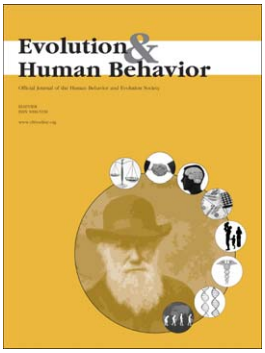

It's the way he tells them (and who is listening): Men's dominance is positively correlated with their preference for jokes told by dominant-sounding men

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It's the way he tells them (and who is listening): Men's dominance is positively correlated with their preference for jokes told by dominant-sounding men

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Abstract

While much research has explored humorous exchange in relation to mate choice, recent perspectives have emphasized the importance of humor for monitoring interest within social partnerships more generally. Indeed, given that similarity is thought to be important in the maintenance of social partnerships, we may expect humor appreciation to vary according to the degree of similarity between humor producers and recipients. In the current study we report evidence for such variation that is specific to men's judgments of other men's humor. Here we manipulated voice pitch in a set of 'one-liner' jokes to create low-pitched and high-pitched versions of men and women telling jokes. A composite measure of men's own dominance was positively correlated with their preference for jokes told by other men with lowered voice pitch (a vocal cue to dominance). A follow-up study demonstrated that self-reported dominance was positively related to men's choice of low-pitch men as friends when judging humorous audio clips but not when judging neutral control audio clips, suggesting that humour may be important in mediating the effect of dominance on friendship choice. These studies indicate systematic variation in humor appreciation related to friendship choices which may function to promote cohesion within male partnerships based on status.

Keywords: Humor, homophily, friendship, alliances, dominance, pitch

1. Introduction

Humor is a ubiquitous feature of human interaction and communication (see Gervais and Wilson, 2005 for a review). Extensive research into the role of humor in mate choice suggests that a good sense of humor primarily functions as a signal of 'mate quality' and thus may be desirable in a romantic partner (see Greengross and Miller, 2011 and Wilbur and Campbell, 2011 for recent discussion). However, the production and appreciation of humor may function to signal interest in the initiation and maintenance of social partnerships more generally (Li et al., 2009). Using humor can signal romantic interest but, in other contexts, humorous conversation can help to defuse conflict or demonstrate shared knowledge and attitudes (Flamson and Barrett, 2008; Gervais and Wilson, 2005). Having a good sense of humor is also associated with having more socially desirable traits, such as friendliness and cooperativeness (Cann and Calhoun, 2001). Furthermore, experimental evidence has shown that while shared appreciation of culture increases affiliation among dyads, only shared appreciation of humorous content increases altruistic behaviour within these dyads, as measured via financial donations (Curry and Dunbar, 2013). Collectively, while sexual selection based theories of humor propose that humorous individuals, particularly men, will be judged as more desirable than their less humorous peers (e.g. Greengross and Miller, 2011), the interest indicator theory proposes that desirable social partners will be judged as more humorous than their less desirable peers (Li et al., 2009).

From the perspective of evolutionary biology, 'desirable' social partners may be those who are perceived to be in good physical condition, and thus appear better-placed to confer direct benefits to recipients (see, e.g., Krupp et al., 2011; Sell et al., 2009). Consistent with this proposal, experimental evidence has shown that both

men and women rate more physically attractive men as funnier than their relatively less-attractive peers (Cowan and Little, 2013a) demonstrating that humor produced by attractive men is appreciated more than humor produced by less attractive men. Moreover, initial attraction to a potential partner is positively correlated with evaluations of that person's humor, in part, because we judge attractive humor-producers as being particularly warm (Li et al., 2009). Humorous exchange among pairs or groups may therefore be contingent on the perceived costs and benefits of initiating and/or maintaining a relationship with those individuals, and function as a relatively low-cost strategy for gauging mutual interest and cooperativeness in social partners.

There are potential benefits in being able to successfully gauge mutual interest and cooperativeness in social partners, given the correlations between phenotypic qualities, such as health, longevity, reproductive success, and dominance, and their strength and/or number of friendships and alliances across many different species, including humans (reviewed in Hruschka, 2010; Seyfarth and Cheney, 2012). For example, in nonhuman species, high-quality friendships are positively associated with male competitive ability and reproductive success, and with indices of female health such as longevity and low stress (reviewed in Seyfarth and Cheney, 2012). Among humans, friends can provide mutual support to one another (reviewed in Hruschka, 2010), such as economic aid provided to partners in economic games (Majolo et al., 2006). Moreover, being socially embedded is positively associated with different indices of mental wellbeing (Cacioppo et al., 2000). Indeed, high-quality social support has direct benefits on human health and longevity, with comparable effect sizes to that of well-established health-promotion measures such as smoking cessation (see Holt-Lunstad et al., 2010 for a meta-

analytic review). Thus, in light of the positive correlations between potential fitness benefits and cooperative partnerships, which suggest that friendship is a potential cause of these benefits, it may be advantageous to attend to cues of interest in others, and appreciating others' humor may function partly as a means toward this end.

