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## Correlated preferences for men's facial and vocal masculinity

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### Abstract

Previous studies have reported variation in women's preferences for masculinity in men's faces and voices. Women show consistent general preferences for vocal masculinity, but highly variable general preferences for facial masculinity. Within individuals, men with attractive voices tend to have attractive faces, suggesting common information may be conveyed by these cues. Here we tested whether men and women with particularly strong preferences for male vocal masculinity also have stronger preferences for male facial masculinity. We found that masculinity preferences were positively correlated across modalities. We also investigated potential influences on these relationships between face and voice preferences. Women using oral contraceptives showed weaker facial and vocal masculinity preferences and weaker associations between masculinity preferences across modalities than women not using oral contraceptives. Collectively, these results suggest that men's faces and voices may reveal common information about the masculinity of the sender, and that these multiple quality cues could be used in conjunction by the perceiver in order to determine the overall quality of individuals.

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### 1. Introduction

Among humans, face, voice, and body attractiveness are influenced by their degree of masculinity or femininity (DeBruine et al., 2006; Fan, Dai, Liu, & Wu, 2005; Fan, Liu, Wu, & Dai, 2004; Feinberg, DeBruine, Jones, & Perrett, in press; Feinberg et al., 2006b; Feinberg, Jones, Little, Burt, & Perrett, 2005b; Perrett et al., 1998; Rhodes, Hickford, & Jeffery, 2000). In turn, it has been demonstrated that sex hormones (primarily testosterone, progesterone, and estrogen) are related to the degree of masculinity and femininity displayed by men's and women's faces (Law-Smith et al., 2006; Penton-Voak & Chen, 2004; Roney, Hanson, Durante, & Maestripieri, 2006), voices (Abitbol, Abitbol, & Abitbol, 1999; Alonso & Rosenfield, 2002; Brukert, Lienard, Lacroix, Kreutzer, & Laboucher, 2006; Dabbs & Mallinger 1999; Feinberg, Jones DeBruine, et al., 2006), and bodies (Jasienska, Ziomkiewicz, Ellison, Lipson, & Thune, 2004).

It is likely that males displaying testosterone-dependent traits to a greater degree can afford to produce such traits despite the immunosuppressive effects (Folstad & Karter, 1992; Thornhill & Gangestad, 1999), antisocial behavior (Archer, Biring, & Wu, 1998; Book, Starzyk, & Quinsey, 2001; Gonzalez-Bono et al., 1999; O'Connor, Archer, & Wu, 2004; Rowe, Maughan, Worthman, Costello, & Angold, 2004; Studer, Aylwin, & Reddon, 2005; Tremblay et al., 1998), and tendency to take risks (Archer, 1999; Booth et al., 1999) that are thought to be associated with high testosterone levels. Thus, facial and vocal masculinity may be considered cues of costly testosterone levels. Furthermore, men in a natural-fertility population with low voice pitch have higher reproductive success than men with relatively high voice pitch do (Apicella et al. In Press).

There is substantial evidence that people who are attractive in one domain (e.g., face, voice, or body) are also attractive in other domains (Collins & Missing, 2003; Feinberg, Jones, DeBruine et al., 2005; Hughes, Dispenza, & Gallup, 2004; Saxton, Caryl, & Roberts, 2006; Thornhill & Grammer, 1999). Indeed both men's (Saxton et al., 2006) and women's (Collins & Missing, 2003; Feinberg, 60

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Jones, DeBruine, et al., 2005) facial attractiveness are positively correlated with the attractiveness of their voices. Both men and women with attractive voices and faces also tend to have attractive body configurations, such as low fluctuating asymmetry (Hughes, Harrison, & Gallup, 2002) in women and a masculine upper-body shape in men (Hughes et al., 2004).

