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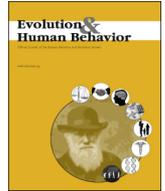


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Original Article

Mate choice, mate preference, and biological markets: the relationship between partner choice and health preference is modulated by women's own attractiveness

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ABSTRACT

Although much of the research on human mate preference assumes that mate preference and partner choice will be related to some extent, evidence for correlations between mate preference and mate choice is mixed. Inspired by biological market theories of mate choice, which propose that individuals with greater market value will be better placed to translate their preference into choice, we investigated whether participants' own attractiveness modulated the relationship between their preference and choice. Multilevel modeling showed that experimentally assessed preferences for healthy-looking other-sex faces predicted third-party ratings of partner's facial health better among women whose faces were rated as more attractive by third parties. This pattern of results was not seen for men. These results suggest that the relationship between mate preference and mate choice may be more complex than was assumed in previous research, at least among women. Our results also highlight the utility of biological market theories for understanding the links between mate preference and partner choice.

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1. Introduction

Models of human mate choice derived from theories of sexual selection (e.g., (Gangestad & Scheyd, 2005; Gangestad & Simpson, 2000; Jennions & Petrie, 1997; Kokko, Brooks, Jennions, & Morley, 2003; Thornhill & Gangestad, 1996) are frequently tested and supported by studies that measure self-reported or experimentally assessed preferences for physical traits (Fink & Penton-Voak, 2002; Little, Jones, & DeBruine, 2011; Miller & Todd, 1998; Thornhill & Gangestad, 1999). A key assumption of these studies is that preferences obtained through self-report or by judging the attractiveness of unfamiliar individuals will, to some extent, reflect actual partner choice. However, since mate choice in humans is mutual (Roberts & Havlíček, 2013; Stewart-Williams & Thomas, 2013) and constrained by the availability of potential partners (Perrett et al., 2002; Pollet & Nettle, 2009), preference for certain characteristics in laboratory studies may not necessarily predict choice of a real-life partner with those characteristics.

Evidence for a correlation between mate preference and mate choice in humans is mixed. For example, in a study that assessed mate choice using a speed-dating paradigm, Li et al. (2013) found that self-reported preferences for physically attractive partners predicted the

attractiveness of the partners people actually chose. By contrast, another speed-dating study found no relationship between self-reported preferences for physical attractiveness and actual partner choices (Todd, Penke, Fasolo, & Lenton, 2007). The different results in these studies could reflect methodological differences; for example, Li et al. (2013) assessed partner choice following online interactions, while Todd et al. (2007) assessed partner choice following face-to-face interactions.

The studies described above tested for possible relationships between self-reported preferences for physical attractiveness and partner choices. However, other studies have investigated the relationship between experimentally assessed preferences for specific physical characteristics and these characteristics in peoples' actual partners. Both DeBruine et al. (2006) and Burriss, Welling, and Puts (2011) found that women's preferences for experimentally manipulated masculine characteristics in men's faces predicted their own masculinity ratings of their current partner. However, Burriss et al. (2011) observed no significant correlation between women's masculinity preferences and third-party masculinity ratings of the women's current partner.

Another method for investigating possible relationships between mate preference and mate choice is to test whether factors that predict systematic variation in mate preference also predict variation in mate choice. The evidence here is also mixed. On one hand, recent work suggests that oral contraceptive use has similar effects on women's mate preferences and partner choice. Little, Burriss, Petrie, Jones, and Roberts

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(2013) found that women's preferences for masculine men weakened after they started using oral contraceptives and also found that women who met their current partner while using oral contraceptives had, on average, partners with less masculine faces. On the other hand, women's own femininity appears to have different effects on their mate preferences and partner choice. More feminine women show stronger preferences for masculine characteristics in male faces (Penton-Voak et al., 2003; Smith et al., 2009), but do not necessarily have more masculine partners (Cornwell & Perrett, 2008).

According to biological market theories (e.g., Noë & Hammerstein, 1994; 1995), high-market-value individuals might be better able to translate their preference into actual choice. However, studies investigating the link between mate preference and actual partner choice have not considered this possibility. To investigate this issue, we tested whether the relationship between participants' face preferences and mate choices is modulated by their own market value. We did this by examining the relationship between participants' preferences for healthy-looking surface characteristics in other-sex faces and the apparent facial health of participants' current partners. If participants' own market value modulates this relationship, it will be stronger among facially attractive participants (i.e., individuals with high market value) than among relatively unattractive participants (i.e., individuals with low market value).

