Perceptions of Human Attractiveness Comprising Face and Voice Cues

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ABSTRACT

In human mate choice, sexually dimorphic faces and voices comprise hormone-mediated cues that purportedly develop as an indicator of mate quality or the ability to compete with same-sex rivals. If preferences for faces communicate the same biologically relevant information as do voices, then ratings of these cues should correlate. Sixty participants (30 male and 30 female) rated a series of opposite-sex faces, voices, and faces together with voices for attractiveness in a repeated measures computer-based experiment. The effects of face and voice attractiveness on face-voice compound stimuli were analyzed using a multilevel model. Faces contributed proportionally more than voices to ratings of face-voice compound attractiveness. Faces and voices positively and independently contributed to the attractiveness of male compound stimuli although there was no significant correlation between their rated attractiveness. A positive interaction and correlation between attractiveness was shown for faces and voices in relation to the attractiveness of female compound stimuli. Rather than providing a better estimate of a single characteristic, male faces and voices may instead communicate independent information that, in turn, provides a female with a better assessment of overall mate quality. Conversely, female faces and voices together provide males with a more accurate assessment of a single dimension of mate quality.

Keywords: attractiveness; face; voice; multiple cues; multilevel model

INTRODUCTION

In humans, the face and voice comprise cues proposed to have evolved through sexual selection to indicate mate quality (Feinberg, 2008; Roberts & Little, 2007) or compete with rival members of the same sex (Puts, 2010). Male and female faces and voices develop during puberty in relation to differential concentration of circulating hormones. In males, higher testosterone-estrogen ratios influence facial morphology such that they lead to a broad chin, prominent eyebrow ridge, small eyes, and thin lips (Thornhill & Møller, 1997). Vocal folds situated in the larynx also increase in size owing to higher testosterone levels, thus leading to a lower voice pitch (Hollien, 1960). In females, higher estrogen levels inhibit the effect of testosterone on morphological changes and influence the development of features such as large eyes and full lips (Thornhill & Møller, 1997). Higher estrogen levels also prevent the vocal folds from enlargement and thus lead to higher voice pitch (Hollien, 1960).

There is some evidence of a positive relationship between testosterone and attractive male faces (Penton-Voak & Chen, 2004). Furthermore, females have been shown to prefer more masculine faces (Keating, 1985; Penton-Voak et al., 2001; Scheib, Gangestad, & Thornhill, 1999; although see Perrett et al., 1998; Penton-Voak, Jacobson, & Trivers, 2004). A relationship also exists between testosterone and male voice pitch (Dabbs & Mallinger, 1999; Evans, Neave, Wakelin, & Hamilton, 2008; although see Bruckert, Lienard, Lacroix, Kreutzer, & Leboucher, 2006) and females have been shown to prefer low pitch male voices (Apicella, Feinberg, & Marlowe, 2007; Bruckert et al., 2006; Collins, 2000; Feinberg, Debruine, Jones, & Little, 2008).

In contrast, attractive female faces are positively related to high estrogen (Law-Smith et al., 2006) and feminine faces are more attractive to males (Feinberg et al., 2005; Johnston et al., 2001; Jones et al., 2007; Law-Smith et al., 2006; Perrett et al., 1998). A relationship also exists between estrogen and female voice pitch (Abitbol, Abitbol, & Abitbol, 1999).

Further research has shown that high pitch female voices are judged to be more attractive (Collins & Missing, 2003; Feinberg et al., 2005).

Thus far, research aimed at further understanding the evolution of cues and human preferences have typically investigated face and voice attractiveness in isolation (Wells, Dunn, Sergeant, & Davies, 2009) although the investigation of multiple cues has recently received increasing attention (e.g., Fraccaro et al., 2010; Saxton, Burriss, Murray, Rowland, & Roberts 2009). Multiple cues are beneficial since together they could provide a better assessment of mate quality and increase the chance of producing healthy offspring (Møller & Pomiankowski, 1993). Investigating attractiveness in the presence of multiple cues may also prove to be informative regarding the relative strength and function of these cues when integrated (Roberts & Little, 2007; Wells et al., 2009).

Multiple cues can be categorized as informative or non-informative (for a review, see Candolin, 2003). Of interest here are two types of informative cues: *back-up signals* and *multiple messages*. All cues signal information with some degree of error or dishonesty (Guilford & Dawkins, 1991; Møller, & Pomiankowski, 1993). Back-up signals are informative because they provide more information with regard to a single trait, thus, reducing a potentially erroneous interpretation (Candolin, 2003). As such, back-up signals are expected to be related but could have various effects on the receiver e.g., by producing equivalent or enhanced responses when presented together (see Partan & Marler, 1999). Multiple messages are also informative in that they can similarly provide information about the sender. However, each cue may signal information independently of the other. Rather than providing a better assessment of a single trait, multiple messages can be interpreted together to form a broader assessment of overall mate quality (Candolin, 2003). Multiple messages are, therefore, likely to be unrelated and can produce a variety of responses from the receiver (see Partan & Marler, 1999).

