Los Angeles, California, USA

CHOI DEBLIECK

Dipartimento di Psicologia
Università degli di Studi Milano-Bicocca
Milan, Italy

Attractiveness of natural faces was compared to perfectly symmetrical faces constructed on the computer from digitized photographs, in order to assess the role of left-right symmetry in beauty assessment. Three different groups of participants viewed separate series of sequentially presented faces (natural faces, left-left, and right-right) and provided attractiveness ratings on a 5-point Likert scale. The results revealed statistically significant lower ratings for the computer constructed left-left and right-right compared to the natural faces. The discussion is in the context of a biological trend away from perfect symmetry in primates consequent to adaptive evolutionary alteration favoring functional asymmetry in the brain, perception, and face.

Keywords beauty, body asymmetry, brain, brain evolution, symmetry, facial expressions

Received 9 December 2005.

Address correspondence to Dr. Dahlia W. Zaidel, Department of Psychology, University of California at Los Angeles (UCLA), P.O. Box 951563, Los Angeles, CA 90095-1563, USA.
E-mail: dahliaz@ucla.edu

INTRODUCTION

The left and right halves of natural human faces form a balanced entity but the halves are not identical, whether appearing statically or in motion. The asymmetrical anatomical and functional markers are subtle, and the majority cannot be discerned upon casual observation. But they can be teased apart under laboratory conditions. The asymmetries are compatible with gradual adaptive evolutionary growth, both functional and anatomical, in humans and non-human primates (Fernandez-Carriba et al., 2002; Hauser, 1993, 1997; Sherwood et al., 2003; Zaidel et al., 1995).

However, one of the controversial issues remains the role played by bilateral left-right symmetry in beauty judgments. Due to the fact that in most species other than humans, perfect bilateral symmetry is a marker of fitness and high genetic quality (Cronin, 1992; Hamilton et al., 1990; Moller, 1995; Swaddle, 1999), the notion of bilateral facial asymmetry in humans has received a great deal of attention. Experimental studies using computerized morphing and averaging techniques commonly report that symmetry and attractiveness are positively correlated (e.g., Grammer & Thornhill, 1994; Rhodes et al., 1998), whereas studies using other techniques such as computer constructed left-left (LL)/right-right (RR) stimulus faces claim that bilateral symmetry is not relevant to attractiveness (Chen et al., 1997; Knowner, 1996; Langlois & Roggman, 1990; Samuels et al., 1994; Swaddle & Cuthill, 1995; Zaidel et al., 1995). Neither approach is ideal because both deal with stationary faces in photographs. However, morphing and averaging techniques accentuate appearance of symmetry; they distort natural face proportions by eliminating existing structural asymmetries and any blemishes or moles, thereby exaggerating appearance of symmetry and smooth complexion. The LL/RR approach allows natural structural asymmetries to remain in place, although it may accentuate any pre-existing blemishes or moles. But if beautiful faces are used in a LL/RR study then such accentuation should be minimized. The inconsistency in the results stemming from differences in the techniques could be resolved by looking at both very beautiful and regular faces. Thus, the present study included very beautiful faces as well.

Although perfect symmetrical appearance is the epitome of gene quality in most animals, this standard is altered somewhat in humans because human brain organization is heavily asymmetrically biased in favor of left-right organization and this is expressed in perception, cognition, and motor control. Indeed, quantitative cephalometric measurements, including three-dimensional computerized assessments of the face as a whole and of specific facial parts,

