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Female Preferences for Male Vocal and Facial Masculinity in Videos

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Abstract

Vocal and facial masculinity are cues to underlying testosterone in men and influence women's mate preferences. Consistent with the proposal that facial and vocal masculinity signal common information about men, prior work has revealed correlated female preferences for male facial and vocal masculinity. Previous studies have assessed women's preferences for male facial and vocal masculinity by presenting faces and voices independently and using static face stimuli. By contrast, here we presented women with short video clips in which male faces and voices were simultaneously manipulated in masculinity. We found that women who preferred masculine faces also preferred masculine voices. Furthermore, women whose faces were rated as relatively more attractive preferred both facial and vocal masculinity more than did women whose faces were rated as less attractive. These findings complement other evidence for cross-modal masculinity preferences among women and demonstrate that preferences observed in studies using still images and/or independently presented vocal stimuli are also observed when dynamic faces and voices are displayed simultaneously in video format.

Introduction

Adult male vocal and facial masculinity are testosterone-dependent traits that develop at puberty (Hollien 1960; Verdonck et al. 1999) and continue to be positively related to adult testosterone levels (Dabbs & Mallinger 1999; Penton-Voak & Chen 2004; Bruckert et al. 2006; Roney et al. 2006; Evans et al. 2008; Puts et al. 2011; but see also Peters et al. 2008). Men's testosterone levels are also positively associated with dominance (Mazur & Booth 1998). Furthermore, masculinized men's voices (Tusing & Dillard 2000; Feinberg et al. 2006; Puts et al. 2006, 2007; Jones et al. 2010a) and faces (Perrett et al. 1998; Swaddle & Reierson 2002; Boothroyd et al. 2007; Jones et al. 2010b) are perceived as more dominant than are feminized voices and faces. Vocal masculinity is also associated with measures of dominance, such as body size (Evans et al. 2006; Puts et al. 2011) and physical strength (Puts et al. 2011). Facial masculinity among men has been observed to positively correlate with other objective indices of mate value, such as symmetry (Gangestad & Thornhill 2003; Little et al. 2008), physical strength (Fink et al. 2007), and disease resistance (Rhodes et al. 2003; Thornhill & Gangestad 2006). As testosterone can have immunosuppressant effects (Folstad & Karter 1992; Wichmann et al. 1997; Chen & Parker 2004), vocal and facial masculinity may be cues to heritable immunocompetence and/or dominance (Zahavi 1975; Folstad & Karter 1992; Fink & Penton-Voak 2002; Feinberg 2008).

Among men, testosterone is positively related to mating effort (Booth & Dabbs 1993; McIntyre et al.

2006; Peters et al. 2008), dominant behaviour and social status (Mazur & Booth 1998), while it is negatively related to measures of relationship and offspring investment (Booth & Dabbs 1993; Storey et al. 2000; Roney et al. 2006; Gray et al. 2007; Van Anders et al. 2007; Gettler et al. 2011). Although women prefer masculine, low-pitched men's voices (here, we refer to pitch as the perception of fundamental frequency and/or its harmonics), preferences for facial masculinity are relatively more variable (reviewed in Feinberg 2008).

While not all women prefer masculinity to the same degree, those women who prefer masculine men's faces also tend to prefer masculine men's voices (Feinberg et al. 2008a), and individual differences among women influence vocal and facial masculinity preferences in similar ways. Women's facial and vocal masculinity preferences are strongest during the late-follicular menstrual cycle phase (Penton-Voak et al. 1999; Penton-Voak & Perrett 2000; Puts 2005; Feinberg et al. 2006), among women not using hormonal contraception (Feinberg et al. 2008a), who experienced puberty at an earlier age (Jones et al. 2010c) and when women rate men as potential short-term partners (Little et al. 2002; Puts 2005). Furthermore, vocal and facial masculinity preferences are positively related to women's self-perceived attractiveness (Little et al. 2001; Vukovic et al. 2008). Other indices of a women's mate value, such as a feminine waist-to-hip ratio (Penton-Voak et al. 2003; Smith et al. 2009), and third-party attractiveness ratings (Penton-Voak et al. 2003) are also associated with increased facial masculinity preferences. Women with feminine, higher pitched voices also have stronger vocal masculinity preferences than do women with masculine, lower-pitched voices (Vukovic et al. 2010). Increased masculinity preferences among women with relatively higher mate value may reflect a greater ability among these women to procure parental and/or relationship investment from more masculine men (Little et al. 2001; Penton-Voak et al. 2003; Feinberg et al. 2006; Vukovic et al. 2008; Smith et al. 2009).