Since an attractive face and voice are proposed to communicate the same biologically relevant information in both males and females (i.e., high testosterone and estrogen respectively), they are likely to be back-up signals (Feinberg, 2008). Indeed, a number of studies have shown a relationship between female (Collins & Missing, 2003; Feinberg et al., 2005; Fraccaro et al., 2010; Lander, 2008; Saxton et al., 2009) and male (Feinberg et al., 2008; Hughes, Dispenza, & Gallup, 2004; Saxton, Caryl, & Roberts, 2006; Saxton et al., 2009) cues. However, while there is concordance between findings from the investigation of female cues, the relationship between face and voice attractiveness in males is equivocal.

Feinberg et al. (2008) found a correlated female preference for masculine faces and voices but using non-source matched stimuli (i.e., face and voice masculinity were manipulated on a continuum and pairings were not from the same individual). While this suggests a relationship between female preferences for masculine faces and voices, it does not address the question of whether these preferences relate to attractive faces and voices that correlate within individuals. The studies by Feinberg et al. (2008) and Saxton et al. (2006) both used a forced-choice paradigm, where participants continually chose the more attractive of two simultaneously presented stimuli (relative judgement) as opposed to rating a single stimulus on a scale (absolute judgement) (Lander, 2008). When participants provided an absolute judgement for faces and voices separately, male face and voice attractiveness ratings were not found to be related (Lander, 2008).

In a recent study, however, Saxton et al. (2009) asked participants to rate each stimulus individually using a rating scale and found a correlation between male face and voice attractiveness (although not when analyzed by sex of the rater purportedly owing to small sample size). In their study, one group of participants rated the attractiveness of individual components while another rated compound stimuli attractiveness. Moreover, participant averages rather than individual ratings for each stimulus were included in the analysis. Using multiple regression, Saxton et al. (2009) showed that faces contributed marginally more than voices to compound (face, body, and voice) stimuli attractiveness. One issue with the Saxton et al. (2009) study may be that participants were assumed to be homogeneous in their attractiveness preferences. Using average ratings could lead to an ecological fallacy (Robinson, 1950). That is, stimuli averages could be erroneously inferred as representative of individual stimuli attractiveness. Importantly, examination of group or participant averaged data can produce different size or even direction of a relationship between variables compared to correlations between individual observations. Regressing participant averages could, therefore, produce misleading estimates of face and voice effects on compound stimuli attractiveness.

Although there is some evidence of universal attractiveness (e.g., Cunningham, Roberts, Barbee, Druen, & Wu, 1995), individual differences in mate preferences occur for a number of reasons (see Jennions & Petrie, 1997) and have been shown to have an important influence on attractiveness ratings compared to shared preferences (Hönekopp, 2006). Accommodating sources of variance between individuals and stimuli may provide more accurate estimates of face and voice effects that would compliment the findings of Saxton et al. (2009). The present study, therefore, aimed to elucidate the relationship between face and voice attractiveness for both male and female stimuli and, by using a multilevel model analysis, provide more powerful estimates of their relative effect when presented together in compound (Hoffman & Rovine, 2007).

METHOD

Participants

Sixty students (30 males, *M* = 21 yrs, *SD* = 3; 30 females, *M* = 20 yrs, *SD = 4*) recruited from Nottingham Trent University rated the attractiveness of opposite sex faces and voices in a computer-based experiment. The faces and voices were presented in blocks on their own and together with their matched sample in a repeated measures design. Participants received credits as part of a research scheme for taking part.

Measures

Forty sets of stimuli (faces and voices matched to source) were used. The faces (see Fig. 1) were photographs of white Europeans (20 males, *M* = 24 years, *SD* = 3.4; 20 females, *M* = 23 yrs, *SD* = 5.0) with a neutral expression taken using a Canon US30D camera with an EF-50mm f/1.4 lens under flash lighting. Photographs were isolated on a neutral-grey background with features such as hair removed using Photoshop CS2 and then adjusted to be equivalent in size using inter-pupillary distance. Sexual dimorphism was also measured using an identical method to Penton-Voak et al. (2001). For each photograph, *z* scores of measurements were used to calculate masculinity using the formula: z(lower face height/face height) - *z*(face width/lower face height) - *z*(eye size) - *z*(mean height of eyebrow above top of eye) - *z*(cheekbone prominence), with high scores indicated greater masculinity. The scores were reversed for female photographs so that high scores indicated greater femininity (see Finberg et al., 2005) A sample of each voice speaking a neutral phrase (stranger than fiction) was recorded in a sound attenuated room. Voice pitch was determined by measuring the fundamental frequency (F0; Male, *M* = 111.74 *Hz*, *SD* = 15.59; Female, *M* = 200.53 *Hz*, *SD* = 16.86). Participants were alone during recording where they were instructed to say the phrase three times in a normal speaking-voice; the average phrase (determined by mean F0) was used for each stimulus. Voices were recorded using a PMD 660 digital recorder with an AKG C451B microphone. Pitch was measured with Praat software (www.fon.hum.uva.nl/praat) using autocorrelations with the floor set to 60 *Hz* and ceiling to 300 *Hz*. The samples were converted to 44.1K *Hz* sampling rate and 16-bit quantization.