We investigated the relationship between experimentally assessed preferences for apparent health in faces and third-party ratings of the apparent health of actual partners' faces because (i) health perceptions are thought to play a particularly important role in mate preferences (Stephen et al., 2012; Tybur & Gangestad, 2011); (ii) judgments of apparent health from facial cues are correlated with measures of individuals' actual health (e.g., Kalick, Zebrowitz, Langlois, & Johnson, 1998; Roberts et al., 2005); and (iii) preferences for health cues in other-sex faces, unlike preferences for traits such as masculinity/femininity, do not show large sex differences (Little et al., 2011). We used third-party ratings of our participants' facial attractiveness as a proxy for their market value in light of research indicating that facial attractiveness predicts frequency of mating opportunities and other measures of reproductive potential (e.g., Rhodes, Simmons, & Peters, 2005).

2. Methods

2.1. Participants

Fifty-one heterosexual romantic couples took part in the study. All individuals were White and between the ages of 18 years and 35 years (men: $M = 22.3$ years, $SD = 3.21$ years; women: $M = 21.6$ years, $SD = 2.55$ years). The age difference between partners ranged from 0 to 8 years ($M = 1.50$ years, $SD = 1.79$ years) and the length of the relationship ranged from 2 to 178 months ($M = 22.6$ months, $SD = 27.1$ months). 82% of the relationships were longer than 6 months, and 62% of the relationships were longer than 12 months. Participants were recruited via the University of Aberdeen's student population, meaning that at least one individual in each couple was a student at the University of Aberdeen.

2.2. Stimuli for health preference test

First, full-colour images of 50 White male (mean age = 24.4 years, $SD = 3.99$ years) and 50 White female (mean age = 24.3 years, $SD = 4.04$ years) faces with neutral expression and direct gaze were taken under standardized lighting conditions and against a constant background. None of these individuals were from the romantic couples. These images were then aligned on pupil position and masked so that clothing was not visible. These images have been used in other recent face perception studies (Fisher et al., 2014; Wang, Hahn, Fisher, DeBruine, & Jones, 2014).

One hundred heterosexual men (mean age = 25.6 years, $SD = 5.98$ years) and 100 heterosexual women (mean age = 24.1 years, $SD = 5.08$ years) rated the 50 male face images for health on a 7-point scale (1 = much less healthy than average, 7 = much healthier than average). Inter-rater agreement, as measured by Cronbach's alpha, was high for these ratings (female raters = .97, male raters = .97), and male and female raters' average ratings for each face were highly correlated ($r = .97, p < .001$). A different set of 100 heterosexual men (mean age = 26.1 years, $SD = 5.75$ years) and 100 heterosexual women (mean age = 24.8 years, $SD = 5.54$ years) rated the 50 female face images for health on the same scale. Inter-rater agreement for these ratings was also high (female raters = .95, male raters = .97), and male and female raters' average ratings for each face were, again, highly correlated ($r = .97, p < .001$). None of these raters took part in other aspects of the study.

We excluded 4 of the male face images from the set because of image characteristics that would interfere with the manipulation of color and texture cues of perceived health (e.g., hair over the forehead). No female faces had to be excluded. We then selected the 15 men rated least healthy (mean health rating = 3.03, $SD = 0.35$) and the 15 men rated healthiest (mean health rating = 4.25, $SD = 0.25$). We also selected the 15 women rated least healthy (mean health rating = 2.83, $SD = 0.29$) and the 15 women rated healthiest (mean health rating = 4.32, $SD = 0.28$). Specialist software (Tiddeman, Burt, & Perrett, 2001) was then used to create a prototype face with the average shape, color, and texture information for each of these four sets of faces. Healthy and unhealthy prototypes are shown in Fig. 1.