The findings described above suggest that humans display multiple cues to the same underlying quality. However, a few key questions regarding the evolution of multiple quality cues in humans remain unresolved. While many studies show that women have consistent preferences for masculine men's voices across studies (Collins, 2000; Feinberg, Jones, Law-Smith, et al., 2006; Feinberg et al., 2004; Saxton et al., 2006), different studies have yielded preferences in women for masculine (DeBruine et al., 2006; Johnston, Hagel, Franklin, Fink, & Grammer, 2001), average (Cornwell et al., 2004; Swaddle & Reiersen, 2002), and feminine (Perrett et al., 1998; Rhodes, Hickford, & Jeffery, 2000) men's faces. It has been suggested that differences in the computer graphic methods that have been used in different studies of preferences for masculinity in men's faces may explain these variable findings for women's face preferences (Penton-Voak & Chen, 2004; Rhodes, 2006; Swaddle & Reiersen, 2002). However, studies using the same method to manipulate masculinity in male faces have found different general preferences: DeBruine et al. (2006) reported a general preference for masculinity among women, Cornwell et al. (2004) found that average faces were generally preferred by women to feminized or masculinized versions, and Perrett et al. (1998) reported that women demonstrated strong aversions to masculinity in men's faces. More important, DeBruine et al. (2006) compared the strength of women's preferences for masculine faces using different types of computer graphic methods, finding that women who preferred facial masculinity did so for each type of manipulation.

Given that both male vocal and facial masculinity are influenced by testosterone, and masculinity and femininity affect voice and face attractiveness, why are women's preferences for masculinity in the voice consistently above chance, but women's preferences for masculinity in the face vary considerably more from study to study? Studies have revealed a great deal of individual variation in female preferences for both facial and vocal masculinity. Sources of variation in women's preferences for male vocal masculinity that have been identified to date include relationship context (Puts, 2005), menstrual cycle phase (Feinberg, Jones, Law-Smith, et al., 2006; Puts, 2005), and height (Feinberg, Jones, Little, et al., 2005). Women prefer masculinity more when in the most fertile menstrual cycle phase (Feinberg, Jones, Law-Smith, et al., 2006; Puts, 2005) and when rating voices as potential short-term partners (Puts, 2005). Taller and heavier women also prefer men with voice characteristics rated as more masculine sounding (Feinberg, Jones, Little, et al., 2005). Similar sources of systematic variation in face

preferences have also been found (see Table 1 for an extensive list of studies).

This overlap in sources of individual differences (i.e., menstrual cycle and relationship context) between face and voice is consistent with the hypothesis that preferences for masculinity in men's faces and voices may be concordant, despite variation across studies in women's generalized preferences for male facial masculinity. Indeed, previous studies showing positive associations between the strength of women's preferences for masculinity in men's faces and both putative male pheromones (Cornwell et al., 2004) and the reported masculinity of partnered women's romantic partners (DeBruine et al., 2006) suggest correlated preferences for masculinity in different domains. Nevertheless, while Feinberg, Jones, Law-Smith, et al. (2006) found that women with the lowest average estrogen levels demonstrated the largest cyclic shifts in vocal masculinity preferences, Welling et al. (in press) found that women with the highest average estrogen levels demonstrated the largest cyclic shifts in facial masculinity preferences (see also Johnston et al., 2001, for further evidence that particularly feminine women

Table 1  
Potential sources of variation in women's preferences for male facial masculinity

Potential source of variation in facial masculinity preference	Direction of relationship with facial masculinity preferences	Study	
Being in a committed relationship	–	Little et al. (2002)	t1.4
Rating faces in a relationship context			t1.5
Short-term	+	Little et al. (2002)	t1.6
Long-term	–		t1.7
Oral contraceptive use	Can mask masculinity preferences	Little et al. (2002)	t1.8
Self-rated attractiveness	+	Little et al. (2001)	t1.9
Women's attractiveness as rated by men	+	Penton-Voak et al. (2003)	t1.10
Waist–hip ratio	–	Penton-Voak et al. (2003)	t1.11
Menstrual-cycle phase	– at nonfertile phases	Frost (1994), Johnston et al. (2001), Penton-Voak and Perrett (2000), Penton-Voak et al. (1999) Jones, Little, et al. (2005)	t1.12
State progesterone level	– as progesterone increases		t1.13
State testosterone level	+ as testosterone increases	Welling et al. (2007)	t1.14
Second-to-fourth digit ratio	+	Scarborough and Johnston (2005)	t1.15
Age	+	Little et al. (2001)	t1.16
Paternal investment	–	Penton-Voak et al. (2004)	t1.17

160 show larger cyclic shifts in preferences for faces of  
165 masculine men).