have repeatedly found anatomical asymmetries (Farkas, 1994; Ferrario et al., 1993, 1994, 1995, 2003; Peck et al., 1991; Skvarilova, 1994; Vig & Hewitt, 1975). In addition, functionally, humans display asymmetrical emotions in the wo halves of the face; expressions such as smiling, sadness, and disgust are more salient in the left than in the right half in most people (Nicholls et al., 2004; Skinner & Mullen, 1991; Triggs et al., 2005; Zaidel et al., 1995; Zhou & Hu, 2004). Indeed, everything else being equal, it is quite common to see asymmetric moles (e.g., Marilyn Monroe, Cindy Crawford), asymmetric grins or moving talking faces (e.g., Drew Barrymore), which do not seem to detract from general facial attractiveness or popularity. Rarely do these facial features appear bilaterally symmetrical. Their asymmetrical presence is not arbitrary or coincidental and should be pursued in the search for the role played by natural left-right organization in beauty appearance. In the present study, many of the stimulus faces previously received very high beauty ratings (Zaidel & Cohen, 2005) and the comparison of the LL and RR of these faces to each other in that study revealed no statistically significant difference. This article compared attractiveness ratings of natural faces to the perfectly symmetrical LL and RR equivalents. If perfect symmetry is critical for beauty decisions then if higher ratings would be expected for these perfectly symmetrical computer constructed faces.

METHODS

Participants

Three separate groups of right-handed participants were tested. They were all undergraduate students enrolled in introductory psychology courses at the University of California, Los Angeles (UCLA). Their participation in the study gave them partial course credit. Three groups comprising different participants were involved: The group that judged the natural faces consisted of 29 females and 19 males, the group that judged the LL faces consisted of 19 females and 20 males, and the group that judged the RR faces consisted of 17 females and 12 males.

Materials

The stimuli comprised 74 grayscale photographs of head-on (frontal) faces (women = 41; men = 33), taken under symmetrical lighting (Zaidel et al., 1995; Zaidel & Cohen, 2005). Each digitized photograph generated a LL and

a RR face. This was accomplished on a computer (with Photoshop) when each photograph was split in half down the mid-sagittal plane and each half was united with its own mirror image (Zaidel et al., 1995; Zaidel & Cohen, 2005). The LL and RR faces were perfectly symmetrical. Of the 74 faces, 36 received particularly high attractiveness ratings; they were of ("beautiful") models working in the beauty industry (Zaidel & Cohen, 2005). The rest were of students ("regular") at UCLA (Chen et al., 1997; Zaidel et al., 1995). Within the series of 74 stimuli, the "beautiful" and "regular" were randomly intermixed. In all, there were 3 sets of stimuli: (1) natural faces, (2) LL, and (3) RR.

Procedures

The 3 sets of stimuli (with 74 trials per set) were each viewed and rated by a different group of participants. Participants were tested individually. The order of stimulus appearance in the sequence of trials was randomized for each participant. In each of the sets, participants viewed 1 stimulus face per trial on a Macintosh computer screen with exposure duration of 7 sec, and were asked to judge its attractiveness on a 5-point Likert scale. This scale extended from "1" (very unattractive) to "5" (very attractive).

RESULTS

Within each stimulus set, the mean attractiveness response for each stimulus face was calculated across all subjects. The data were then analyzed with 4 *t*-tests and significance level was set to $p = .01$ (reflecting the Bonferroni adjustment for multiple comparisons). Figure 1 summarizes the results graphically (error bars are standard error of the mean), particularly with regards to "beautiful" (Zaidel & Cohen, 2005) and "regular" (Zaidel et al., 1995). Table 1 displays the *t*-test values and significance levels. The statistical

Table 1. Tests of significance (*t*-tests) and significance levels on 4 comparisons. Significance was set to 0.01 per comparison (according to the Bonferroni correction for multiple comparisons)

Comparison	*t* value	*p* value
Normal Full-Face and LL: "Beautiful"	−2.47	<0.01
Normal Full-Face and RR: "Beautiful"	−5.50	<0.0006
Normal Full-Face and LL: "Regular"	−6.08	<0.0001
Normal Full-Face and RR: "Regular"	−5.58	<0.0001