Vocal and facial masculinity are both related to the same underlying physiological processes (i.e. testosterone expression) and are assessed by potential mates in similar fashions. To date, however, no study of vocal and facial masculinity preferences has used simultaneous presentation of dynamic cross-modal stimuli.

Studies using video stimuli have typically focused on comparing preferences for images of unmanipulated still and dynamic faces, and while some research has found evidence for a positive relationship between the attractiveness of male faces presented in videos and photographs (Roberts et al. 2009a,b), others have not (Rubenstein 2005; Lander 2008; Penton-Voak & Chang 2008). Nevertheless, recent work suggests that the attractiveness ratings of men's voices and faces, presented independently (but from the same video recording), were positively correlated (Lander 2008). Surprisingly, Roberts et al. (2009a) found no significant difference in attractiveness ratings between videos presented with or without sound. Importantly, these studies did not specifically investigate preferences for vocal and facial masculinity; therefore, participants' attractiveness ratings may have been influenced by multiple characteristics. For instance, while perceptions of vocal and facial attractiveness are influenced by masculinity, vocal and facial attractiveness are also positively correlated with bilateral symmetry (Scheib et al. 1999; Little et al. 2001; Hughes et al. 2008). Furthermore, by averaging attractiveness ratings across observers, Roberts et al. (2009a) and Lander (2008) were unable to address whether the relationships between vocal and facial attractiveness were influenced by individual differences between raters (Feinberg et al. 2008a). To address the aforementioned issues, we independently manipulated the masculinity of video and audio tracks of short video clips of men speaking and had these stimuli rated for attractiveness. If vocal and facial masculinity function as cues to testosterone, then preferences for vocal and facial masculinity may be positively related across manipulations.

To our knowledge, only one study thus far has investigated preferences for masculine facial structure using photorealistic dynamic stimuli. Morrison et al. (2010) manipulated the facial masculinity of male faces in soundless videos and found that preferences for male facial sexual dimorphism were not significantly different from chance. It is unclear, however, whether the findings from Morrison et al. (2010) are attributable to the dynamic aspect of video as opposed to static images or whether women's preferences for facial masculinity in dynamic videos are related to individual differences in preferences, as is observed in experiments using static images. Given that our primary experience with faces is dynamic in nature, it is critical to demonstrate that the observed influence of masculinity on women's mate preferences is not restricted to instances where faces are static. To determine whether individual differences influence women's preferences for male masculinity in dynamic stimuli, we collected attractiveness rat-

ings of the female viewers (Penton-Voak et al. 2003). If women's facial attractiveness ratings are positively related to facial masculinity preferences (Penton-Voak et al. 2003) and if vocal and facial masculinity are common cues of testosterone, then women's facial attractiveness may also be positively associated with vocal masculinity preferences.

Methods

Participants

Protocols for this study were approved by the McMaster Research Ethics Board. Female participants (n = 63; mean age = 18.71 yr, SD = 1.71) were recruited from McMaster University and compensated with course credit for participation. Participant age and ethnicity were self-reported. All participants were heterosexual as assessed via the Kinsey Scale of Sexual Orientation (Kinsey et al. 1948). All participants were naïve to the experimental hypotheses.