We then randomly selected 10 individual male and 10 individual female face images from the original set of 50 male and 50 female faces and manufactured two versions of each of these faces: one version with increased apparent health and one with decreased apparent health. Following previous research on variation in preferences for apparent facial health (Jones, Little, et al., 2005; Jones, Perrett, et al., 2005), versions with increased apparent health (high health faces) were manufactured by adding 50% of the linear differences in color



Fig. 1. The healthy (left) and unhealthy (right) prototypes used to manufacture stimuli for the health preference tests.

and texture between the healthy and unhealthy prototypes to each individual face, moving the color and texture information along this axis towards the healthy prototype. Similarly, versions with decreased apparent health (low health faces) were manufactured by subtracting 50% of the linear differences in color and texture between the healthy and unhealthy prototypes from each individual face, moving the color and texture information along this axis towards the unhealthy prototype. Male faces were manipulated using the male prototypes, and female faces were manipulated using the female prototypes. Examples of these stimuli are shown in Fig. 2. Note that this process manipulates color and texture information associated with apparent health (e.g., potentially cues of skin blood perfusion, carotenoid availability and biological aging; see Stephen et al., 2012 for discussion of these cues), but does not affect other aspects of the images (e.g., shape information or identity). Previous research has established that this method for manipulating facial cues of apparent health reliably alters health perceptions in the intended manner (Jones, Little, et al., 2005; Jones, Perrett, et al., 2005).

2.3. Health preference test

Participants in the main study (i.e., the individuals making up our 51 heterosexual couples) were shown the 10 pairs of other-sex faces (each pair consisting of a high and low health version of the same individual) and were asked to choose the face in each pair that they thought was more attractive. Trial order and the side of the computer monitor on which any given image was presented were fully randomized.

For each participant, we calculated the percentage of trials on which they chose the high health version. Percentages were transformed into modified sex-specific z-scores by first subtracting the chance value (50%) and then dividing the result by the standard deviation of that score for same-sex participants. Consequently, a score of 0 indicates no preference for healthy or unhealthy faces, a score of +1 indicates a preference for healthy faces one standard deviation above chance (not above the mean preference), and a score of –1 indicates a preference

one standard deviation below chance. These health preference scores were used in our main analysis.

2.4. Rating participants' facial attractiveness and health

In addition to assessing their health preference, we also took a full-face photograph of each of the participants in the main study (i.e., each of the individuals making up our 51 heterosexual couples). These photographs were taken with neutral expression and direct gaze, under standardized lighting conditions and against a constant background. Face images were then aligned on pupil position and masked so that clothing and hair were not visible.

Forty heterosexual participants (20 men and 20 women; mean age = 24.2 years, $SD = 3.62$ years) then rated the 51 male and 51 female face images for attractiveness and health using 1 (much less attractive/healthy than average) to 7 (much more attractive/healthy than average) scales. Male attractiveness, male health, female attractiveness, and female health were rated in different blocks of trials. Both block order and trial order within each block were fully randomized. None of these raters took part in other aspects of the study. Inter-rater agreement was high for all four sets of ratings (all Cronbach's alphas > .87), and male and female raters' ratings were highly correlated within each of the four sets (all $r > .80$, all $p < .001$). Consequently, we calculated the average health and attractiveness ratings for male and female faces and converted these average male attractiveness, male health, female attractiveness, and female health ratings to z scores. These facial attractiveness ratings and facial health ratings were used in our main analyses.

3. Results

First, we used one-sample t-tests to compare health preference scores with what would be expected by chance alone. Both male and female participants showed a significant preference for healthy faces when assessing other-sex faces for attractiveness (One sample t-tests against 0, men: $M = 1.16$, $SD = 1.00$, $t(50) = 8.25$, $p < .001$; women: $M = 1.00$, $SD = 1.00$, $t(50) = 7.18$, $p < .001$). An independent-samples t-test showed no significant sex difference in health preferences ($t(100) = 0.76$, $p = .45$).

To investigate the possible moderating effect of own attractiveness on the relationship between preference and choice, we conducted multilevel analysis using R (R Core Team, 2013), *lme4* (Bates, Maechler, Bolker, & Walker, 2014), and *lmerTest* (Kuznetsova, Brockhoff, & Christensen, 2014). In order to address the interdependence of data from the male and female members of each couple, this model included a random intercept term by couple.

In this model, we constructed a multilevel regression equation with partner's facial health rating as the dependent variable and participant's health preference score, participant's own facial attractiveness ratings, participant's sex (coded as 0 = female, 1 = male), and all possible interactions among these three variables simultaneously entered for each participant. Note that all continuous variables are z-scores, meaning that the statistics reported below are standardized betas. There was a



Fig. 2. Examples of male (top) and female (bottom) face stimuli with increased (left) and decreased (right) apparent health. Faces were manipulated in color and texture cues.