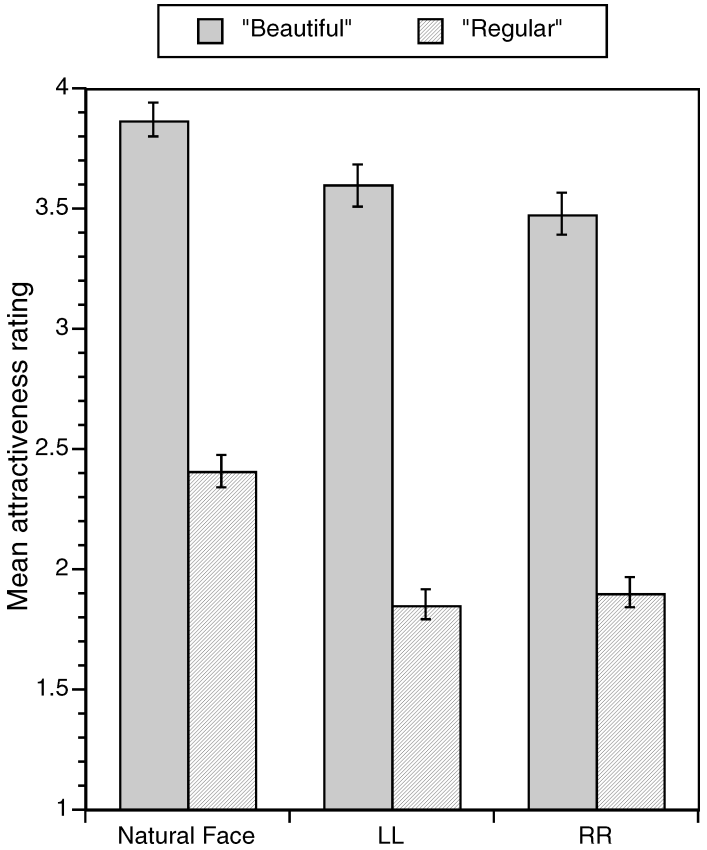

Figure 1. Mean attractiveness ratings for normal (natural) faces, left-left (LL) and right-right (RR) on a 5-point Likert scale. For illustration, the means are organized according to "beautiful" and "regular."

comparisons clearly show that normal faces received significantly higher attractiveness ratings compared to the LL and RR.

DISCUSSION

This study compared attractiveness judgment of normal full-faces to the perfectly symmetrical LL and RR created from them. It was found that regardless of how high the attractiveness rating of the normal full-faces, perfectly symmetrical faces received significantly lower beauty ratings. Many of the stimulus faces (belonging to models) received high attractiveness ratings

in a previous study (Zaidel & Cohen, 2005). Indeed, as Figure 1 shows, the LL and RR of these faces received high ratings as well, and yet, these ratings were significantly lower than their original natural faces. This in turn suggests that whatever it is that makes a face very attractive or not is carried over to the symmetrical version (LL and RR) of that face. If symmetry is what makes a face attractive then higher ratings would be found for LL and/or RR, in both regular and beautiful faces. But this did not happen here. Rather, the results are consistent with notions expressed in previous findings, namely of natural functional asymmetries in normal faces (Benson & Laskin, 2001; Chen et al., 1997; Nicholls et al., 2004; Reis & Zaidel, 2001; Triggs et al., 2005; Zaidel et al., 1995).

Although it was found that computer-constructed perfectly symmetrical faces are not as attractive as natural faces, faces that are too asymmetrical may be perceived as distorted (e.g., facial deformities). So, although deviations from symmetry are critical perceptual units in detecting appearance of health, in both animals and humans (Zaidel et al., 2005), the natural subtle asymmetry of the human face does not appear to be that important for assessing facial attractiveness. What constitutes "too asymmetrical" is not clear; unilateral facial deformities would fall into that category whereas others, natural types would not. A continuum for bilateral left-right organization where perfect symmetry is on one end, and extreme asymmetry on the other end, is probably biologically operational. Both ends would be perceived as unattractive. The acceptable range for how attractiveness is judged in faces must lie somewhere within the continuum but the borders of the range are as yet unknown and remain to be determined.