166 Since any costs of producing multiple ornaments will  
167 outweigh the benefits of redundant ornaments, why would  
168 men produce more than one cue to testosterone levels?  
169 While both facial and vocal masculinity are influenced by  
170 testosterone, neither facial nor vocal masculinity is perfectly  
171 correlated with testosterone levels. In other words, each cue  
172 also has a degree of error (Candolin, 2003; Møller &  
173 Pomiankowski, 1993). Indeed, people can modify their  
174 voice pitch (within physiological constraints) and their  
175 apparent facial masculinity (e.g., altering brow height;  
176 Campbell, Benson, Wallace, Doesbergh, & Coleman, 1999).  
177 Thus, it is possible that there remains selection pressure  
178 from receivers for senders to produce multiple cues to the  
179 same underlying quality in order to (a) more easily detect  
180 dishonesty, (b) reduce error in cue perception, or both. Both  
181 proximate explanations result in an ultimate effort to evoke  
182 a more robust assessment of the sender's overall quality. If  
183 multiple quality cues are used by receivers to detect  
184 dishonest cues, it may then be an evolutionarily stable  
185 strategy (Maynard-Smith, 1976) for senders to produce  
186 consistent multiple quality cues. Alternatively, senders'  
187 multiple quality cues could merely demonstrate to receivers  
188 that they are of such quality that they can spend their  
189 resources on more than one ornament if such ornaments  
190 themselves are costly.

191 There is evidence of inconsistencies between generalized  
192 vocal and facial masculinity preferences and also inconsis-  
193 tencies in the nature of individual differences in the  
194 strength of masculinity preferences. Furthermore, although it  
195 has been demonstrated numerous times that people are  
196 sending multiple quality cues across visual and vocal  
197 domains, it is unknown if these cues are used in a consistent  
198 manner. To address these issues, we examined the extent to  
199 which the strength of men's and women's preferences for  
200 male facial masculinity is associated with the strength of  
201 their preferences for male vocal masculinity. As studies have  
202 shown that hormonal contraception is associated with a  
203 disruption of potentially adaptive facial masculinity prefer-  
204 ences (Little, Jones, Penton-Voak, Burt, & Perret, 2002) and  
205 a disruption of correlations between preferences for male-  
206 typical putative pheromones and facial masculinity prefer-  
207 ences (Cornwell et al., 2004), we investigated whether  
208 women using hormonal contraceptives have similar face and  
209 voice masculinity preferences to those not using hormonal  
210 contraceptives. As others have found that relationship status  
211 (partnered vs. single) affects facial masculinity preferences  
212 (Little et al., 2002), we also investigated the role of  
213 relationship status on the association between facial and  
214 vocal masculinity preferences.

## 215 2. Methods

216 Protocols were approved by the ethics committee at the  
217 School of Psychology, University of Aberdeen (UK).

### 218 2.1. Participants

219 As Internet research on face attractiveness is common-  
220 place and produces results similar to those of laboratory  
221 studies (Feinberg, Jones DeBruine, et al., 2005; Feinberg  
222 et al., in press; Jones et al., in press; Wilson & Daly, 2004),  
223 the experiment was run online. Recent research has also  
224 demonstrated that Internet-based studies on voice attractive-  
225 ness (using voice pitch manipulations of the same strength as  
226 used in the current study) reveal preferences that are  
227 consistent with laboratory studies, and that the use of varied  
228 computer speakers in these studies does not affect the ability  
229 to perceive voice attractiveness, femininity, and age in a  
230 manner consistent with use of sets of identical, professional-  
231 quality headphones (Feinberg et al., in press). Data from  
232 repeat user IDs were excluded from analysis (following  
233 Kraut et al., 2004). Participants were 1759 people (age range  
234 17–40 years; mean age=24.3 years, S.D.=6.042 years; 1213  
235 women) recruited from lists of online psychology experi-  
236 ments and through the media.

### 237 2.2. Stimuli

238 Here we used face stimuli from DeBruine et al. (2006) to  
239 test preferences for facial masculinity. These were six male  
240 faces that had been masculinized and feminized by changing  
241 two-dimensional (2-D) shape by  $\pm 50\%$  of the vector shape  
242 differences between an average male face and an average  
243 female face. This technique is also identical to facial  
244 masculinity manipulations used in many other studies of  
245 preferences for masculinity in male faces (see DeBruine  
246 et al., 2006, for a review). DeBruine et al. (2006) have  
247 previously demonstrated that the versions of these face  
248 images with increased masculinity of 2-D shape are  
249 perceived as more masculine and dominant than the versions  
250 in which masculinity of 2-D shape was reduced (see also  
251 Welling et al., in press).

