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Observer age and the social transmission of attractiveness in humans: Younger women are more influenced by the choices of popular others than older women

Anthony C. Little[1]*, Christine A. Caldwell[1], Benedict C. Jones[2] and Lisa M. DeBruine[2]

[1]School of Natural Sciences, University of Stirling, UK
[2]Institute of Neuroscience and Psychology, University of Glasgow, UK

Being paired with an attractive partner increases perceptual judgements of attractiveness in humans. We tested experimentally for prestige bias, whereby individuals follow the choices of prestigious others. Women rated the attractiveness of photographs of target males which were paired with either popular or less popular model female partners. We found that pairing a photo of a man with a woman presented as his partner positively influenced the attractiveness of the man when the woman was presented as more popular (Experiment 1). Further, this effect was stronger in younger participants compared to older participants (Experiment 1). Reversing the target and model such that women were asked to rate women paired with popular and less popular men revealed no effect of model popularity and this effect was unrelated to participant age (Experiment 2). An additional experiment confirmed that participant age and not stimulus age primarily influenced the tendency to follow others' preferences in Experiment 1 (Experiment 3). We also confirmed that our manipulations of popularity lead to variation in rated prestige (Experiment 4). These results suggest a sophisticated model-based bias in social learning whereby individuals are most influenced by the choices of those who have high popularity/prestige. Furthermore, older individuals moderate their use of such social information and so this form of social learning appears strongest in younger women.

Individuals often learn from others and selection for social learning mechanisms may occur when there are costs to acquiring accurate behavioural information via individual learning (Richerson & Boyd, 2005). In terms of mate choice, using the judgements of others may be beneficial if it allows an individual to assess potential mates more quickly and efficiently than through individual trial and error. There are potentially very large costs if individuals choose their mates badly, with desertion or infidelity posing very real risks.

Mate-choice copying has been observed among females in a number of different non-human species (Brown & Fawcett, 2005; Dugatkin, 2000; Galef & Laland, 2005; White, 2004), including fish (Dugatkin & Godin, 1992, 1993; Godin, Herdman, & Dugatkin, 2005;

*Correspondence should be addressed to Anthony C. Little, Psychology, School of Natural Sciences, University of Stirling, Stirling FK9 4LA, UK (email: anthony.little@stir.ac.uk).

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Witte & Ryan, 2002) and bird species (Galef & White, 1998; Swaddle, Cathey, Correll, & Hodkinson, 2005; White & Galef, 2000). These studies have generally shown that in choice tests where females observe another female (termed model) to be paired with one of two males (termed targets), female observers are subsequently more likely to prefer the target male they had seen paired over the male they had seen unpaired (Hoglund, Alatalo, Gibson, & Lundberg, 1995).

Inspired by work on non-human animals, research also suggests that social learning may influence human mate preferences (for review see Little, Jones, DeBruine, & Caldwell, 2011). While some research has shown that the presence of wedding rings on men did not increase women's preferences for those men (Uller & Johansson, 2003), other studies have found that images of men labelled as married were more attractive than those labelled as single (Eva & Wood, 2006) and that women rate men as more desirable when shown surrounded by women than when shown alone or with other men (Hill & Buss, 2008). Another study has shown that women prefer pictures of men when they are alongside images of other women who were looking at the face with smiling (i.e., positive) expressions compared to face stimuli in which the women had neutral (i.e., relatively negative) expressions (Jones, DeBruine, Little, Burriss, & Feinberg, 2007). Women therefore do appear to mimic the attitude of other women to particular men. Such effects of learning do not appear limited to human targets. In a study of preferences for objects, target objects which were presented with face images looking at them with a happy expression were liked more than objects which were presented with faces looking at them with a disgust expression (Bayliss, Frischen, Fenske, & Tipper, 2007). Objects not looked at were rated equally for both expressions.

Alongside partnership status, simple presence of possible mates, and expressions of attitude towards the male, the physical traits of the observed model may also play a role in social transmission of preference. Previous studies have shown that men and women are influenced in their judgements of attractiveness by the apparent choice of attractive members of the same sex. Sigall and Landy (1973) used real individuals to show that positive characteristics are attributed more frequently to men who are paired with attractive rather than unattractive women. In this way they show that an attractive partner may 'radiate beauty'. Such a phenomenon is suggestive of a more sophisticated form of mate-choice copying, whereby women can use the attractiveness of a partner that a man can acquire in order to judge the man's own attractiveness. A more recent study using images that were presented with a fictitious partner has shown that both men and women find a face paired with an attractive partner to be more attractive than one paired with an unattractive partner for a long-term but not a short-term relationship (Little, Burriss, Jones, DeBruine, & Caldwell, 2008; see also Waynforth, 2007). Effects specific to long-term preferences in humans suggest that social information is being used to infer non-physical traits that make a target a good long-term partner, such as resources or intelligence, which may be difficult to determine from physical appearance alone.