Although these results are consistent with other studies that looked at facial attractiveness through LL and RR symmetrical composites (Chen et al., 1997; Knowner, 1996; Langlois et al., 1994; Samuels et al., 1994; Swaddle & Cuthill, 1995; Zaidel et al., 1995) the present study is the first to include beautiful faces in the same stimulus series. The LL and RR of these faces were markedly different than the regular faces, as can be seen clearly in Figure 1. They remained more beautiful even in the perfectly symmetrical condition than those constructed from the regular faces.

Many facial parameters contribute to the appearance of beauty, but they are not all understood. Evolutionary pressures and genetic factors have most likely contributed to the nature and appearance of facial left-right balance: The higher apes have been documented to show facial asymmetries associated with communication signals (Hauser, 1993, 1997; Fernandez-Carriba et al., 2002; Sherwood et al., 2003). Human facial halves are part and parcel of

a communicative system that includes combinatorial syntactical language, facial expressions, gestural and body language (Reis & Zaidel, 2001; Zaidel et al., 1995). All are generated and perceived asymmetrically by functionally specialized left and right cerebral hemispheres. Given that the higher apes already display functional facial asymmetries, one has to associate the deviation from the perfect symmetry seen in other biological organisms with adaptive brain evolution, one that extends from non-human primates to humans. That is, growth of a functionally asymmetrical brain culminating in humans, but with antecedents in the higher apes (and possibly even earlier). The status of facial functional symmetry (the appearance of beauty, emotional expressions) in humans can thus be interpreted to reflect an evolved alteration developed to match an asymmetrical brain and promote an efficient interaction between brain and face. The upper and lower limits of the asymmetry with regards to attractiveness, however, remains to be determined in future research.

REFERENCES

Benson, K. J., & Laskin, D. M. (2001). Upper lip asymmetry in adults during smiling. *Journal of Oral Maxillofacial Surgery*, *59*, 396–398.

Chen, A. C., German, C., & Zaidel, D. W. (1997). Brain asymmetry and facial attractiveness: Beauty is not simply in the eye of the beholder. *Neuropsychologia*, *35*, 471–476.

Cronin, H. (1992). *The ant and the peacock*. Cambridge: Cambridge University Press.

Farkas, L. G. (Ed.). (1994). *Anthropometry of the head and face* (2nd ed.). New York: Raven Press.

Fernandez-Carriba, S., Loeches, A., Morcillo, A., & Hopkins, W. D. (2002). Functional asymmetry of emotions in primates: New findings in chimpanzees. *Brain Research Bulletin*, *57*, 561–564.

Ferrario, V. F., Sforza, C., Dellavia, C., Tartaglia, G. M., Colombo, A., & Caru, A. (2003). A quantitative three-dimensional assessment of soft tissue facial asymmetry of cleft lip and palate adult patients. *Journal of Craniofacial Surgery*, *14*, 739–746.

Ferrario, V. F., Sforza, C., Miani, A., Jr., & Serrao, G. (1995). A three-dimensional evaluation of human facial asymmetry. *Journal of Anatomy*, *186*, 103–110.

Ferrario, V. F., Sforza, C., Miani, A. J., & Tartaglia, G. (1993). Craniofacial morphometry by photographic evaluations. *American Journal of Orthodontics and Dentofacial Orthopedics*, *101*, 327–337.

Ferrario, V. F., Sforza, C., Pogio, C. E., & Tartaglia, G. (1994). Distance from symmetry: A three-dimensional evaluation of facial asymmetry. *Journal of Oral Maxillofacial Surgery*, *52*, 1126–1132.

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

Hamilton, W. D., Axelord, R., & Tanese, R. (1990). Sexual reproduction as an adaptation to resist parasites (a review). *Proceedings of the National Academy of Sciences, USA*, *87*, 3566–3573.