252 To create masculine and feminine voices, six men's  
253 voices (spanning the normal range of male voice pitch)  
254 were manipulated in pitch (i.e., perception of fundamental  
255 frequency and corresponding harmonics)  $\pm 20$  Hz, using  
256 methods identical to those of Feinberg, Jones, Little, et al.  
257 (2005). Briefly, Praat's (Boersma & Weenink, 2007) pitch-  
258 synchronous overlap add algorithm was applied to the  
259 signal to manipulate the fundamental frequency and  
260 corresponding harmonics independently of other acoustic  
261 features (i.e., formant frequencies) associated with per-  
262 ceived masculinity (Feinberg, Jones, Little, et al., 2005).  
263 These methods have not only been used in several studies  
264 of attractiveness and dominance judgments of human voices  
265 (Feinberg, Jones, Law-Smith, et al., 2006; Feinberg et al.,  
266 2005b; Puts, Gaulin, & Verdolini, 2006), but also by several  
267 researchers studying the relationship between perceptions of  
268 these acoustic manipulations and social behavior in red deer  
269 (Reby et al., 2005) and rhesus macaques (Fitch & Fritz,  
270 2006; Ghazanfar et al., 2007). See Fig. 1 for illustrations of  
271 face and voice stimuli.

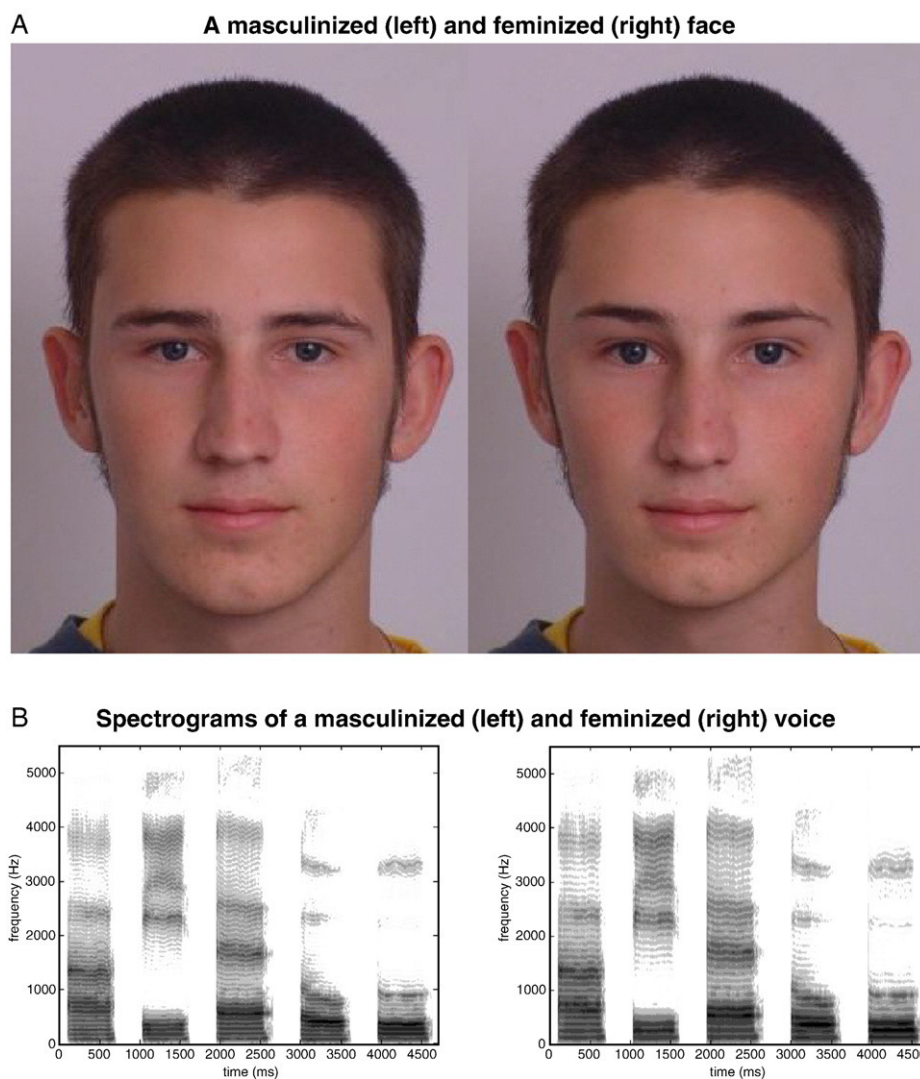


Fig. 1. Masculinized and feminized faces (A) and spectrograms of masculinized and feminized voices (B). Harmonic spacing (distance between the thin horizontal lines) is equal to the fundamental frequency (pitch) of the voice. Thus the voice on the left side of (B) has a lower pitch than the voice on the right side of (B). Note that the formant frequencies (dark bands on the spectrogram) and time (x-axis) do not change when pitch has been manipulated.

### 272 2.3. Procedure

273 Voices and faces were presented in separate blocks in  
 274 random order. Masculine and feminine stimuli were  
 275 presented in a forced-choice paradigm: Voices were  
 276 presented side by side and participants chose how much  
 277 they preferred either voice or face by selecting one of the  
 278 ratings above the stimulus preferred. Faces were presented in  
 279 an identical fashion. For voices, both voices were not played  
 280 simultaneously, but rather, participants pushed play buttons  
 281 on-screen to hear each voice individually. This method of  