Table 1

Results of multilevel regression predicting partner's facial health rating for the initial model.

	β	S.E.	t	p
Intercept	-0.134	0.188	-0.711	.479
Health preference score	0.096	0.091	1.050	.298
Own attractiveness	-1.042	0.114	-9.161	<.001
Sex	-0.019	0.160	-0.116	.908
Health preference score * Own attractiveness	0.293	0.083	3.509	<.001
Own attractiveness * Sex	0.485	0.200	2.424	.018
Health preference score * Sex	0.034	0.122	0.277	.783
Health preference score * Own attractiveness * Sex	-0.351	0.142	-2.481	.016

Sex refers to participant's sex (coded as 0 = female, 1 = male).

significant three-way interaction among health preference score, own facial attractiveness ratings, and sex ($\beta = -0.35$, $t = -2.48$, $p = .016$). All other effects were qualified by this interaction (see Table 1).

To interpret this three-way interaction, we ran separate analyses for male and female participants. For male participants, their health preference score did not interact with their own attractiveness and neither health preference score nor own attractiveness predicted partner's facial health rating (all $|\beta| < 0.10$, all $|t| < 0.62$, all $p > .53$). For female participants, their health preference score did interact with their own attractiveness ($\beta = 0.37$, $t = 3.13$, $p = .003$), such that the relationship between health preference score and partner's facial health rating was greater for more attractive women.

The effects of own attractiveness and health preference score on women's partner's facial health rating were fully qualified by the interaction described above. The significant negative effect of own attractiveness ($\beta = -0.39$, $t = -2.30$, $p = .026$) reflected that, at the baseline level of zero health preference (i.e., which is 1.00 SD below the mean of women's preference for health), there is a negative relationship between own attractiveness and partner's facial health rating. Further analysis showed that, at 1.00 SD above women's average health preference, the effect of own attractiveness was positive and near-significant ($\beta = 0.36$, $t = 1.89$, $p = .065$). The effect of health preference score at the baseline level of average own attractiveness was not significant in this model ($\beta = 0.20$, $t = 1.39$, $p = .17$).

4. Discussion

The current study tested whether the correspondence between a person's preferences for particular facial attributes and the facial attributes of their actual chosen partner is modulated by that person's own market value. Our analyses show that the relationship between preference for facial cues of apparent health and actual partner's apparent facial health was stronger among more attractive women. These results for women are then consistent with biological market theories of mate choice (e.g., Noë & Hammerstein, 1994; 1995), which predict that individuals with higher market value will be better placed to translate their preferences into actual mate choices.

By contrast with our results for women, men's attractiveness did not moderate the relationship between their preference for facial cues of apparent health and their actual partners' apparent facial health. This sex difference is in line with evidence that physical attractiveness is a better predictor of women's than men's market value (Buss, 1989; Feingold, 1990; Shackelford, Schmitt, & Buss, 2005). Thus, while our results suggest that men's attractiveness may not moderate the relationship between their mate preference and choice, other measures of their market value that were not considered in this study (e.g., their resource-holding potential) may have such a moderating effect.

Face preferences may be related to mate choice in one of two ways. On one hand, preferences may drive partner selection if people seek partners possessing the traits that they prefer (Burriss et al., 2011). On the other hand, partner selection may drive preferences if visual experience with a partner's characteristics increases preferences for those characteristics. While humans generally show preferences for familiar stimuli (Moreland & Zajonc, 1982; Zajonc, 1968) and visual exposure can increase preferences for novel similar faces (Buckingham et al., 2006; Little, DeBruine, & Jones, 2005; Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003), health preferences in the current study were predicted by the interaction between own attractiveness and partner's health and not by partner's health alone. Consequently, the relationship between preference and choice that was observed among women in the current study cannot be solely a consequence of the effects of visual experience with one's partner's face.

Previous studies investigating the link between preference and choice (e.g., Burriss et al., 2011; DeBruine et al., 2006) did not consider the possible moderating effects of own market value. The results of the current study suggest that the extent to which mate preferences

predict actual partner choice can depend, in part, on own market value, at least among women. More fundamentally, our data demonstrate the utility of considering biological market theories (e.g., Noë & Hammerstein, 1994; 1995), not only for our understanding of mate preferences or mate choice, but also for our understanding of the relationship between preference and choice.

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