Hauser, M. D. (1993). Right hemisphere dominance for the production of facial expression in monkeys. *Science*, *261*, 475–477.

Hauser, M. D. (1997). *The evolution of communication*. Cambridge: MIT Press.

Knowner, R. (1996). Facial asymmetry and attractiveness judgment in developmental perspective. *Journal of Experimental Psychology*, *22*, 662–675.

Langlois, J. H., & Roggman, L. A. (1990). Attractive faces are only average. *Psychological Science*, *1*, 115–121.

Langlois, J. H., Roggman, L. A., & Musselman, L. (1994). What is average and what is not average about attractive faces. *Psychological Science*, *5*, 214–220.

Moller, A. P. (1995). Bumblebee preference for symmetrical flowers. *Proceedings of the National Academy of Sciences, USA*, *92*, 2288–2292.

Nicholls, M. E., Ellis, B., Clement, J. G., & Yoshino, M. (2004). Detecting hemifacial asymmetries in emotional expression with three-dimensional computerized image analysis. *Proceedings of the Royal Society London B Biological Science*, *271*, 663–668.

Peck, S., Peck, L., & Kataia, M. (1991). Skeletal asymmetry in esthetically pleasing faces. *The Angle Orthodontist*, *61*, 43–48.

Reis, V. A., & Zaidel, D. W. (2001). Functional asymmetry in the human face: Perception of health in the left and right sides of the face. *Laterality*, *6*, 225–231.

Rhodes, G., Proffitt, F., Grady, J. M., & Sumich, A. (1998). Facial symmetry and the perception of beauty. *Psychonomic Bulletin and Review*, *5*, 659–669.

Samuels, C. A., Butterworth, G., Roberts, T., Graupner, L., & Hole, G. (1994). Facial aesthetics: Babies prefer attractiveness to symmetry. *Perception*, *23*, 823–831.

Sherwood, C. C., Holloway, R. L., Gannon, P. J., Semendeferi, K., Erwin, J. M., Zilles, K., & Hof, P. R. (2003). Neuroanatomical basis of facial expression in monkeys, apes, and humans. *Annals of the New York Academy of Science*, *1000*, 99–103.

Skinner, M., & Mullen, B. (1991). Facial asymmetry in emotional expression: A meta-analysis of research. *British Journal of Social Psychology*, *30*, 113–124.

Skvarilova, B. (1994). Facial asymmetry: An X-ray study. *Acta Chirurgiae Plasticae*, *36*, 89–91.

Swaddle, J. P. (1999). Visual signalling by asymmetry: A review of perceptual processes. *Proceedings of the Royal Society, London, B*, *354*, 1383–1393.

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

Triggs, W. J., Ghacibeh, G., Springer, U., & Bowers, D. (2005). Lateralized asymmetry of facial motor evoked potentials. *Neurology*, *65*, 541–544.

Vig, P. S., & Hewitt, A. B. (1975). Asymmetry of the human facial skeleton. *The Angle Orthodontist*, *45*, 125–129.

Zaidel, D. W., Aarde, S. M., & Baig, K. (2005). Appearance of symmetry, beauty, and health in human faces. *Brain and Cognition*, *57*, 261–263.

Zaidel, D. W., Chen, A. C., & German, C. (1995). She is not a beauty even when she smiles: Possible evolutionary basis for a relationship between facial attractiveness and hemispheric specialization. *Neuropsychologia*, *33*, 649–655.

Zaidel, D. W., & Cohen, J. A. (2005). The face, beauty, and symmetry: Perceiving asymmetry in beautiful faces. *International Journal of Neuroscience*, *115*, 1165–1173.

Zhou, R., & Hu, S. (2004). Effects of viewing pleasant and unpleasant photographs on facial EMG asymmetry. *Perceptual and Motor Skills*, *99*, 1157–1167.