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Original Article

The sound of female shape: a redundant signal of vocal and facial attractiveness

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ABSTRACT

There is more to female attractiveness than a pretty face. Human mate choice decisions are guided by different cues, which in combination may give a better estimate of a general condition. We hypothesized that such signal redundancy might be true for vocal and visual cues of human female attractiveness. To test this we used photographs of women's faces, recorded their voices and asked men to rate both types of stimuli on attractiveness. We found a significant relationship between males' ratings of female faces and voices. Moreover, low levels of fluctuating asymmetry of women's bodies and faces were associated with high ratings on facial and vocal attractiveness. Applying the Geometric Morphometric Methodology we performed a multivariate regression analysis of attractiveness ratings with landmark data obtained from women's faces. We found similar facial shape changes for ratings of facial and vocal attractiveness that are both negatively related to facial and body FA. Findings suggest that females with an attractive face also tend to have an attractive voice and that this redundant information is reflected in female facial shape.

1. Introduction

Animals show a great variety in how they advertise their mate value. In some species courtship behaviors are highly complex and often involve multiple cues from different modalities. For instance, several bird and fish species present bright colors in concert with elaborate songs or other intricate courtship behaviors.

While in animal species multiple cues are most prominent in males, findings in human research suggest that multiple cues are important when males assess female mate quality.

The female face alone – the most reliable predictor for overall physical attractiveness (Currie & Little, 2009) – bears multiple features that play a crucial role in the perception of attractiveness. Such features are skin texture, skin coloration (*e.g.*, Fink, Grammer, & Thornhill, 2001; Matts, Fink, Grammer, & Burquest, 2007; Stephen, Law Smith, Stirrat, & Perrett, 2009), non-average sexually dimorphic features so called 'hormone markers' (*e.g*, Johnston, 2006) and facial symmetry (*e.g.*, Grammer & Thornhill, 1994; Perrett et al., 1999).

Although the significance of different cues in the perception of female attractiveness is undisputed, questions remain on the role of multiple cues in human mate choice. For instance, if a single feature already indicates mate quality, what is the benefit of having additional cues communicating the same mate value? Moreover, the development of anatomical structures or complex behaviors entails energetic costs. For this reason there must be a trade-off between the costs and benefits of using multiple cues in human mate choice.

To explain the adaptive function of multiple cues in animal mate choice several theoretical models have been devised that might be also applied to human mate choice decisions. For instance, the 'multiple-message' hypothesis (Johnstone, 1996; Møller & Pomiankowski, 1993) claims that different cues convey different aspects of mate quality. More precisely, preferences for different features evolved because each of these features communicates a specific quality or fitness aspect. Cues may either inform about an overall condition over long time scales or about a current physical state. The former may be good indicators of gene quality or immunocompentence (Kanda, Tsuchida, & Tamaki, 1996; Verthelyi, 2006) whereas the latter refer to rather flexible cues such as peculiarities of the skin texture and skin coloration (Fink et al., 2001; Matts et al., 2007; Stephen, Law Smith, Stirrat, & Perrett, 2009) that indicate the current female reproductive state. Although different features convey different qualities, they may add up to enable an connective evaluation of a potential mate's overall quality (Candolin, 2003).

In contrast to the 'multiple-message', the 'redundant signaling' hypothesis (or 'back-up signal' hypothesis) claims that multiple cues convey similar information on different communication channels, thereby lowering the probability of making inaccurate assessments of mate quality. In other words, multiple cues serve as a back-up signal that ensures a low rate of mate choice errors because a potential partner is assessed by two or even more features. Consequently, the 'redundant signaling' or 'back-up' hypothesis requires multiple cues as reliable indicators of a common mate value. These 'redundant' indicators are more

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likely to inform about an overall condition over long time scales rather than being context dependent such as indicators of a current physical state. Moreover, assessments of an overall condition for long-term decisions may be more reliable when they are based on multiple features with a stable appearance. Morphological features have such a stable appearance and are largely context independent because they are manifested during the course of gestation. Therefore they represent good candidates to empirically test the back-up hypothesis with regard to human mate choice decisions. Particularly correlations between morphological traits such as facial symmetry and sexual dimorphism (*i.e.*, 'hormone markers') are considered as evidence that these traits signal a common underlying mate value (Gangestad & Thornhill, 2003; Koehler, Simmons, Rhodes, & Peters, 2004; Little et al., 2008).

Symmetry of bilateral structures is estimated as a low level of asymmetry, which is the formal sum of directional asymmetry (DA) and fluctuating asymmetry (FA). In contrast to DA, which measures whether one side is consistently different from the other, FA describes small random deviations from perfect bilateral symmetry (Valen, 1962). These small deviations arise during embryogenesis and reflect the ability of a developing organism to cope with environmental stressors (Waddington, 1957). Hence, a low level of FA of fully developed anatomical structures is assumed to be a non-falsifiable signal of individual's immune competence and developmental stability (Gangestad, Thornhill, & Yeo, 1994; Thornhill & Gangestad, 1993). The significance of FA on mate choice decisions has been demonstrated for several species (Møller & Thornhill, 1998). Low levels of FA in both faces and body structures positively influence ratings of human attractiveness and health (Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004; Grammer & Thornhill, 1994; Perrett et al., 1999). Previous research showed that attractiveness ratings of the female face and body are significantly associated with both the amount of fluctuating asymmetry and specific localized shape differences in regions of known estrogen sensitivity (Schaefer et al., 2006). These findings support the assumption that symmetry might serve as a back-up signal in human mate choice decision (Currie & Little, 2009).