Although there are potential benefits to friendship and access to social support (Holt-Lunstad et al., 2010; Hruschka, 2010; Seyfarth and Cheney, 2012), friendships are dynamic and have to respond to changing life circumstances (reviewed in Hruschka, 2010). Indeed, it is costlier, in terms of time and effort, to maintain relationships with friends than with other social partners such as kin (Roberts and Dunbar, 2011). Therefore, the potential benefits of friendships and alliances may only be adaptive if they result in durable bonds, and, in turn, our choice of friends or allies should be made judiciously. There is considerable evidence that similarity (i.e. 'homophily') between social partners is important in the initiation and maintenance of social partnerships (see Massen and Koski, 2014 for recent discussion), complementing theoretical models on the positive effects of homophily on the evolution and maintenance of cooperative behavior (Riolo et al., 2001). For example, similarity in social boldness is a correlate of friendships among non-kin in chimpanzees (Massen and Koski, 2014). In humans, indices of upper body strength such as grip strength predict social connections among the Hadza tribe (Apicella et al., 2012), while Western adolescents appear to form social partnerships according to their level of extraversion (Nelson et al., 2011).Individuals with similar phenotypes may, therefore, be particularly likely to use humorous exchange as a means toward monitoring interest within dyads or groups of similar individuals. This strategy may be particularly beneficial within such groups. For

example, while attractive and/or dominant individuals might be particularly desirable as social partners because of their apparent high social-standing (see, e.g., Hume and Montgomerie, 2001; Langlois et al., 2000; Little and Roberts, 2012), these individuals are thought to be in a relatively better bargaining position in social conflicts and as such can 'afford' to disregard the welfare of others in comparison to their relatively less attractive and/or dominant peers (Sell et al., 2009). Consistent with this theoretical proposal, indices of attractiveness and/or dominance are positively correlated with self-report measures of anger and aggression in past and hypothetical conflicts (Sell et al., 2009). Moreover, physically-dominant men have a weaker preference for distributing resources evenly among their peers (Price et al., 2011), with recent work demonstrating that this relationship is qualified by men's current access to resources, such that strong men with access to resources are relatively less egalitarian than strong men without access to resources (Petersen et al., 2013). Collectively, while there may be a premium placed on cues of interest signalled by desirable social partners (e.g. Li et al., 2009), there may be costs to associating with individuals of comparatively high status. Thus, humor appreciation may be particularly apparent *within* similar social partnerships in order for such dyads or groups to monitor and maintain the quality of their relationships. Indeed, given that physical cues to dominance are associated with perceptions of traits that may be undesirable in a social partner (Little et al., 2011; Puts et al., 2012a, 2012b), and shared appreciation of humor appears to play a specific role in promoting cooperative behaviour (Curry and Dunbar, 2013), knowledge of a dominant social partner's humorous qualities may be particularly valuable if it signals cooperativeness from an otherwise-formidable social partner. This proposal is

consistent with recent experiments which demonstrate integration of social knowledge with physical cues in our judgements of others (Quist et al., 2013).

Given that humor appreciation and production are valuable for signalling interest in the initiation and maintenance of social partnerships (Curry and Dunbar, 2013; Li et al., 2009), and that similarity among social partners predicts partnership formation (e.g., Apicella et al., 2012; Massen and Koski, 2014; Nelson et al., 2011), here we tested whether humor appreciation is contingent on the phenotypic characteristics of both the signaller and receiver. In order to measure this, men and women completed physical and psychometric measures of attractiveness and dominance (i.e. their phenotypic 'condition'), and were tested to see if their preference for 'one-liner' jokes varied according to the speaker's vocal attractiveness and dominance. Previous research using computer-manipulations of voice pitch has established that low-pitch versions of men's and women's voices are perceived as more dominant than high-pitch versions of men's and women's voices (see Fraccaro et al., 2013 for a review). Moreover, while low-pitch versions of men's voices are perceived as more attractive than high-pitched versions, raised-pitch versions of women's voices are perceived as relatively more attractive than low-pitch versions (see Fraccaro et al., 2013 for a review). Thus, we investigated whether attractive and dominant listeners reported a stronger preference for jokes told by relatively attractive and dominant speakers respectively. Specifically, given that cohesion and cooperation within groups is thought have had greater net benefits on male than female fitness over evolutionary history (see Benenson et al., 2013 for discussion), aiding males in reducing the costs of conflict *between* groups (reviewed in McDonald et al., 2012), we predicted that dominant men would express a stronger preference for jokes told by their dominant peers, as such a strategy would be particularly

beneficial for monitoring interest within similar-status partnerships with formidable allies.