Stimuli

Participant attractiveness

Female participants were photographed with a FujiFilm FinePix S5 Pro digital camera (FujiFilm Corp., Minato-Ku, Tokyo, Japan) with a Nikkor 60mm 2.8AF lens. Photographs were taken in colour, under standardized lighting conditions. Images were captured in RAW and exported to uncompressed TIFF format with FinePix 5.3 software. We standardized inter-pupillary distance to control for image size, and images were masked to reduce visual cues, such as hairstyle, that have been shown to influence masculinity preferences (DeBruine et al. 2009).

Masculinity preferences

Stimuli were collected from male undergraduates (n = 4; mean age = 17.75 yr, SD = 0.50) filmed in an anechoic sound attenuated booth (Whisper Room SE 2000) under standardized lighting conditions speaking the word 'one'. We selected the identities used in the current study at random from a larger set of stimuli. Post-manipulation voice pitch was similar to the normal male range after manipulation (111–159 Hz). Furthermore, we used four original voices here because many other studies of mate-choice relevant responses to manipulated vocal cues in human (Feinberg et al. 2005, 2006, 2008a,b, 2011; Vukovic et al. 2008; Jones et al. 2010b; O'Connor et al. 2011) and non-human (i.e. red deer, Charlton et al. 2008) studies have used similar numbers of voices. Furthermore, in human studies, research using 4–6 voices (Feinberg et al. 2005, 2006, 2008a,b, 2011; Vukovic et al. 2008; Jones et al. 2010b; O'Connor et al. 2011) found equivalent effects to many studies using identities ranging from dozens to hundreds of stimuli (Collins 2000; Collins & Missing 2003; Puts 2005; Welling et al. 2007; Feinberg et al. 2008b; DeBruine et al. 2010), suggesting that small numbers of stimuli, manipulated systematically, produce results that generalize to larger stimuli sets. Although the clips were short, previous work has established that 100 ms exposure to a face is sufficient for attractiveness judgments to be formed that are indistinguishable from those formed following far longer exposure times (Willis & Todorov 2006). Furthermore, these utterances are similar in length to a series of vowel sounds (for review, see Feinberg 2008) or a person saying the word 'had', which have been shown to be sufficient to make consistent judgments of vocal attractiveness (Bruckert et al. 2010). Videos were captured with a Panasonic AG-HVX200P video camera (Panasonic, Secaucus, NJ, USA) with a progressive scan rate of 23.98 frames per second, 24-bit colour depth and a 9×16 aspect ratio. Audio was captured using an external Sennheiser MKH 70 (Sennheiser, Wennebostel, Germany) cardioid condenser microphone input to the video camera with a 48-kHz audio frequency sampling rate and 16-bit amplitude quantization in Adobe On Location CS3 software (Adobe Systems, San Jose, CA, USA). Both the still camera and video camera were white balanced using ExpoDisc.

We created our facial stimuli by manipulating the masculinity of still images from each frame of the video (Tiddeman & Perrett 2002). Still images were extracted from each uncompressed AVI file, and each frame was converted to a still image in TIFF format using Adobe Premier Pro.

We first created two prototypes to serve as endpoints when manipulating images in masculinity. One male and one female prototype were made by averaging together 32 facial images in colour, shape and texture (Perrett et al. 1998). Prototypes were made symmetrical by averaging the shape, colour and texture of each face with its mirror image (separately) (for details, see Perrett et al. 1998) and did not include the faces of any participants in this study.