Following the choice of attractive individuals over unattractive individuals is likely an example of bias. Once social learning evolved it would pay to be selective about who to learn from because some models will be more successful than others (Henrich & Gil-White, 2001). This has led to the notion that there are mechanisms promoting differential attention to particular models (Boyd & Richerson, 1985; Henrich & McElreath, 2007), so called 'model-based biases' (following Henrich & McElreath, 2003). One aspect of the model that might promote social learning are cues to prestige. Learners should preferentially pay attention to prestigious people, 'prestige bias' (Henrich & McElreath, 2007), because selective social learners would then have an advantage over those who

were not selective. It has been argued that prestige evolved from social learning strategies to identify appropriate models from whom to learn (Henrich & Gil-White, 2001). The possession of prestige ensures that prestigious individuals are listened to and have influence and, although the source of prestige can be unclear to observers, if others consider someone prestigious then it might be assumed that they are useful model for social learning. Indeed, several lines of research suggest that social learning is biased towards prestigious models (Bauer, Schlottmann, Bates, & Masters, 1983; Eckel & Wilson, 2007; Ryckman, Sherman, & Rodda, 1972).

Another type of bias has been observed in fish species whereby young guppies are more likely to copy the mate choice of older models than younger models (Amlacher & Dugatkin, 2005; Dugatkin & Godin, 1993). Older guppies are also less likely to be influenced by the choices of younger females (Dugatkin & Godin, 1993). As age is related to experience, this suggests a sophisticated social learning bias involving tradeoffs between personal and public information use (e.g., Kendal, Coolen, van Bergen, & Laland, 2005; Laland, 2004) that could lead to more adaptive learning.

Following demonstrations of prestige bias in other areas, here we examine female bias in the use of information about a target man's attractiveness. To do this we paired men with a fictional model female partner who was described as being either high or low in popularity, a marker of prestige (Experiment 1). If individuals learn from another's choices, we expect that the preferences of our participants will vary according to another person's choice of partners. If participants are biased more by high-prestige models, then men should be rated as more attractive when paired with high popularity models. Further, following findings in non-human animals, we predicted that younger women would be more likely to be influenced by the choices of other women than older women were (Experiment 1). Previous studies have suggested that social learning of attractiveness is seen mainly for mate-choice relevant judgements involving opposite-sex targets paired with same-sex models (Little, Caldwell, Jones, & DeBruine, 2011). We additionally tested this notion by reversing the target and model sex so that women were rating target females paired with popular/less popular model males (Experiment 2). Given that social learning of attractiveness is mainly relevant for opposite-sex targets, we predicted no influence of model popularity in Experiment 2. In Experiment 1, we used young targets and models which might have meant that older women viewed the stimuli as less relevant to their mate choice. To examine the interplay of target age and participant age we conducted an additional experiment which used a wider variety of target and model ages (Experiment 3). Finally, to validate the link between our popularity manipulation and prestige, we examined the effect that our manipulations of popularity had on ratings of prestige and attractiveness (Experiment 4).

EXPERIMENT 1

In Experiment 1, we examined whether the attractiveness of specific target male individuals was influenced by pairing them with female model partners labelled as either popular or less popular. We predicted that if women are more influenced by the choices of prestigious models than males paired with more popular female models would be rated as more attractive than those paired with less popular models. We additionally tested for effects of observer age and predicted that younger women may show a stronger effect of social learning than older women.

Method

Participants

Participants in Experiment 1 were 174 women (aged 17–52, mean [*M*] = 24.6, *SD* = 7.7, in condition A = 85, B = 89). All participants were volunteers visiting an online testing site and were selected for being heterosexual and between the ages of 16 and 65.