 282 forced-choice voice presentation has been used in other  
 283 Internet-based studies of voice attractiveness (Feinberg et al.,  
 284 *in press*). All orders of stimuli presentation and the side that  
 285 stimuli were presented on were fully randomized.

286 Subsets of female raters self-reported whether or not they  
 287 are currently using hormonal contraceptives or have used  
 288 hormonal contraceptives within the last 3 months prior to

testing (Feinberg, Jones, Law-Smith, et al., 2006; Jones, 289  
 Perrett, et al., 2005; Welling et al., *in press*). Participants also 290  
 reported whether or not they were currently in a romantic 291  
 relationship (Little et al., 2002). One hundred twelve women 292  
 reported using hormonal contraceptives. 293

### 294 3. Results

For analyses, we calculated the number of trials on 295  
 which each participant chose the more masculine voice 296  
 (vocal masculinity preference) and the more masculine face 297  
 (facial masculinity preference). Poisson-based generalized 298  
 linear models with log-link functions were used to analyze 299  
 these data. Using the number of masculine faces or voices 300  
 chosen (as opposed to rating scale data) controls for the 301  
 possibility that correlations between facial and vocal 302  
 masculinity preferences may occur as a result of some 303

304 participants being more willing to use the scale end points  
305 than other participants.

### 306 3.1. Generalized preferences

307 We utilized a generalized linear model to test for  
308 general associations among vocal and facial masculinity  
309 preferences [dv=facial masculinity preference; factors: sex  
310 of rater (male, female); covariates: vocal masculinity  
311 preference, age of rater]. The test model was significantly  
312 different than the intercept-only model (both  
313  $\chi^2_5 > 141.864$ ,  $p < .0001$ ). Analysis of deviance evaluated  
314 goodness of fit (both  $D_{1754} = 1765.204$ ,  $D/df = 1.006$ ).  
315 Vocal masculinity preferences significantly predicted  
316 facial masculinity preferences [ $\beta = .005$ , S.E. = 0.024,  
317  $0.0001 < \text{confidence interval (CI)} < 0.01$ ;  $\chi^2_1 = 5.194$ ,  
318  $p = .023$ ]. No other effects or interactions were significant  
319 (all  $\chi^2_1 < 1.114$ ,  $p > .291$ ).