Next, we manipulated facial masculinity to create a masculinized and feminized version of each frame (for example, see Fig. 1). This was carried out by adding (masculinized) or subtracting (feminized)

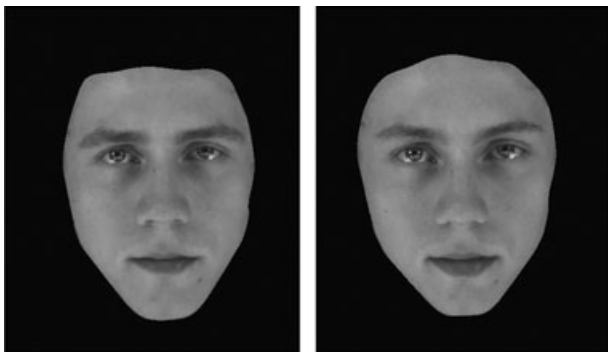

Fig. 1: Example of masculinized (left) and feminized (right) facial stimuli.

50% of the difference in shape between the male and female prototypes. We standardized interpupillary distance and masked the images in the same manner as mentioned earlier. Prototype-based image transformations were carried out using specialist computer graphics software (Tiddeman et al. 2001). This method of facial image transformation has been used successfully in face preference studies (see Feinberg 2008 for review) and has been shown to correlate positively with women's ideal or actual partner's masculinity (DeBruine et al. 2006) and with facial masculinity preferences observed using other facial image transformation methods (DeBruine et al. 2006, 2009).

Audio files were extracted as wav files using Adobe Premier Pro. We created a feminized (raised pitch) and masculinized (lowered pitch) version of each audio recording. We manipulated voice pitch using the pitch-synchronous overlap add (PSOLA France Telecom) method in Praat software (Boersma & Weenink 2009). This method of voice manipulation selectively manipulates fundamental frequency and related harmonics while controlling for other spectrotemporal features of the acoustic signal (Moulines & Charpentier 1990; Feinberg et al. 2005, 2008a).

Voice pitch was manipulated by raising or lowering voice pitch by ±0.5 equivalent rectangular bandwidths of the baseline frequency (see Fig. 2 for spectrographic representation). This scale more precisely accounts for the difference between natural frequencies and pitch perception than do alternative scales (Tranmüller 1990). The resulting change in pitch is approximately equivalent to a 20 Hz manipulation for an average male voice pitch of 120 Hz. This level of pitch manipulation has been used in previous research on voice pitch preferences (Feinberg et al. 2008a; Vukovic et al. 2008; Apicella & Feinberg 2009; Jones et al. 2010a) and has been shown to positively influence perceptions of masculinity (Feinberg et al. 2005) and dominance (Feinberg et al. 2006; Jones et al. 2010a; Vukovic et al. 2011).

Masculinized and feminized audio and still images were re-compiled as AVI files in Adobe Premier Pro. Videos were then converted to MPEG-4 format at a resolution of 490 × 425 pixels, 24-bit colour, with a sampling rate of 44.1 kHz and 16-bit amplitude quantization with the AAC audio codec using QuickTime Pro (Apple Inc., Cupertino, CA, USA). This resulted in four videos per voice–face masculinity combination (masculine voice and face, masculine voice and feminine face, feminine voice and masculine face and feminine voice and face) for a total of 16 videos.

Procedure

Assessing participant attractiveness

Male participants (n = 10; mean age = 19.40, SD = 1.35) were asked to rate each female face for attractiveness on a 7-point scale from 1 (very unat-

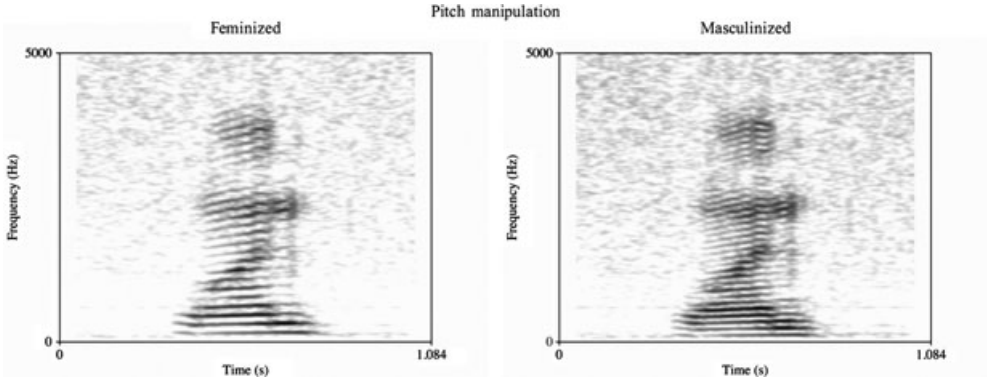

Fig. 2: Spectrographic representation of one pair of male voices used in this study. All participants spoke the word 'one'.