Stimuli

The stimuli were 10 composite male and 10 composite female images (see Figure 1 for example images). Each composite image was composed of 5 randomly selected male or female images from a set of 50 young adult male and 50 young adult female facial photographs which had been taken under standard lighting conditions with neutral facial expressions. The composite faces were created using specially designed software. Key locations (179 points) were manually marked around the main features (e.g., points outline, eyes, nose, and mouth) and the outline of each face (e.g., jaw line, hair line). The average location of each feature point in the 5 faces for each composite was then calculated. The features of the individual faces were then warped to the relevant average

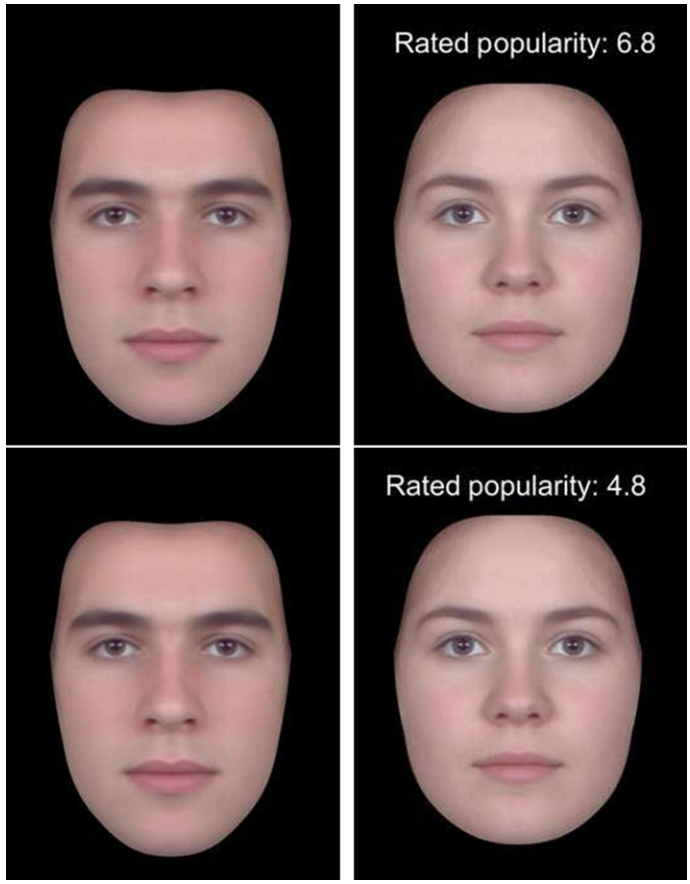

Figure 1. Example face pairs shown to participants in Experiments 1 with popular (top) and less popular (bottom) labelled model partners.

shape before superimposing the images to produce a photographic quality result. This technique has been used to create composite images in previous studies (Benson & Perrett, 1993; Little & Hancock, 2002; Tiddeman, Burt, & Perrett, 2001). The composite images were made perfectly symmetrical by combining them with their mirror image, creating images symmetrical in both shape and colour.

The popularity manipulation was the addition of text using the text tool in Corel Photo paint. Each model (the face paired with the target face to be rated) was randomly allocated a popularity score between 4 and 7 (to one decimal place, e.g., 5.6 was generated) as the popular numbers. The less popular version was always 2 points less popular (2–5). Mean popularity of the popular versions was 5.56 and of the less popular versions was 3.56.

Final images were a set of 20 pairs of a male target and female model (10 versions of the pairs in which the model was more popular and 10 versions of the pairs where the model was less popular). The model images had their rated popularity noted on the image as seen in Figure 1.

Procedure

Participants were presented with a short online questionnaire assessing their age, sex, and sexual orientation. Participants were then presented with paired images. The male target image was presented on the left hand side of the screen for attractiveness rating. Each target male image was paired with a female face, which was labelled with a rated popularity, on the right hand side of the screen. Participants were asked to rate only the male images for their attractiveness as a long-term partner using a 7-point scale from 1 (low attractiveness) to 7 (high attractiveness). Participants were asked to rate men's attractiveness as a long-term partner because previous research has demonstrated that social learning effects on face preferences are greater when women assess men's attractiveness for long-term relationship contexts than for short-term relationship contexts (Little *et al.*, 2008).

Participants saw each male target face/female model face only once, with model popularity varying by condition. In order to dissociate image from popularity manipulation, the 10 unique target/model image pairs were split into two sets containing 5 images each: Set A (images 1–5) and Set B (images 6–10). Participants were randomly allocated to one of two conditions, condition A in which participants saw the partners were of high popularity in set A and low popularity in set B and condition B in which participants saw partners were of high popularity in set B and low popularity in set A. This meant participants rated 10 male faces in total, five of which were paired with women of high popularity and five of which were paired with women of low popularity.

