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Functional asymmetry in the human face: Perception of health in the left and right sides of the face

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The expression of health on the human face, like beauty or emotions, is an important biological display. Previous findings of left–right functional asymmetry in facial attractiveness and the linkage of attractiveness and health in evolutionary biology notions have prompted the present study. A total of 38 pairs of left–left and right–right facial composites were viewed by 24 subjects on a computer screen, and the task was to decide which member of the pair looked healthier or there was no difference. The results revealed a significant interaction between face side and sex of face. Right–right composites of women's faces were judged significantly healthier than left–left, whereas in men's faces, no significant left–right difference emerged. As these results parallel previous findings of attractiveness in the identical set of faces, we propose that evolutionary biology notions linking the appearance of health and of attractiveness apply to the human face as well.

INTRODUCTION

The human face serves a range of biological functions which facilitate communication between the observer and the observed. Not only are the individual's identity and emotional expressions perceived and processed in the observer's brain, so is information about beauty and health. Previously, we found a sex-related left–right asymmetry in facial attractiveness, with higher ratings for right–right composites of women's faces than for left–left composites but with no significant difference between right–right and left–left in men's faces (Chen, German, & Zaidel, 1997; Zaidel, Chen, & German, 1995). In addition, we found an asymmetry in smiling saliency, with the smile judged more pronounced in the left–left composite, in both sexes (Zaidel et al., 1995). In biological and evolutionary theory, attractiveness and health are nearly synonymous. Considering this and our previous finding of facial functional asymmetry, we now wanted to determine whether or not the perception of health is also asymmetrically organised in the face.

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In every species, the central nervous system analyses health signals of potential mates in order to ensure successful survival of the offspring through the inheritance of disease-resistant genes. Elaborate adaptive strategies within the animal kingdom to attract a potential mate have repeatedly been described (e.g., Cronin, 1991; Gould & Gould, 1989). Consider, for example, the case of the peacock and the peahen. The peacock, like many other birds, has evolved to have a particularly long tail which, at first glance, does not appear to have any functional purpose. In fact, the peacock's tail represents secondary sexual characteristics. As Darwin noted regarding many species of birds, spectacular colours, feather modifications and displays have no use in foraging, flying, or nest building (Cronin, 1991). The answer most likely lies in mate selection strategies, as research by evolutionary biologists suggests that secondary sexual characteristics are a reliable indicator of health quality (Møller & Nielsen, 1997; Møller & Paola, 1998). Folstad and Karter (1992) and Wedekind (1992) independently found that a link between parasite resistance and secondary sexual characteristics exists because sex hormones, especially testosterone, lower immunocompetence. When the peahen is courted, the size of the tail as well as the colour and sheen of the potential mate's feathers are judged. In other words, the peahen is using secondary sexual characteristics to assess the appearance of health of her potential mates (e.g., strong, healthy, agile, parasite-resistant). So, even though the peacock's tail does not enhance his ability to fly, it does increase his chances of reproductive success (everything else being equal). However, how the human brain assesses the display of health in faces is poorly understood.

The foregoing is based on sexual selection notions which are anchored in Darwinian evolution ideas. The concept of health appearance (i.e., how people should look when they are healthy) versus real health in humans is difficult to tease apart largely because of lack of empirical data. Consequently, the correlation between real health signals displayed on the face and perceived health is little understood. However, studies on the relationship between the concept of health and attractiveness have been reported. Two separate studies have found that tanned people were judged healthier than those who were pale (Broadstock, Borland, & Gason, 1992; Miller, Ashton, McHoskey, & Gimbel, 1990). Another study investiged the relationship between facial attractiveness and actual health in adolescents (Kalick, Zebrowitz, Langloes, & Johnson, 1998) and found that ratings of adolescent facial attractiveness were not related to adolescent actual health, whether during adolescence or later in life. Instead, the study revealed a ''halo effect'', that is, relatively more attractive faces were rated as healthier. In another study in which subjects viewed photographs of HIV-positive individuals, unattractive faces were judged more likely to have acquired HIV through homosexual activity than attractive faces, and this was particularly true for men's faces (Boehm, Wambaugh, Riney, & Kunzelman, 1996). Together, the available findings suggest that when it comes to the facial

display of health, there is a complex interaction between health status, physical attractiveness, social stereotypes, inferences regarding sexual activity, and a host of other factors. Importantly, the distinction between perceived health and real health can be blurred by attractiveness status.