Q2 320 A separate generalized linear model [dv=vocal masculi-  
321 nity preference; factor: sex of rater (male, female);  
322 covariates: facial masculinity preference and age of rater]  
323 was significantly different than the intercept-only model  
324 ( $\chi^2_5 = 184.621$ ,  $p < .0001$ ). Analysis of deviance evaluated  
325 goodness of fit (both  $D_{1754} = 3361.775$ ,  $D/df = 1.917$ ).  
326 Facial masculinity preferences significantly predicted  
327 vocal masculinity preferences ( $\beta = .312$ , S.E. = 0.084,  
328  $0.139 < \text{CI} < 0.485$ ,  $\chi^2_5 = 12.444$ ,  $p < .001$ ). Additionally,  
329 women had stronger vocal masculinity preferences in  
330 men's voices than men did ( $\beta = .825$ , S.E. = 0.1733,  
331  $0.485 < \text{CI} < 1.165$ ,  $\chi^2_5 = 22.669$ ,  $p < .001$ ). Facial masculinity  
332 preferences predicted vocal masculinity preferences more  
333 strongly among men than women ( $\beta = -.123$ , S.E. = 0.0416,  
334  $-0.204 < \text{CI} < -0.041$ ,  $\chi^2_5 = 8.669$ ,  $p = .003$ ). No other effects  
335 or interactions were significant (all  $\chi^2_1 < 3.291$ , all  $p > .07$ ,  
336 which is the nonsignificant main effect of age on vocal  
337 masculinity preferences).

338 One-sample *t* tests revealed that, for both men and  
339 women, vocal and facial masculinity preferences were  
340 significantly above 50% (i.e., chance). Table 2 displays  
341 these statistics. For both male and female raters, vocal  
342 masculinity preferences were positively and significantly  
343 correlated with facial masculinity preferences (women:  
344  $r_{1213} = .246$ ,  $p < .0001$ ; men:  $r_{547} = .366$ ,  $p < .0001$ ). Fisher's *r*-  
345 to-*z* test revealed a significantly higher correlation between  
346 vocal and facial masculinity preferences among men than  
347 women ( $Z = 2.57$ ,  $p = .010$ ).

t2.1 Table 2  
t2.2 Generalized face and voice masculinity preferences

t2.3	Sex of rater	Modality of masculinity preference	<i>T</i> value	Mean % of masculine voices chosen	S.D.	<i>df</i>	<i>p</i> value
t2.4	Male	Voice	14.52	65.9	25.9	546	<.0001
t2.5		Face	12.13	65.1	29.6	546	<.0001
t2.6	Female	Voice	28.56	69.3	23.6	1212	<.0001
t2.7		Face	9.67	58.0	28.6	1212	<.0001

Table 3  
Hormonal contraceptives and masculinity preferences

Using hormonal contraceptives	% Masculine stimuli chosen		
	Face	Voice	
No	58.33	70.39	t3.5
Yes	54.88	68.21	t3.6

### 3.2. Potential influencing factors

350

We created two generalized linear models for women's  
351 ratings (dv's=facial or vocal masculinity preference; hormo-  
352 nal contraceptive use, relationship status; covariates: vocal/  
353 facial masculinity preference, age of rater). Both models  
354 were significantly different than the intercept-only model  
355 (both  $\chi^2_8 > 17.01$ ,  $p < .03$ ). Analysis of deviance examined  
356 goodness of fit (both  $D_{312} < 308$ ,  $D/df < 0.99$ ).  
357

We observed an interaction between hormonal contra-  
358 ceptive use and the predictive strength of facial mascu-  
359 linity preferences on vocal masculinity preferences  
360 ( $\beta = .005$ , S.E. = 0.024,  $0.0001 < \text{CI} < 0.01$ ,  $\chi^2_1 = 4.277$ ,  
361  $p = .039$ ) and vice versa ( $\beta = .141$ , S.E. = 0.0529,  
362  $0.38 < \text{CI} < 0.245$ ,  $\chi^2 = 7.148$ ,  $p = .008$ ). In both cases,  
363 predictions were stronger among women not using  
364 hormonal contraceptives. We also observed a significant  
365 main effect of hormonal contraceptive use on facial  
366 masculinity preferences ( $\beta = -.556$ , S.E. = 0.227,  
367  $-1.002 < \text{CI} < -0.110$ ,  $\chi^2_1 = 5.976$ ,  $p = .014$ ). Women using  
368 hormonal contraceptives had weaker masculinity prefer-  
369 ences than women not using hormonal contraceptives. No  
370 other effects or interactions were significant (all  
371  $\chi^2_1 = 1.117$ , all  $p > .278$ ).  
372