Within the instructions, participants were told that the faces on the right were the partners of the people on the left. Images were presented in a random order, and rating the face on the scale initiated the next trial.

Results

We calculated the mean score given to male targets paired with a high popularity model and the mean score given to male targets paired with a low popularity model. We ignored condition as this only varied the popularity rating (high vs. low) associated with specific faces shown to participants and approximately equal numbers of participants in each condition accounted for any differences in ratings due to specific faces.

A repeated measures ANCOVA with model popularity (high popularity/low popularity) as a within-participant factor and age of participant as a covariate revealed a significant main effect of model popularity, $F(1,172) = 20.86$, $p < .001$, $\eta_p^2 = 0.108$, and an interaction between model popularity and age of participant, $F(1,172) = 7.78$, $p = .006$, $\eta_p^2 = 0.043$. There was no main effect of age of participant, $F(1,172) = 0.01$, $p = .915$, $\eta_p^2 < 0.001$. Mean rating scores can be seen in Figure 2.

To examine the effect of age on social influence we conducted a correlation between participant age and a difference score. The difference score for each participant was calculated as the mean rating of men paired with popular models minus the mean rating of men paired with less popular models. The difference score then reflects how influenced a participant was by the popular model, with higher scores indicating male target attractiveness was higher for men paired with popular than less popular models. This revealed a significant negative correlation between participant age and difference score ($N = 174$, $r = -0.208$, $p = .006$, rho $= -0.163$, $p = .032$). The relationship can be seen in Figure 3 and indicated that older participants were less likely to be influenced by the model than younger participants.

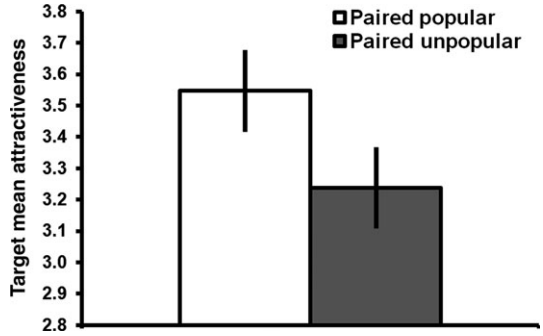

Figure 2. Rated attractiveness of target males paired with more popular and less popular female models in Experiment 1 (±1SE of mean).

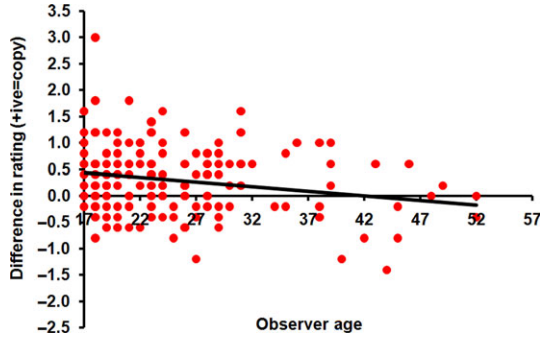

Figure 3. Scatterplot of age against difference score for Experiment 1. Positive and negative scores indicate greater influence of paired model popularity while scores close to zero indicate judgements were not much influenced by paired model popularity.

Discussion

In Experiment 1, we found that women rated target men paired with a popular female model as more attractive than men paired with a less popular female model and that this effect was strongest in younger women. Together these effects demonstrated that the popularity of a man's partner impacts on his attractiveness to other women and that younger women are more likely to be influenced by the mate-choice decisions of other women than older women are. This latter finding is in line with notion that, because of differing experience with partner choices, older women may rely more on their own judgements informed by experience while younger women may pay more attention to the choices of others rather than rely only on their own less experienced judgement.

EXPERIMENT 2

Previous studies have suggested that social learning of attractiveness is seen mainly for mate-choice relevant targets, and is therefore more likely to be observed when individuals are judging opposite-sex targets and less likely to be observed for other types of targets, such as same-sex targets (Little, Caldwell, *et al.*, 2011). To examine this proposition, In Experiment 2, we repeated Experiment 1 but reversed target and model. In Experiment 2, women were asked to rate the attractiveness of target women paired with popular and unpopular men. No effect of model popularity in Experiment 2 would suggest that social learning applies mainly to opposite-sex mate choice for heterosexual women and would additionally rule out low level or demand characteristic explanations of the effect seen in Experiment 1.

Method

Participants

Participants in Experiment 2 were 79 women (aged 16–58, $M = 23.7$, $SD = 8.7$, in condition A = 39, B = 40). Participants were recruited and selected as in Experiment 1.