In the present study, we were concerned with the left–right organisation of the appearance of health in the face, on the assumption that there is a neuroanatomical underpinning in the brain of the observer for this type of assessment. First we analysed the health judgements across all our observers, and then we compared these judgements to previously obtained attractiveness judgements (Zaidel et al., 1995) of the same set of faces.

METHOD

Participants

A total of 24 right-handed undergraduate students, 12 females and 12 males, enrolled in introductory psychology courses volunteered to participate in the experiment in exchange for partial course credit.

Materials

A total of 38 pairs of faces (21 women, 17 men) consisting of left–left and right–right composites from a previous study were the stimuli (Chen et al., 1997; Zaidel et al., 1995). Each composite was created on a Macintosh computer from a head-on, symmetrically lit face, by aligning each facial half with its own mirror image, hence left–left and right–right.

PROCEDURE

On a Macintosh computer screen, a pair of left–left and right–right faces (of the same individual) was presented side-by-side for 10 seconds. There were 38 such trials and women's and men's faces were intermixed within the series of trials. The laterality of a facial composite on the computer screen was counterbalanced within each face sex. The task for each participant was to decide which member of the pair appeared healthier or if there was no difference between the two faces.

RESULTS

ANOVA of health judgements

The frequency of selecting the left–left, right–right, or "same" (i.e., no difference) was determined for each of the participants, and the mean was entered into a repeated-measures ANOVA. (The responses of the female and male viewers did not appear to be significantly different.) The within-subject

variables in the ANOVA were Face Sex (women, men) and Face Side (left–left, right–right, same). A significant main effect for face side emerged, $F(2,46)=32.39$, $p<.00001$, reflecting a lower mean for left–left than for right–right. The main effect for Face Sex was not significant, $F(1,23)=4.02$, $p<.06$. The two-way interaction, Face Sex × Face Side, was significant, $F(2,46)=4.76$, $p<.01$. Figure 1 shows the nature of this interaction.

In view of the significant interaction, analyses for simple effects were applied to the data. A significant difference between left–left and right–right emerged only for women's faces, ($t=-2.95$; d.f. = 23; $p=.007$), with a nonsignificant difference for men's faces ($t=-1.79$; d.f. = 23; $p=0.09$). The mean for judging both faces "same" was low by comparison, in both women's and men's faces (see Figure 1).

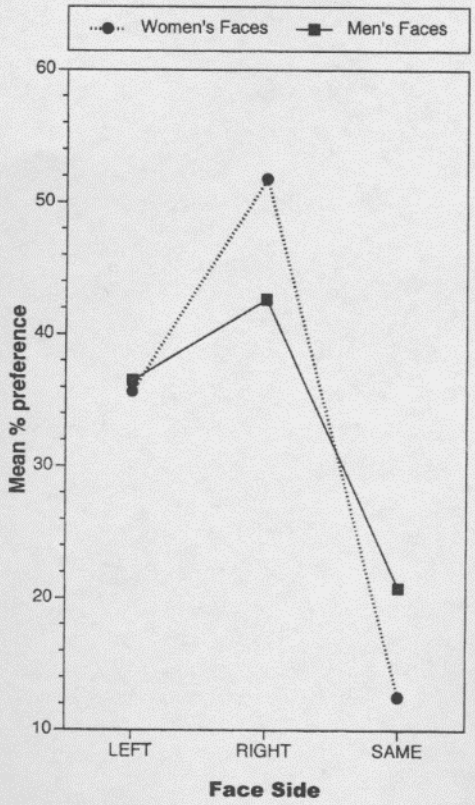

Figure 1. The mean percent preference for left–left, right–right, or same (i.e., no difference) by subjects viewing pairs of faces and deciding which one looks healthier.