tractive) to 7 (very attractive). Faces were presented consecutively and fully randomized for order. Other studies have used similar numbers of participants to generate average ratings of traits such as health and masculinity (Feinberg et al. 2005; Jones et al. 2005). Facial attractiveness scores were calculated per female participant by averaging ratings across male participants. Inter-rater agreement among male participants on female participant facial attractiveness was extremely high (Cronbach's $\alpha = 0.97$).

Masculinity preferences

Female participants were asked to rate each video for attractiveness on a 7-point scale from 1 (very unattractive) to 7 (very attractive). Participants initiated video playback on a computer monitor (30'' Apple Cinema Display, monitor resolution 2560 × 1080, 24 bit colour). Dynamic video playback duration was approximately one-second, and videos were visible on-screen until participants entered their attractiveness rating. Videos were fully randomized for order of presentation and played sequentially.

Results

To investigate preferences for vocal and facial masculinity, we averaged the attractiveness ratings of each stimulus within each category to create an attractiveness score per voice–face combination for each participant (see Table 1 for descriptive statistics per voice–face combination). All analyses were carried out with SPSS 17 (IBM Corp., Armonk, NY, USA), using two-tailed probability estimates. Inter-rater agreement among female participants on video stimuli attractiveness was high (Cronbach's $\alpha = 0.88$).

To investigate the influence of masculinity manipulations on women's preferences, we used a repeated measures ANOVA [within-subject factors: facial masculinity (feminine and masculine) and vocal masculinity (feminine and masculine)]. We observed a main effect of vocal masculinity on preferences ($F_{1,62} = 18.48$, $p < 0.001$), where across levels of facial masculinity, participants rated masculinized male voices ($\bar{x} = 3.25$, SE = 0.10) as more attractive than feminized male voices ($\bar{x} = 2.95$, SE = 0.09). There were no other significant effects or interactions (all F-values < 2.38, all p-values > 0.128).

Table 1: Descriptive statistics of attractiveness ratings per voice–face combination

Stimuli manipulation	$\bar{x}$	SE
Masculinized face		
Masculinized voice	3.21	0.12
Feminized voice	2.92	0.10
Feminized face		
Masculinized voice	3.31	0.10
Feminized voice	2.98	0.09

Judgements made on a 7-point scale (1 = very unattractive, 7 = very attractive).

Individual Differences in Masculinity Preferences

To determine whether there were differences in voice and face masculinity preferences among individuals, we used a mixed design ANOVA [within-subject factors: facial masculinity (feminine and masculine) and vocal masculinity (feminine and masculine); between subjects factor: ethnicity of rater (Caucasian, non-Caucasian), covariate: women's third-party facial attractiveness ratings]. We observed a main effect of facial masculinity on preferences ($F_{1,60} = 6.55$, $p = 0.013$), where, across levels of vocal masculinity, participants rated feminized male faces ($\bar{x} = 3.16$, SE = 0.09) as more attractive than masculinized male faces ($\bar{x} = 3.09$, SE = 0.10). This was qualified by interactions between women's own facial attractiveness and facial masculinity preferences ($F_{1,60} = 4.78$ $p = 0.033$). Here, preferences for facial masculinity were positively related to women participant's facial attractiveness (see below for statistical tests). Additionally, we found a significant interaction between women's own facial attractiveness and vocal masculinity preferences ($F_{1,60} = 7.41$, $p = 0.008$), where preferences for vocal masculinity were positively related to women participant's facial attractiveness (see below for statistical tests). There were no other significant effects or interactions (all F-values < 1.56, all p-values > 0.217).