The stimuli were presented using E-prime 2.0 experimental software. The vocal samples were presented at a comfortable volume level through Beyerdynamic DTX 900 headphones.

Procedure

The experiment was conducted in three counterbalanced blocks (faces, voices, face-voice compound). Participants rated the attractiveness of each stimulus presented in a random order within a block, on a scale of 1 (not attractive) to 9 (attractive). Each stimulus was presented for ~2 seconds after which participants were instructed to press a number key indicating the attractiveness rating.

RESULTS

The results of face and voice attractiveness predicting face-voice compound attractiveness (see Table 1) were analyzed using a two level cross-classified multilevel model because each participant rated the same series of stimuli in a repeated measures design (for a discussion of nested versus cross-classified structures, see Baayen, Davidson, & Bates, 2008). Regression parameter estimates were obtained in R (R Development Core Team, 2009) using the linear mixed-effects model package (lme4; Bates & Maechler, 2009). Table 2 shows the multilevel regression estimates for male and female face-voice compound attractiveness with participants and stimuli variance at Level 2 and residual variance at Level 1. Face and voice attractiveness ratings were centered by participant means to obtain unbiased estimates of their stimulus average effects (see Enders & Tofighi, 2007).

For male stimuli, face attractiveness, $b = .43$, $p < .001$, 95% CI [.34, .50], and voice attractiveness, $b = .20$, $p < .001$, 95% CI [.14, .25], both predicted overall attractiveness ratings. An interaction between face and voice attractiveness did not materially improve the model (ΔAIC = -0.4, $\Delta\chi^2(1) = 2.4$, $p > .05$) and was thus omitted. Random variance was evident between stimuli (.02), between participants (1.91) or attributable to residual error (1.38). Estimates obtained from an intercept only model suggested the proportion of variance to be 7% for stimuli, 50% for participants, and 43% residual error. There was no appreciable correlation between the attractiveness of male faces and voices, r_{551} = -.01, 95% CI [-.09, .07]. Further analysis revealed a significant positive relationship between face masculinity measurements and attractiveness, r_{551} = .13, p < .001, 95% CI [.05, .21]. There was also a significant negative relationship between male voice pitch and attractiveness, r_{551} = -.27, p < .001, 95% CI [-.34, -.2].

For female stimuli, face attractiveness, b = .51, p < .001, 95% CI [.42, .58], and voice attractiveness, b = .09, p < .01, 95% CI [.02, .15], both predicted overall attractiveness ratings, with face attractiveness having, on average, a much larger effect. Adding an interaction between face and voice attractiveness improved the model (ΔAIC = -7.3, $\Delta\chi^2(1) = 9.3$, p < .001) and significantly predicted overall attractiveness, b = .054, p < .01, 95% CI [.02, .07]. Fig. 2 illustrates the impact of the interaction: the impact of face attractiveness on the overall rating was enhanced by high voice attractiveness. Random variation was evident between stimuli (.16), between participants (.93), and attributed to residual error (1.38). Estimates obtained from an intercept-only model suggested the variance to be apportioned 28% to stimuli, 26% to participants, and 46% residual error. The correlation between the attractiveness of female faces and voices was positive, r_{551} = .20, p < .001, 95% CI [.12, .28]. Further analysis, however, revealed a nonsignificant relationship between face femininity measurements and attractiveness, r_{551} = .03, p > .05, 95% CI [-.05, .11]. There was also no significant relationship between female voice pitch and attractiveness, r_{551} = -.05, p > .05, 95% CI [-.13, .03].

DISCUSSION

Our findings provided further support for earlier research (Saxton et al., 2009) that found faces and voices positively and independently influence the attractiveness of male and female compound stimuli attractiveness. However, the influence of voices on face-voice compound attractiveness was shown to be much smaller relative to faces. More powerful estimates of effects may have been found because multilevel model analyses can accommodate multiple sources of variance within data (Hoffman & Rovine, 2007). This is particularly important in repeated measures experiments where there is likely to be variance in effects owing to differences between both stimuli and participants. There was, for example, a large proportion of random variance attributed to differences between individuals in ratings of both male and female stimuli.