To further investigate the role of hormonal contraceptives  
373 on masculinity preferences, we analyzed the relationship  
374 between women's facial and vocal masculinity preferences  
375 separately for those women using hormonal contraceptives  
376 and those not using hormonal contraceptives. Only those  
377 women not using hormonal contraceptives exhibited corre-  
378 lated preferences for facial and vocal masculinity (not using  
379 hormonal contraceptives:  $r_{307} = .337$ ,  $p < .0001$ ; using hormo-  
380 nal contraceptives:  $r_{112} = .112$ ,  $p = .22$ ). Fisher's *r* to *z* test  
381 revealed that the positive correlation between facial and  
382 vocal masculinity preferences was significantly stronger  
383 among women not using hormonal contraceptives than  
384 among women using hormonal contraceptives ( $z = 2.134$ ,  
385  $p = .033$ ). Further analysis revealed that there was no  
386 difference in the strength of the relationship between vocal  
387 and facial masculinity preferences among women not using  
388 hormonal contraceptives and men ( $z = -0.462$ ,  $p = .644$ ).  
389 Table 3 highlights mean masculinity preferences of women  
390 using and not using hormonal contraceptives.  
391

### 3.3. Additional analyses

398

We repeated our analyses, substituting rating scale data  
399 for the forced-choice data analyzed thus far. Rating scale  
400 responses were coded using 0 (*feminine face* or *voice rated*) 401

402 *much more attractive*) to 7 (*masculine face or voice rated*  
403 *much more attractive*), and the average rated masculinity  
404 preference calculated separately for the voice and face  
405 preference tests for each participant. Normal-based identity  
406 models of 8-point scale data revealed no qualitative  
407 differences between the findings for 8-point scale data and  
408 forced-choice data.

409 We also repeated our analyses of forced-choice (percent  
410 masculine voices or faces chosen) and 8-point scale data  
411 using analysis of covariance (ANCOVA). Findings from  
412 these ANCOVA analyses showed no qualitative differences  
413 from those of our custom generalized linear models.

#### 414 4. Discussion

415 We found that preferences for men's facial and vocal  
416 masculinity were positively correlated among both male and  
417 female judges. These results are consistent with findings that  
418 men with attractive faces also tend to have attractive voices  
419 (Saxton et al., 2006). The collective results of these two  
420 studies lend support to the theory that women's preferences  
421 for vocal and facial masculinity are consistent, most likely  
422 because men's faces (Penton-Voak & Chen, 2004) and  
423 voices (Brukert et al., 2006; Dabbs & Mallinger, 1999)  
424 advertise common information about the senders' testostero-  
425 ne levels. Thus, we suggest that not only do men's faces  
426 and voices transmit common information about the under-  
427 lying quality of the sender (Saxton et al., 2006), but also that  
428 perceivers use this cross-modal information in a way that  
429 may better inform their mate-choice decisions.

430 When analyzing general preferences, it appears that  
431 women showed a weaker relationship between facial and  
432 vocal masculinity preferences than men did. This pattern of  
433 results, however, occurred because only women not using  
434 hormonal contraceptives exhibited correlated preferences for  
435 vocal and facial masculinity. Thus, hormonal contraceptive  
436 use appears to mask the relationship between preferences for  
437 vocal and facial masculinity. Indeed, there was no significant  
438 difference in correlation strength between facial and vocal  
439 masculinity preferences among women not using hormonal  
440 contraceptives and men. Although it is likely that women's  
441 attractiveness ratings of masculinity in voices are mate-  
442 choice relevant, as they appear only to correlate with facial  
443 masculinity preferences after puberty (Saxton et al., 2006),  
444 and menstrual cycle shifts in women's preferences for  
445 masculinity in voices are specific to men's but not women's  
446 voices (Feinberg et al., 2006), some researchers have  
447 suggested that men's attractiveness ratings of other men  
448 are an index of dominance (Penton-Voak et al., 2003). Future  
449 research should investigate the motivations that underpin  
450 same-sex attractiveness ratings of faces and voices.