In contrast to our predictions for men, we had no strong *a priori* basis with which to predict a relationship between women's phenotypic condition and their appreciation of jokes spoken by women in high or low pitch voices. Research on sex differences in primate sociality proposes that while group size may have positive benefits to male fitness, female fitness increases from *minimizing* group size. Thus, excluding potential rivals for mates, in turn, may increase a female's access to resources (Benenson et al., 2013). Both dominant (see Burbank, 1987; Campbell, 1999; see also Watkins et al., 2012) and attractive (Vaillancourt, 2013; see also Benenson et al., 2013) women are potentially effective competitors for resources and/or mates. Indeed, women can compete with other women both via denigrating or excluding attractive rivals, and by denigrating women based on body size, promoting body shapes that are negatively correlated with physical dominance (i.e. 'thinness', reviewed in Vaillancourt, 2013), at least in Western cultures. Given that raised voice pitch in women is positively correlated with perceived attractiveness but is negatively correlated with perceived dominance (reviewed in Fraccaro et al., 2013), we have no clear basis with which to predict that differences *between* women in their phenotypic condition will be correlated with their *appreciation* of humor delivered by attractive and/or dominant female speakers. Indeed, given that attractiveness is both an important feature of denigration among females and a trait that may afford females a strategic advantage over same-sex rivals for access to mates (see, e.g., Fisher and Cox, 2009; Maner et al., 2009; see also Vaillancourt, 2013 for related discussion), there is no clear basis to predict that attractive women gain any advantage than their

less attractive peers do in appreciating humor directed toward them by other attractive women.

2. Method

2.1 Participants

One hundred undergraduate students from the INSTITUTION participated in exchange for course credit (44 males; Mean age = 20.4 years, SD= 5.2 years, Range = 16-56 years). Two female participants were excluded from analyses; one for not consenting to participate in the full study and one for being unable to complete the experiment due to a failure in the electricity supply to the lab, leaving a total of 98 participants. We decided to collect data from 40-50 participants of each gender, and to terminate data collection either by the end of the Winter semester 2013 or when we had reached the predefined target of N=100 (selecting the end-point that occurred first). Previous research on humor production and appreciation (e.g. Bressler et al., 2006), voice perception (e.g. Puts et al., 2011) and physical appearance and social perception (e.g. Fink et al., 2007) have used roughly comparable sample sizes.

2.2 Joke stimuli

Four male (mean age = 22.8 years, SD = 3.6) and four female (mean age = 19.5 years, SD = 1.9) Canadian participants with similar accents were asked to read a subset of eight ‘one-liner’ jokes taken from a larger set of joke stimuli (used in Bressler and Balshine, 2006) in their natural voice as if they were telling a joke to someone (see Supplemental Materials). Participants were given the opportunity to read the jokes before they made the recording. Recordings were made using a

Sennheiser MKH 800 P48 microphone using the cardioid pickup pattern in a sound-attenuated booth. Recordings were made in mono, using Adobe Soundbooth, at a sampling rate of 96 kHz and with 32-bit amplitude quantization and saved as uncompressed wav files.

Masculinized and feminized versions of each recording were then manufactured by raising and lowering pitch using the pitch-synchronous overlap add (PSOLA) algorithm in Praat (Boersma and Weenink, 2007) by 0.5 equivalent rectangular bandwidths (ERBs) of the original frequency. This PSOLA method has been used successfully in other studies of human voice perception (e.g., Feinberg et al., 2005; Puts et al., 2006). Whereas the PSOLA method alters voice pitch, other aspects of the voice are perceptually unaffected (Feinberg et al., 2005). The manipulation performed here is roughly equivalent to a 20% change in Hz for women's speech and a 13% change in Hz for men's speech in this particular sample, which are above established JND's for detection, attractiveness, and masculinity perception (Re et al., 2012), and takes into account the fact that pitch perception is on a log-linear scale in comparison to the natural frequencies (i.e. Hertz, Traunmüller, 1990). After manipulation, amplitudes were scaled to a consistent presentation amplitude (70dB SPL) using the root-mean-squared method.

This process created 8 pairs of voice recordings in total for each participant who had their voice recorded (each pair consisting of a raised-pitch and lowered-pitch version of the same recording). From these, we selected clean recordings of masculinized and feminized versions of four men and four women telling two jokes each (i.e. 16 voice pairs, with each voice pair consisting of a masculinized and feminized version of an identical joke from an identical speaker). Within the final stimulus set, the mean fundamental frequency of the feminized versions was 154.84

Hz (SD = 24.44 Hz) for the men's recordings and 278.40 Hz (SD = 12.58 Hz) for the women's recordings. The mean fundamental frequency of the masculinized versions was 115.41 Hz (SD = 23.79 Hz) for the men's recordings and 227.73 Hz (SD = 31.45 Hz) for the women's recordings.

2.3 Pilot Study: Manipulation Check

An opportunity sample of twenty-three psychology undergraduate students from the INSTITUTION participated in our pilot study (8 males, Mean age = 22.4 years, SD = 8.2 years, Range = 18-53 years). After answering basic demographic questions concerning only age, sex, nationality, ethnicity, relationship status, and handedness, participants were asked to listen to all 32 voice clips in a self-paced online questionnaire on a computer in a quiet lab setting, with each joke repeated four times (masculinized male, feminized male, masculinized female, feminized female). Jokes were presented in a random order. Our manipulation check was conducted in order to ensure that our main analysis was not confounded by differences in humor style within the stimulus set, which has been highlighted as an important variable within previous work (Cowan and Little, 2013b). Thus, participants were asked to rate the jokes on a 7 point scale (ranging from 1 '*high in affiliation'*, to 4 '*neutral*', to 7 '*high in aggression*') to identify if any of the jokes could be classed as aggressive.