It is a plausible conclusion that the signal of FA may be present in all anatomical structures because they are subjected to the same developmental conditions during ontogeny. Hence, FA also occurs in non-visible inner anatomical structures such as the voice apparatus (Hirano, Kurita, Yukizane, & Hibi, 1989) and might therefore be perceptible in acoustic cues produced by this voice apparatus. Since vocal communication plays a predominant role in human social interactions, acoustic cues should transport important information about potential mates particularly when visual cues are ambiguous or not available. Also, a relationship between body symmetry and vocal attractiveness in both sexes has been illustrated (Hughes, Harrison, & Gallup, 2002) but the link between acoustic cues in relation to female facial and body FA has not been investigated yet. Previous studies have already found an influence of acoustic characteristics (*e.g.*, voice pitch) on perceptions of female attractiveness (Collins & Missing, 2003; Feinberg, DeBruine, Jones, & Perrett, 2008). For example, Feinberg et al. (2005) found that men preferred face images of women with higher pitched voices over women with lower pitched voices. Moreover, in their female samples, the author showed that voice pitch is moderately correlated with facial femininity, which has been assessed via a composite index of some facial distance ratios as defined by Penton-Voak et al. (2001). However, such a composite index omits any information about facial shape. For example, this composite index includes the ratio between the cheekbone distance D3 (distance between the leftmost and rightmost pixels of the face on a horizontal line beneath the eyes) and the jaw width D6 corresponding to the face width at the *y* coordinates of the mouth corners. This ratio, like any ratio, lacks information about the relative positions of all the endpoints of the measurements (Slice, 2005). Thus, it is unlikely that such a composite index conveys sufficient information about facial cues relevant for the perception of attractiveness or femininity. This may be the reason why the ratio used to compute the composite index or the composite index itself is not significantly correlated or shows significant but low correlation with visual judgments of facial attractiveness (Penton-Voak et al., 2001). Therefore, facial shape analysis should include morphometric tools that preserve the relative position of the above mentioned endpoints to quantify and visualize facial cues related to perceived attractiveness.

It was the aim of the current study to show that multiple cues that share a common mate value serve as back up signals in human mate choice decisions. To identify such a redundancy we investigated both visual and acoustic cues and their association with measures of shape.

For the purpose of our study, we collected photographs of female faces and recordings of female voices and we measured females' body and facial FA. Subsequently we asked two different pools of male raters to evaluate either the attractiveness of the female faces or the attractiveness of the corresponding voice recordings. A third pool of males was recruited for ratings of an independent sample of female faces. To go beyond previous research we applied a landmark-based Geometric Morphometric Methodology (GMM)—a multivariate statistical tool which was developed to capture, statistically analyze and visualize shape information of anatomical structures (Bookstein, 1991). On the basis of single landmark configurations we related visual and vocal attractiveness ratings to the underlying facial shape. Compared to other statistical procedures, GMM provides a more comprehensive picture of how single features of facial shape change in concert with ratings on attractiveness. We hypothesized that auditory and visual cues convey a redundant signal of female attractiveness. Therefore we expected that both ratings of facial but also vocal attractiveness are reflected in low levels of body FA and facial FA. Using GMM we projected ratings of visual and acoustic attractiveness onto facial shape. This enabled us to provide visual representations of the interrelations between the two modalities. The shape regressions were also performed using an independent sample of female faces to test whether this resulted in similar changes of facial shape as expected for the initial samples.

In summary, our study intended to uncover commonalities between the perception of vocal and visual attractiveness and whether these cues communicate redundant information. We also aimed to contribute to the discussion on the use of multiple cues in human mate choice decisions by showing that the 'redundant signaling' hypothesis might be valid for morphological features that signal female mate quality.

2. Materials and methods

2.1. Participants

2.1.1. Initial samples

We measured the body asymmetry, recorded the voices and photographed the faces of 42 female students of the University of Vienna (mean age = 24.2, SD = 5.5, range = 19–42). Bone injuries were enquired in a questionnaire. 103 heterosexual males (mean age = 26.0, SD = 7.1, range = 19–67) rated the female voices on attractiveness. Two thirds of the participants were students from the University of Vienna. One third of the participants were recruited in a public place.

Sixty-two heterosexual male students (mean age = 25.2, SD = 4.1, range = 18–44) rated the photographed female faces on attractiveness. All participants were native German speakers, who had no speech or hearing pathology.

2.1.2. Independent sample

Facial photographs from 34 female students of the University of Vienna were taken. None of these facial stimuli were involved in the initial sample. A group of 42 heterosexual males (mean age 31.7, SD = 7.1, range = 20–44) recruited via an online interface rated the female faces on attractiveness. None of these males participated in the rating studies mentioned above.

All participants that were involved in our study did not receive any financial compensation and were kept blind to the study's aims.