451 Our findings highlight the importance of investigating  
452 preferences for male masculinity while taking into account  
453 possible sources of individual differences in preferences  
454 such as menstrual cycle phase (Feinberg, Jones, Law-Smith,  
455 et al., 2006; Penton-Voak et al., 1999; Puts, 2005), age (Little

et al., 2001; Saxton et al., 2006), and relationship context 456  
(Little et al., 2002; Puts, 2005). In the current study, age 457  
predicted the strength of women's preferences for vocal 458  
masculinity but not the strength of their preferences for facial 459  
masculinity (although a near-significant result was 460  
observed). Age, however, is still a potential influencing 461  
factor for cross-modal masculinity preferences, as age has 462  
been found to correlate positively with women's facial 463  
masculinity preferences in other studies in a manner 464  
consistent with the results of this study (Little et al., 2001). 465  
Additionally, menstrual cycle, self-rated attractiveness, and 466  
relationship context may contribute to the collective findings 467  
reported here. 468

469 We found that women not using oral contraceptives had 469  
stronger facial and vocal masculinity preferences than 470  
women using oral contraceptives. Since progesterone is a 471  
major component of most hormonal contraceptives, this 472  
finding complements those showing that raised progester- 473  
one during the menstrual cycle is associated with increased 474  
preferences for feminine faces (Jones et al., 2005; Welling 475  
et al., in press) and voices (Puts, 2005). While Feinberg, 476  
Jones, Law-Smith, et al. (2006) demonstrated that these 477  
associations may be stronger among women with high trait 478  
estrogen levels, Welling et al. (in press) recently found that 479  
these associations may only emerge in women with 480  
relatively high levels of estrogen during the late follicular 481  
phase of the cycle (i.e., women with high "trait" estrogen). 482  
Johnston et al. (2001) also found evidence for more 483  
feminine women (as scored by a questionnaire) exhibit 484  
larger menstrual cycle shifts in facial masculinity prefer- 485  
ences than masculine women do. Future research should 486  
be conducted to further explore these individual differ- 487  
ences in the magnitude of cyclic shifts in women's 488  
masculinity preference. 489

490 We also found that use of hormonal contraceptives was 490  
associated with a lack of correlated cross-modal masculinity 491  
preferences. This finding is consistent with that of Cornwell 492  
et al. (2004) who found that correlated preferences for 493  
opposite-sex putative pheromones and facial masculinity 494  
were also found among women not using hormonal contra- 495  
ceptives but were not found among women using hormonal 496  
contraceptives. We exercise caution in interpreting this as 497  
hormonal contraceptive use causally disrupting preferences, 498  
as we cannot be sure that there were no other factors 499  
associated with masculinity preferences that differed 500  
between the two groups. For example, Little et al. (2002) 501  
reported that their oral-contraceptive-using group attested to 502  
having had more previous sexual partners than those not 503  
using oral contraceptives. 504

505 By focusing our analytic lens on the *perceivers* rather 505  
than the *senders*, we have found that preferences for facial 506  
and vocal masculinity vary consistently between individuals 507  
in a manner suggesting that preferences in the different 508  
modalities are yoked. Furthermore, our finding is consistent 509  
with data showing concordant preferences between visual 510  
and olfactory preferences: individuals' preferences for 511

masculine male faces are positively related to their preferences for male-typical putative pheromones (Cornwell et al., 2004). Thus, it is likely that the human body produces multiple ornaments that are cues to the same underlying quality and that these are used in conjunction by perceivers to assess the overall quality, dominance, or both of the individual in question.

Our findings provide evidence that humans have evolved to use multiple cues of the same mate quality, as has been found in many species (Candolin, 2003; Møller & Pomiankowski, 1993). Other work on humans has determined that men also send multiple correlated cues of mate quality, such as symmetry and masculinity (Gangestad & Thornhill, 2003) and symmetry and visible skin condition (Jones et al., 2004), potentially producing a better overall assessment of generalized mate quality (Johnstone, 1995, 1996). Thus it is likely that humans have evolved different ways of sending and receiving multiple mate-quality cues. Indeed, many seemingly disparate cues display common information about a single trait (Candolin, 2003) or the qualities of multiple traits (Johnstone, 1995, 1996). Both theories need not be mutually exclusive, and can be used in conjunction to provide a clearer picture of the individual's potential fitness.

We encourage future research to examine the extent to which multiple cues of the same qualities are integrated in forming mate preferences, and how individual differences in preferences may mediate or moderate these relationships. Indeed, more work needs to be done to determine if people sending disparate cues of mate quality are treated differently than those sending concordant mate-quality cues.

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