To analyse these data, a mean style rating was created from all four voice ratings of each joke. One sample t-tests were used to determine if any of the jokes were significantly greater than '*neutral'*. One joke (Joke number 4; see Table 1, Supplemental Materials) was significantly greater than '*neutral'* and thus could be classed as '*aggressive'* in style (M = 4.61, SD = 0.96), t(22) = 3.05, p = .006. Subsequent analyses were therefore completed using the seven remaining jokes.

Supplemental materials show further analyses based on the full joke set and Joke number 4 to allow for comparison, although excluding Joke number 4 did not alter any of the overall conclusions derived from the findings within our data.

2.4 Procedure

All procedures carried out in this study were approved by the INSTITUTION'S Psychology Ethics Committee. Participants were tested alone in a quiet lab setting. The stimuli were presented online using the same computer and headphones each time. Participants completed the joke-rating task at their own pace. On the first page, participants completed basic demographic questions (only age, sex, nationality, ethnicity, relationship status, and handedness) and were asked to rate their own attractiveness and their own masculinity on a 1 (not very attractive/masculine) to 7 (very attractive/masculine) scale.

Participants were told that, across a number of trials, they would listen to the same joke spoken by two different voices. On each trial they were instructed to choose the funnier joke and indicate how much funnier they thought that joke was relative to the other joke in the pair using a –4 to 4 scale, (–4 to –1: feminized joke rated as '*a lot more funny,*' '*more funny,*' '*just more funny,*' and '*guess more funny'* than the masculinized joke. 1 to 4: masculinized joke rated as *'guess more funny', 'just more funny', 'more funny'* and *'a lot more funny'* than the feminized joke). Across trials, a participant would listen to an identical joke-pair twice; once read by a masculinized versus feminized version of a male speaker, and once read by a masculinized versus feminized version of a female speaker. The order of the jokes, the side of the screen the masculinized voice was presented on, and the sex of speaker were randomized across all 16 trials. Following on from the joke preference

task, participants completed the dominance subscale of the International Personality Items Pool (Goldberg, 1999). Scores on this questionnaire (Mean Male Score = 32.39, SD = 5.61; Mean Female Score = 28.39, SD = 6.19) were similar to previous studies that have used this questionnaire (e.g., Havlicek et al., 2005).

Following the ratings and questionnaires, the experimenter measured each participant's flexed bicep circumference (following a method described by Sell et al., 2009, males M = 30.83cm, SD = 3.11; females M = 27.48cm, SD = 3.06), in addition to their height in centimetres, weight in kilograms, and waist and hip circumference in centimetres. Body Mass Index (BMI) was calculated using each participants' height and weight (males M = 23.09 kg/m^2, SD = 3.68; females M = 23.23 kg/m^2, SD = 3.56) and waist to hip ratio (WHR) was calculated using participants' waist and hip circumference (males M = 0.90, SD = 0.60; females M = 0.77, SD = 0.64). Participant's hand-grip strength was also measured using a dynamometer (Jamar Hydraulic Hand Dynamometer, Model 5030J1), three times with each (alternating) hand. Given that handgrip strength on dominant and non-dominant arms were very highly correlated ($r=.91$, $p<.001$), we calculated participants' mean hand-grip strength (males M = 38.19 kg, SD = 7.31; females M = 25.40 kg, SD = 4.49). Following the joke preference task, dominance questionnaire and anthropometric measures, participants were thanked, debriefed and dismissed.

2.5 Initial processing of data

Following data collection, the voice preference data were coded such that responses scored as –4 to –1 were coded as 0, denoting a preference for the feminized voices, and responses scored as 1 to 4 were coded as 1, denoting a preference for the masculinized voices. Across trials we used this data to calculate for each participant

the proportion of trials on which the masculinized speaker was judged to be funnier than the feminized speaker when judging male joke-tellers and the proportion of trials on which the masculinized speaker was judged to be funnier than the feminized speaker when judging female joke-tellers. For both variables, high scores (i.e. values closer to 1) indicate a stronger preference for jokes spoken in masculine (i.e. lowered) voice pitch. Analyses whereby the dependent variable is analysed as a continuous, rather than binary, variable are included as a supplementary file. Coding the dependent variable as a continuous variable does not alter the overall conclusions made within the manuscript.

3. Results

3.1 Initial analyses

First, we carried out one-sample t-tests against the chance value of 0.5 to explore whether men and women, on average, preferred jokes spoken by other men and women in high or low voice pitch. Men, on average, did not prefer jokes spoken in raised or lowered pitch when judging male joke-tellers, $t(43) = -1.56$, $p = .126$, 95% CI [-0.10, 0.01], $r = .23$, or when judging female joke-tellers, $t(43) = -1.04$, $p = .304$, 95% CI [-0.09, 0.03], $r = .16$. Women, on average, did not prefer jokes spoken in raised or lowered pitch when judging male joke-tellers, $t(53) = -1.83$, $p = .072$, 95% CI [-0.09, 0.004], $r = .24$, or when judging female joke-tellers, $t(53) = 1.24$, $p = .221$, 95% CI [-0.02, 0.08], $r = .17$, although the former was close to significance indicating a possible preference among women for jokes spoken by men in raised-pitch.