To interpret the interaction described above, we investigated the relationship between facial masculinity preferences, vocal masculinity preferences, and third-party attractiveness ratings. Vocal masculinity preferences were calculated by subtracting attractiveness ratings of feminized male voices from attractiveness ratings of masculinized male voices, for each level of facial manipulation. This resulted in two scores: preference for masculinized male voices paired with feminized faces and preference of masculinized male voices paired with masculinized faces. We then averaged these two preference scores. Facial masculinity preferences were calculated by subtracting attractiveness ratings of feminized male faces from attractiveness ratings of masculinized male faces, for each level of pitch manipulation. This

resulted in two scores: preference for masculinized male faces paired with feminized voices and preference of masculinized male faces paired with masculinized voice. We then averaged these two preference scores. This resulted in a general vocal masculinity preference score and a general facial masculinity preference score, where higher numbers reflect higher average attractiveness ratings independent of the masculinity of the other modality.

Third-party facial attractiveness ratings were significantly positively correlated with both vocal masculinity preferences ($r = 0.303$, n = 63, p = 0.016) and facial masculinity preferences ($r = 0.264$, n = 63, p = 0.036). Additionally, we found a significant positive correlation between facial masculinity and vocal masculinity preferences ($r = 0.371$, n = 63, p = 0.003). The positive correlation between vocal and facial masculinity preferences remained significant after controlling for women's facial attractiveness ($r = 0.316$, n = 60, p = 0.012).

Discussion

In the current study, we simultaneously manipulated the masculinity of voices and faces in short video clips of men speaking and examined women's preferences for the men in these videos. We found a positive correlation between women's preferences for male vocal and facial masculinity. We also found that women's own facial attractiveness positively predicted their preferences for vocal and facial masculinity. We found no evidence that preferences for masculinity in one modality were modulated by the level of masculinity in another modality (i.e. facial masculinity did not directly affect preferences for vocal masculinity and *vice versa*). Preferences for both vocal and facial masculinity may be adaptive as the expression of masculinity in men's voices and faces is dependent upon testosterone levels (Hollien 1960; Verdonck et al. 1999) and therefore may cue heritable dominance and/or immunocompetence (Zahavi 1975; Folstad & Karter 1992; Fink & Penton-Voak 2002; Puts et al. 2007; Feinberg 2008; Jones et al. 2010a). Assessing multiple cues to the same underlying quality is potentially adaptive for the perceiver, as multiple cues may increase the fidelity of masculinity as a cue to testosterone, reduce the efficacy of potentially dishonest cues and allow perceivers to focus on different modalities given noisy visual or auditory environments (Candolin 2003).