Variation in attractiveness preference has been shown to have an important influence on attractiveness ratings compared to shared preferences (Honekopp, 2006). They arise for a number of reasons, such as parental influence, sexual history, and self-perceived attractiveness (Jennions & Petrie, 1997; Perrett et al., 2002; Pfaus, Kippin, & Centeno, 2001). Further research could include factors related to individual differences in order to elucidate their influence on the direction and size of attractiveness effects. Including further sources of variance in multilevel model analyses could provide a more fruitful approach for future attractiveness research.

The analysis of female face and voice contributions to face-voice compound stimuli attractiveness was the first to show an interaction between these modalities. Female faces and voices were proposed to express levels of estrogen that are attractive to males because they indicate fertility (Law-Smith et al., 2006). The positive relationship between estrogen levels and female face and voice attractiveness ratings has been suggested elsewhere (Feinberg, 2008) to indicate that these are back-up signals. All cues transmit information with some degree of error or dishonesty (Guilford & Dawkins, 1991; Møller & Pomiankowski, 1993) and, therefore, amalgamating multiple redundant cues could provide a more accurate estimate of a single characteristic (i.e., fertility). An unexpected finding was that no significant correlation was found between female face femininity and face attractiveness nor between female voice pitch and voice attractiveness. Nevertheless, the pattern of the interaction in Fig. 1 was consistent with the interpretation that female voices provide information about a single dimension of mate quality over and above that provided by faces alone.

In contrast, there was no significant correlation between male face and voice attractiveness. This was congruent with some research (Lander, 2008; Oguchi & Kukuchi, 1997) but contrasts with other work (Feinberg et al., 2008; Saxton et al., 2006, 2009). The lack of correlation between female attractiveness ratings of male faces and voices in the findings here suggest that indicators of testosterone were either unrelated in an individual or that face attractiveness was judged using a different criterion compared to voice attractiveness. The analysis here revealed a relationship between male face masculinity and face attractiveness in addition to a relationship between male voice pitch and voice attractiveness. Although not conclusive, it hints that the development of face and voice characteristics in males could be differentially determined by testosterone. Future research could consider the relationship among testosterone levels, voice pitch, and face morphology together in a male population.

The lack of relationship could alternatively arise because the face and voice of males are multiple messages; communicating different unrelated messages with regard to mate quality as opposed to providing a more accurate depiction of a single dimension of mate quality. For example, male faces could communicate information related to health and genetic quality (e.g., Rhodes et al., 2003; Roberts et al., 2005) while voices may provide some indication of dominance (e.g., Hodges-Simeon, Gaulin, & Puts, 2011; Puts, Gaulin, & Verdolini, 2006). Each cue would potentially carry independent elements of information that would both be expected to influence overall attractiveness. The results showed that despite being unrelated, face and voice attractiveness positively and independently contributed to male compound stimuli attractiveness. However, determining precisely what male face and voice cues could be communicating remains a topic for further investigation.

Our findings were the first to show an interaction between female face and voice attractiveness on overall attractiveness judgments. Moreover, the relationship between female face and voice attractiveness adds weight to the position that they communicate back-up signals, putatively providing males with a more accurate perception of fertility. The functions of face and voice attractiveness in perceptions of human male attractiveness are equivocal. It is unclear whether a non-relationship between male face and voice attractiveness arises because testosterone markers are unrelated in an individual or whether the cues are assessed under different criteria. Rather than providing a better estimate of a single dimension of mate quality, male face and voice attractiveness may instead communicate independent information that, in turn, provides a female with a more robust assessment of overall mate quality.

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Table 1: *Mean attractiveness ratings for male and female stimuli comprising face, voice, and face-voice compound stimuli*

	Face M *(SD)*	**Voice** M *(SD)*	**Face+Voice** M *(SD)*
Male	3.32 *(1.32)*	4.41 *(1.26)*	3.48 *(1.43)*
Female	3.92 *(1.01)*	4.9 *(.66)*	3.88 *(1.02)*

Table 2: *Parameter estimates for a cross-classified 2 level Fixed Effect Model (Random Intercept) predicting compound attractiveness with face and voice attractiveness effects*

	Male		Female	
Fixed Effects	**Estimate**	***(SE)***	**Estimate**	***(SE)***
Intercept	3.34***	*(.25)*	3.85***	*(.20)*
$Face_c$	.43***	*(.03)*	.51***	*(.01)*
$Voice_c$	.20***	*(.02)*	.09**	*(.03)*
$Face_c$ x $Voice_c$			.05**	*(.01)*
Random Effects				
Stimulus	.02		.16	
Participant	1.91		.93	
Residual	1.38		1.38	

*** $p < .001$ ** $p < .01$; c = centred at participant level

Figure 1: *Example of male (left) and female (right) face stimuli*

Figure 2: *Interaction between face and voice attractiveness effects on face-voice compound attractiveness for female stimuli*