Independent Samples t-tests revealed that there was no significant difference between men and women in their overall preference for masculinized versus

feminized versions of male joke-tellers, $t(96) = 0.09$, $p = .932$, 95% CI [–0.08, 0.07], $r = .03$, or in their overall preference for masculinized versus feminized versions of female joke-tellers, $t(96) = –1.61$, $p = .112$, 95% CI [–0.13, 0.01], $r = .16$. Given that men and women differed significantly on all measures of physical condition (except BMI), psychometric dominance, and self-rated masculinity; all $t(96) > 3.32$, all $p < .05$ (see Table 2 in Supplemental Materials), subsequent analyses on the relationship between phenotypic condition and preference for jokes spoken in masculinized versus feminized voice pitch were split by sex of rater.

3.2 Correlational analyses: Indices of male and female phenotypic condition as a predictor of their preference for masculinized versus feminized joke-tellers

Pearson's correlations were first used to test for the relationship between self-report and objective measures of condition and preference for jokes spoken in masculine voice pitch (among male and female joke-tellers). In women, there were no significant relationships between measures of their own condition and their preference for masculine versus feminine joke-tellers (all r between -.11 and .24, all $p > .076$, see Table 1).

INSERT TABLE 1 AROUND HERE

Among male raters, their preference for masculinized male joke-tellers was positively correlated with their flexed bicep circumference, self-rated attractiveness, and their dominance score on the international personality items pool (all $r > .32$, all $p < .05$). The relationship between men's BMI and preference for jokes spoken by men in masculine voice pitch was close to significance ($p = .066$). None of our measures

predicted men's preference for masculinized versus feminized versions of jokes spoken by women (all unsigned r<.10, all p>.529). In light of these findings, we further explored the relationship between indices of men's dominance and their preference for vocal pitch in male joke-tellers. In order to do this, we converted our measures of men's dominance (Height, weight, BMI, flexed bicep circumference, mean handgrip strength, psychometric dominance, and self-rated masculinity) into standardized z scores and calculated the average of these scores to create a composite measure of dominance for each male. Two males were excluded from this dominance composite measure because they did not provide data on self-rated masculinity. These measures have been used as indices of dominance in prior work within the literature (e.g., Fink et al., 2007; Havlicek et al., 2005; Sell et al., 2009; Thomsen et al., 2011), and measures such as grip strength and flexed bicep circumference are positively correlated with perceived fighting ability derived from vocal cues across cultures (Sell et al., 2010).

3.3 Linear Regression Analyses: Male dominance as a predictor of their preference for voice pitch in male joke-tellers

A linear regression analysis was performed to test for a positive relationship between our composite measure of male dominance and men's preference for jokes told by other men with high vocal dominance (i.e. lower, masculinized, voice pitch). The overall model was significant, $F(1, 40) = 8.15$, $p = .007$, and accounted for 16.9% of the variance in men's joke ratings of other men. Our analysis revealed that men's dominance composite score was positively correlated with their preference for jokes told by males with lower pitched voices ($t = 2.86$, standardized beta = .41, $p = .007$, $R^2 = .17$, see Figure 1).

INSERT FIGURE 1 AROUND HERE

4. Follow-up study: Comparing humorous and standardized content in raised- and lowered-pitch versions of men's and women's voices

In order to test whether our findings in the main study were specific to men's appreciation of other men's humor, or if they simply reflected general 'self-serving' biases among dominant men toward other dominant men, we conducted a further study. Here we tested whether manipulating pitch in speakers influences the listener's preference for them as a friend. Specifically, we tested whether the findings in our first study for men's judgements of men are specific to humorous exchange or if they generalize to other, more arbitrary content delivered by speakers in raised- versus lowered-pitch.

4.1 Method

4.11 Participants

One hundred twenty-seven individuals (52 men, 75 women; mean age=24.03 years, SD=7.19 years) took part in the study. In order that our sample size was comparable to our first study, we decided to collect data from at least 50 participants of each gender. Participants were a mixture of a convenience sample recruited via social networking sites and psychology students participating online for course credit. Previous research on social judgements of computer-manipulated voices has demonstrated that laboratory and online studies produce equivalent results (reviewed in Feinberg, 2008).