In the current study, we observed a main effect of facial masculinity, where across levels of voice pitch, women preferred feminized over masculinized faces. This is similar to findings from other studies of women's facial masculinity preferences (Perrett et al. 1998; Rhodes et al. 2000; Little et al. 2002; Welling et al. 2008). It is possible that women, on average, prefer more feminine male faces because men with more masculine faces, and therefore more testosterone, are less likely to invest in relationships and offspring (for review see Feinberg 2008). Prior research has suggested that variation in women's masculinity preferences may be moderated by women's own mate value (see Feinberg 2008 for review). Indeed, this main effect was qualified by a significant interaction between women's own facial attractiveness and both facial and vocal masculinity preferences, where third-party attractiveness ratings positively predicted both vocal and facial masculinity preferences. This result supports previous findings that third-party attractiveness ratings predict facial masculinity preferences in facial photographs (Penton-Voak et al. 2003). Here, we extend this finding to videos and voices manipulated in masculinity. These findings contribute to a growing body of evidence that indicates preferences for masculinity are greater among women of relatively higher mate value as indicated by a feminine voice and body (Penton-Voak et al. 2003; Smith et al. 2009; Vukovic et al. 2010), self-perceived attractiveness (Little et al. 2001; Vukovic et al. 2008), other-rated attractiveness (Penton-Voak et al. 2003), fertile menstrual cycle phase (Penton-Voak et al. 1999; Penton-Voak & Perrett 2000; Puts 2005; Feinberg et al. 2006), abstention from hormonal contraceptives (Little et al. 2002; Feinberg et al. 2008a) and breastfeeding (Apicella & Feinberg 2009). Increased masculinity preferences among women with relatively higher mate value, as suggested by the positive correlations between masculinity preferences and women's own attractiveness observed in the current study, may be due to these women's greater ability to attract masculine mates (Little et al. 2001; Penton-Voak et al. 2003; Feinberg et al. 2006; Vukovic et al. 2008, 2010). Additionally, this behaviour may also be adaptive if it aids in the ability to retain investment from masculine mates (Little et al. 2001; Penton-Voak et al. 2003; Feinberg et al. 2006; Vukovic et al. 2008, 2010).

Similar to the methods of Morrison et al. (2010), we investigated preferences for facial masculinity using dynamic video stimuli. While Morrison et al. (2010) found that facial masculinity preferences were not significantly different from chance, we found significant preferences for femininity in men's faces. We also found significantly greater preferences for facial masculinity among more attractive women,

which suggests that the influence of mate value on masculinity preferences is not limited to preferences assessed via static images and underlines the importance of accounting for individual differences when investigating masculinity preferences among women. It is possible that differences in stimuli, specifically facial motion, contributed to differences between Morrison et al. (2010) and the current study in the observed influence of facial masculinity on preferences. In comparison with the dynamic facial images used by Morrison et al. (2010), the facial stimuli in our study displayed less overall motion. Although previous work has indicated the importance of behavioural displays in women's mate preferences (Gangestad et al. 2004), Morrison et al. (2010) found that facial movement did not significantly affect attractiveness ratings. It is therefore unlikely that the observed differences in the influence of facial masculinity manipulations on attractiveness ratings between the current study and Morrison et al. (2010) are owing to differences in degree of facial movement.

While women's facial attractiveness accounted for a small although significant proportion of the variance in facial and vocal masculinity preferences (9.2% and 6.9%, respectively), including this variable was enough to alter significance levels for main effects of both facial and vocal masculinity preferences, thus demonstrating the critical need to account for individual differences in studies of masculinity preferences.

In summary, we presented women with dynamic video stimuli manipulated to possess different combinations of masculinity across audiovisual modalities, and found that those women who prefer masculine voices also prefer masculine faces. These results are consistent with those from Feinberg et al. (2008a,b), who also found correlated preferences for masculinity among women who rated still images of faces and voices independently. The positive relationship between women's preferences for masculinity in men's faces and voices remained significant when we controlled for the effects of women's own attractiveness, suggesting that correlated preferences for masculinity in different domains is not solely owing to the effects of women's own attractiveness. Furthermore, these results complement other evidence for cross-modal preferences, such as women's preferences for putative male pheromones and facial masculinity (Cornwell et al. 2004) and men's preferences for female vocal and facial femininity (Fraccaro et al. 2010). We also found that third-party attractiveness ratings were positively correlated with both vocal and facial masculinity preferences. This result supports findings from Penton-Voak et al. (2003), who found that women whose faces were rated as more attractive by a third-party displayed greater preferences for masculinity when shown still images of men's faces. Importantly, this demonstrates that the preferences observed in studies using still images and/or independently presented vocal stimuli are also observed when dynamic faces and voices are displayed simultaneously in video format. Therefore, masculinity preferences observed both here and in prior studies (Penton-Voak et al. 2003; Feinberg et al. 2008a,b) are not likely attributable to the manner of stimuli presentation.

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