Comparison between health and previous attractiveness judgements

As our hypothesis was that there is a relationship between the appearance of health on the face and facial attractiveness, we next determined the frequency of selecting the left–left or right–right for each stimulus face across all participants. We then compared the health judgement data to the attractiveness judgement data from the previously published study (Zaidel et al., 1995) with an ANOVA applied to the faces of women and an ANOVA applied to the faces of men. With each ANOVA, the between-subjects factor was Decision (healthy, attractive) and the within subject factor was Side (left–left, right–right). We found with each ANOVA that the Decision × Side interaction was not significant ($p > .85$), while there was a significant main effect for Decision [men's faces: $F(1, 16) = 9.12$, $p = .008$; women's faces: ($F(1, 20) = 7.27$, $p = .01$], reflecting a generally higher rating for health than for attractiveness, regardless of side. With the women's faces ANOVA there was a significant main effect for Side, $F(1, 20) = 6.84$, $p = 0.01$, which reflected significantly higher ratings for right–right than for left–left, regardless of Decision.

DISCUSSION

Against the background of biological and evolutionary perspectives, and our previous findings on facial attractiveness (Chen et al., 1997; Zaidel et al., 1995), we hypothesised that right–right composites of women's' faces would be judged significantly healthier than left–left. Along the same lines, we predicted no preference for either side of men's faces. Not only did the results confirm our hypotheses, they also reflected our previous findings regarding attractiveness. It is important to note that the identical set of faces used to obtain ratings of health was also used previously for the judgement of attractiveness. The subjects in this experiment were allowed to report ''no difference'' between left–left and right–right faces. They nevertheless perceived differences, particularly in women's faces, and responded accordingly. Thus, the present results are consistent with sex-related, left–right asymmetry in the appearance of health in the face, and suggest a linkage between facial appearance of attractiveness and health.

Facial asymmetry refers to the fact that the human face (women and men) is not morphologically symmetrical. This trait is not deemed to be pathological; rather, it is considered to be normal. Support for this comes from methods in which actual morphological measurements of human faces revealed relative asymmetry (Ferrario, Sforza, Pogio, & Tartaglia, 1994; Ferrario et al., 1993; Sackeim, 1985; Samuels et al., 1994).

How the mind in the brain of the observer processes health cues in someone's face is little understood. Such assessment is often labelled subjective. However, there is no logical reason to believe that ''health assessment'' lacks a

neuroanatomical underpinning. Unfortunately, there are no published reports that we could find that investigated this underpinning. We propose that the asymmetrical display of perceived facial health is not coincidental, but rather may be related to functional asymmetry of the brain. This makes sense from an evolutionary standpoint: if attractiveness is correlated with health (be it honestly or otherwise), then those who display attractiveness will have a selective advantage. This will only work well evolutionarily in the long run, however, if those perceiving these cues have evolved sufficient strategies for reliable detection of honestly correlated indicators of health.

In both non-human species and humans, accurate perception of health can be fooled by various factors; parasites, for instance, can mimic normal features while their very presence indicates disease (Cronin, 1991). However, even if we assume that in non-humans attractiveness is essentially synonymous with health, in humans there may be a myriad of non-biological factors that interfere with the perception of health in people's faces. We do not yet know the breakdown of all those possible factors. Cultural, emotional, or psychological factors could conceivably interfere with accurate estimates. Laboratory experiments involving the appearance of health thus far have relied on conscious (behavioural) decisions. By comparison, more insight may be gained if implicit physiological responses were recorded (say, Galvanic Skin Response). It may be that complex factors interfere with health assessments when subjects are making conscious decisions. What does seem to be clear for now is that the appearance of health in the face is asymmetrically organised and the asymmetry is sex-related. The reasons for this asymmetry in women's faces is rooted in the co-evolution of face and brain in humans, as discussed previously (Zaidel et al., 1995).

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