4.12 Stimuli

In order to minimize rater fatigue, subsets of 12 of the 16 joke-pairs from our main study were used in the current study. These consisted of 6 different jokes and 12 different joke-tellers (6 female, 6 male). The one joke rated in our initial pilot study as aggressive was not included in this study. In order to rule out whether or not our effects in the main study were specific to humor, we also used an identical number of control stimuli, consisting of 12 pairs of statements that were recorded and manipulated in pitch in an identical manner to the main study, except we manipulated voices by +/-0.25 ERBs to further disguise the manipulation. In order to manufacture these stimuli, 12 pairs of voices reading the rainbow passage (Fairbanks, 1960) were used. Each pair consisted of a masculinized and feminized version of the same individual reading an identical statement. We recorded six males (mean age = 18.17 years, SD=0.75 years) and six females (mean age = 18.67 years, SD=0.82 years) reading this statement. Within this set of control stimuli, the mean fundamental frequency of the feminized versions was 122.38 Hz (SD = 10.41 Hz) for the men's recordings and 226.85 Hz (SD = 4.12 Hz) for the women's recordings. The mean fundamental frequency of the masculinized versions was 109.05 Hz (SD = 9.46 Hz) for the men's recordings and 203.85 Hz (SD = 3.24 Hz) for the women's recordings.

4.13 Procedure

Participants were provided with a link to the experiment to complete in their own time. We specifically asked participants to follow a separate link either for males (listen to male voices only) or females (listen to female voices only) and then randomly-allocated them either to listen to the humor stimuli (six trials) or control

stimuli (six trials). On the first page, participants completed identical demographic questions as used in the main study.

When participants proceeded to the main task, they were asked to listen to pairs of voices and indicate which voice in each pair they thought would make the better friend, and how much better they thought their chosen voice would be as a friend, using the scale “a lot better” (-4/4), “better” (-3/3), “just better” (-2/2) and “guess better” (-1/1). Participants completed the task at their own pace and could only proceed to the next trial after listening to both voice clips. Trial order and the side of the screen the masculinized voice was presented on were fully randomized. Immediately following on from our friend preference task, participants completed the dominance subscale of the International Personality Items Pool (Goldberg, 1999). Scores on this questionnaire (Mean Male Score = 30.25, SD = 7.10; Mean Female Score = 29.24, SD=7.97) were similar to the main study.

4.14 Initial processing of data

Data were coded as in the main study, such that responses scored as -4 to -1 were coded as 0, denoting a preference for feminized voices as friends, and responses scored as 1 to 4 were coded as 1, denoting a preference for masculinized voices as friends. We used this data to calculate for each participant the proportion of trials on which the same-sex masculinized speaker was judged to be the better friend than the same-sex feminized speaker. High scores (i.e. values closer to 1) indicate a stronger preference for same-sex friends speaking in low (i.e. masculine/dominant) voice-pitch. Analyses where this dependent variable is not coded as a binary measure are contained within a supplementary file.

4.2 Results

4.21 Initial analyses

First, we carried out one-sample t-tests against the chance value of 0.5 to explore whether men and women, on average, preferred high or low voice pitch in same-sex friends. This analysis revealed that men tended to prefer *raised*-pitch (i.e. feminized; M = .45, SEM = .03) males as friends, although not significantly so, $t(51) = -1.71$, $p = .094$, $r = .23$, whereas women had no overall preference (M = .51, SEM = .03) for raised- or lowered-pitch women as friends, $t(69) = 0.26$, $p = .80$, $r = .03$.

4.22 Correlational analyses: Dominance and men's and women's preference for masculinized versus feminized same-sex friends

Spearman's rho tests were used to examine the relationship between men's and women's score on the dominance questionnaire and their preference for masculine same-sex friends, separately for the four conditions within our study (women judging other women reading the Rainbow passage, women judging other women telling jokes, men judging other men reading the Rainbow passage and men judging other men telling jokes). Nonparametric tests were used because some of our variables were not normally distributed. These analyses revealed no relationship between women's score on the dominance questionnaire and their preference for low-pitch women as friends in either the humor condition ($r_s(32) = .18$; $p = .33$) or control condition ($r_s(34) = -.02$; $p = .90$). For men, we found a significant *positive* correlation between their dominance score and their preference for masculine men as friends in the humor condition ($r_s(24) = .42$; $p = .04$) and a close to significant *negative* correlation between their dominance score and their preference for masculine men as friends in the control condition ($r_s(24) = -.37$; $p = .07$). Using Fisher's r to z

transform to compare the difference between two correlations from independent samples (Preacher, 2002; http://www.quantpsy.org/corrtest/corrtest.htm), the slope of the positive correlation in the humor condition differed significantly from the negative correlation in the control condition (Z = 2.69; p < .01). The non-significant correlations between women's dominance and their preference for low-pitch women as friends did not differ significantly from one another across the two conditions (Z = 0.79; p = .43).

5. Discussion

Here we report evidence for systematic variation in humor appreciation according to the characteristics of both the humor producer and recipient. Specifically, we report a relationship between dominance and humor appreciation that is specific to men's appreciation of other men's humor. In the main study, a composite measure of men's own dominance was positively correlated with their strength of preference for jokes told by other men with lowered voice-pitch, a vocal cue to dominance (standardized beta = .41). No relationships were found between measures of men's own phenotypic condition and their strength of preference for jokes told by women according to voice-pitch or between measures of women's own phenotypic condition and their strength of preference for jokes told by men or women according to voice-pitch. Importantly, our follow-up study, which also demonstrated a correlation between men's dominance and their preference for low voice-pitch men telling jokes, suggests that this relationship is likely to be activated by humorous exchange, which is said to function to signal interest in initiating or maintaining a social partnership (Li et al., 2009). That the positive correlation in the follow-up study between dominance and preference for low-pitch men as friends in the humour condition differed

significantly from the *negative* correlation between dominance and preference for low-pitch men as friends in the control condition suggests that humorous content may offset the otherwise negative social judgements that tend to be associated with masculine men as social partners (see, e.g., Little et al. 2011; Puts et al. 2012a for discussion). Indeed, there was a non-significant tendency for *feminized* (i.e. raised-pitch) versions of men's voices to be perceived by other men (on average) as better friends than masculinized (i.e. lowered-pitch) versions of men's voices, and women demonstrated no overall preference for masculinized or feminized versions of men's voices when judging other men as friends. Collectively, our follow-up study suggests that our findings from the main study are not likely to reflect general self-serving biases among dominant men toward similar social partners.

Our work extends the interest indicator theory of humor appreciation and production (Li et al., 2009) by taking into account the characteristics of both 'signaller' and 'receiver' when exploring the underlying function of humorous exchange. Furthermore, our findings demonstrate a pattern of strategic humor appreciation in men towards other men of a similar perceived status. As the exchange of humor is likely to be a low-cost strategy for monitoring interest within dyads or groups (Li et al., 2009), humor use may be particularly evident among individuals of similar phenotypes, given theoretical and empirical evidence for the importance of similarity in the maintenance of cooperative partnerships (e.g., Apicella et al., 2012; Massen and Koski, 2014; Nelson et al., 2011; Riolo et al., 2001). Moreover, group cohesion is thought to have been particularly important for male fitness over evolutionary history (see Benenson et al., 2013 for discussion), aiding males in reducing the costs of conflict *between* groups (reviewed in McDonald et al., 2012). Humor can help to defuse conflict and demonstrate shared knowledge

and attitudes (Flamson and Barret, 2008; Gervais and Wilson, 2005), and while shared appreciation of culture can promote affiliation, its effects on *altruistic* behaviour appear to be specific to the shared appreciation of humorous content (Curry and Dunbar, 2013). As such, this work suggests that humorous exchange may be a particularly salient cue for cohesion within male groups, especially if such exchanges appear to signal cooperativeness from an otherwise-formidable social partner. Indeed, vocal cues to dominance are positively correlated with measures of men's threat potential (Puts et al., 2012b). Attending to humor directed toward oneself may inform men about individuals who are more likely to reciprocate cooperation, consistent with the interest indicator theory of humorous exchange (Li et al., 2009), which could, in turn, offset the potential costs associated with forming alliances, or in *explicitly* trying to gauge interest in a current partnership. We note here that while the correlational nature of our findings demonstrate that low-dominance men in the main study demonstrated a stronger preference for *feminized* voice-pitch (i.e. low dominance men; see Fraccaro et al. 2013), these findings are still consistent with the proposed importance of 'homophily' in the evolution of cooperation (Riolo et al., 2001) and recent work which suggests that this is a factor in group organization among the Hadza (Apicella et al., 2012). We also note that exploring the role played by different styles of humor within social partnerships, such as aggressive humor controlled for in our analyses, could provide a fruitful line of further enquiry.

Collectively, our findings are consistent with our proposal that dominance-contingent humor appreciation among men may function partly as a low-cost strategy toward monitoring interest within social partnerships based on status. Indeed, given that preferences for specific vocal characteristics in humor producers

varied systematically according to measures of men's dominance, and were specific to men's judgments of other men, our findings suggest that variation in humor appreciation operates in a strategic manner. Of course, our findings do not rule out the possibility that flexible changes *within* men or women in their perceived dominance and/or attractiveness, such as changes in light of recent experience or the surrounding environment, also predict systematic variation in humor appreciation. Indeed, given the importance of gossip in establishing group bonds (Dunbar, 1996) and research on attractiveness-based competition among women (Vaillancourt, 2013), humor as a mechanism for gossip among female friendship groups may shed light on variation in humor production and appreciation among women. Investigating these predictions through experimental priming techniques could provide a means with which to explore these issues.

In summary, our data present novel evidence that men vary systematically in their appreciation of other men's humor. Specifically, a composite measure of men's own dominance was positively correlated with the extent to which they preferred jokes told by men with vocal cues to dominance. More fundamentally, while much of the humor literature has proposed that intersexual selection has played an important role in shaping humorous exchange (e.g. Greengross and Miller, 2011) our findings suggest that male competition and alliance formation could have played a role in shaping the cognitive processes that regulate men's appreciation of other men's humor. This complements other recent work on the importance of male-male competition in shaping social perception (e.g., Hill et al., 2013; Puts, 2010; Watkins et al., 2010a) and behaviour (reviewed in Archer, 2009) more generally. Indeed, while the perceiver's own dominance shapes how men judge other men's dominance from vocal cues (Watkins et al., 2010b), here it shapes how men judge other men's

humor from vocal cues to dominance. This relationship between the dominance of the speaker and listener could be further explored by examining whether humor production and/or appreciation are associated with dominance and/or deference to a social partner when expressed in different humour styles. Given the diversity of humorous exchange at both a cultural and stylistic level (see, e.g. Gervais and Wilson, 2005 for a review), further research on systematic variation in the production and appreciation of humour will likely prove a profitable means with which to explore the interaction between nature and culture in this uniquely human form of social intelligence.

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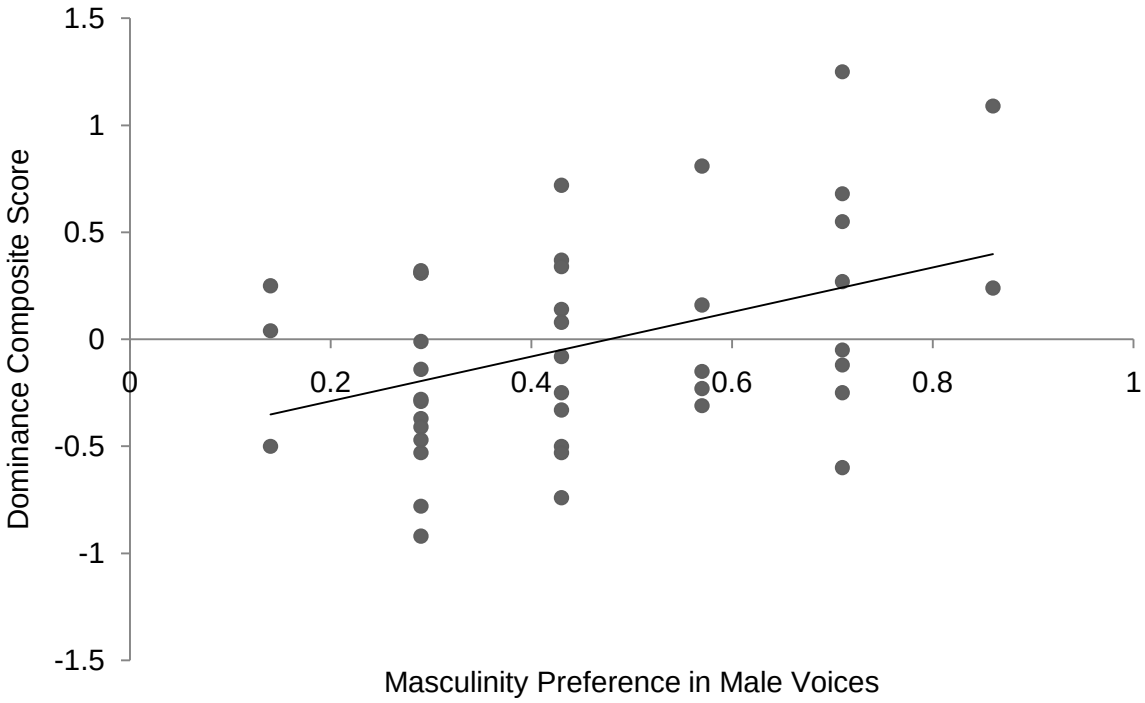

Figure 1. The positive correlation between men's dominance composite score and their strength of preference for jokes spoken by men in masculine (i.e. lowered) voice pitch (t = 2.86 standardized beta = .41 p = .007, R^2 = .17).

Table 1. Pearson's correlations (Correlation coefficients and 95% confidence intervals, which were determined through bootstrapping, 1000 iterations) testing the relationship between objective and self-report measures of men's and women's own phenotypic condition and their preference for jokes spoken in masculine voice pitch in male and female joke-tellers in the set of seven jokes.

	Female Participants (df = 52)		Male Participants (df = 42)	
	Female Voice	Male Voice	Female Voice	Male Voice
Age	–.06 [–.30, .14]	–.07 [–.26, .25]	.01 [–.16,.25]	.16 [–.17, .39]
Height	–.02 [–.28, .23]	.24+ [–.003, .49]	.07 [–.20, .33]	–.12 [–.43, .18]
Weight	–.01 [–.30, .26]	.11 [–.13, .40]	–.06 [–.30, .18]	.21 [–.12, .53]
BMI	.01 [–.28, .25]	.01 [–.22, .25]	–.08 [–.31, .13]	.28+ [–.05, .54]
WHR	.12 [–.15, .35]	.12 [–.13, .38]	.10 [–.18, .37]	–.08 [–.34, .20]
Flexed Bicep circumference	.05 [–.18, .29]	.03 [–.23, .30]	.02 [–.21, .24]	.44* [.14, .67]
Mean hand grip strength	–.03 [–.26, .20]	.05 [–.18, .29]	.03 [–.35, .39]	.22 [–.09, .50]
Psychometric dominance	.05 [–.17, .29]	–.11 [–.41, .20]	–.06 [–.35, .27]	.37* [.02, .62]
Self-rated attractiveness	–.09 [–.15, .31]	.19 [–.04, .41]	.01 [–.29, .34]	.32* [.01, .57]
Self-rated masculinity	.17 [–.01, .32]	–.08 [–.28, .13]	.08 [–.30, .39]	–.02 [–.28, .28]

*p < .05 + p < .10