Stimuli

The stimuli were identical to Experiment 1, except that the popularity manipulation was applied to male stimuli meaning that there were two versions of male stimuli (high popularity/low popularity) and one version of female stimuli with no popularity manipulation applied.

Procedure

The procedure was identical to Experiment 1 except that participants were asked to rate female target stimuli paired with male model stimuli to which the popularity manipulation had been applied.

Results

We calculated the mean score given to female targets paired with a high popularity model and the mean score given to female targets paired with a low popularity model. We ignored condition as in Experiment 1.

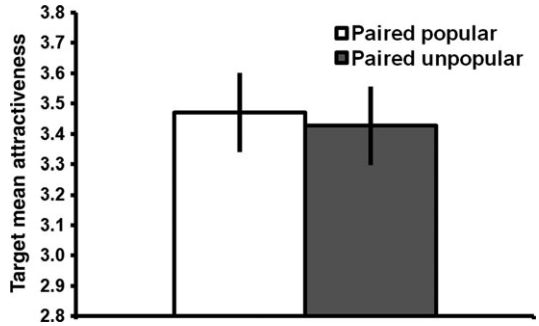

Figure 4. Rated attractiveness of target females paired with more popular and less popular male models in Experiment 2 (±1SE of mean).

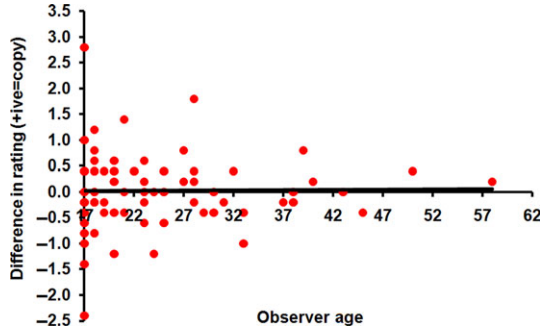

Figure 5. Scatterplot of age against difference score for Experiment 2. Positive and negative scores indicate greater influence of paired model popularity while scores close to zero indicate judgements were not much influenced by paired model popularity.

A repeated measures ANCOVA with model popularity (high popularity/low popularity) as a within-participant factor and age of participant as a covariate revealed no significant main effect of model popularity, $F(1,77) = 0.09, p = .764, \eta_p^2 = 0.001$, and no interaction between model popularity and age of participant, $F(1,77) = 0.02$, $p = .885$, $\eta_p^2 < 0.001$. There was also no main effect of age of participant, $F(1,77) = 0.78, p = .381$, $\eta_p^2 = 0.010$. Mean rating scores can be seen in Figure 4.

To examine the effect of age on social influence we conducted a correlation between participant age and a difference score (as calculated in Experiment 1). This revealed no significant correlation between participant age and difference score ($N = 79, r = -0.017$, $p = .885$, rho = 0.026, $p = .820$). The relationship can be seen in Figure 5.

Discussion

Experiment 2 served as a control study for Experiment 1, reversing target and model. In Experiment 2, no effect of model popularity or observer age was found. Together these two findings demonstrated that the social learning effect seen in Experiment 1 appears somewhat specific to opposite-sex judgements and that older and younger observers are

not differently affected by opposite-sex model popularity when rating targets of the same sex. Experiment 2 also demonstrated that the effects seen in Experiment 1 cannot be accounted for by demand characteristics of the study. We note that Experiment 2 has a smaller sample size than Experiment 1 but also that the effect size observed in Experiment 2 is much smaller than that seen in Experiment 1, meaning that sample size is unlikely to account for the difference in the influence of participant age between the two experiments. Indeed, using G*Power to determine the sample size needed for $r = -0.017$ to be significant 1-tailed indicated that we would have needed to have tested more than 37,400 participants to find a significant effect of age. The positive sign for the Spearman's correlation also highlights the absence of an effect of age in Experiment 2.

EXPERIMENT 3

While social learning of attractiveness was less evident in older participants in Experiment 1, this could, in part, be accounted for by the fact that our stimuli were of young adults and so less relevant to older women. In Experiment 3, we re-examined whether the attractiveness of specific individuals was influenced by the popularity of their partners using a range of differently aged couples as stimuli. Experiment 3 also employed real photographs to increase the ecological validity of our tests.

Method

Participants

Participants in Experiment 3 were 200 women (aged 16–61, $M = 26.3$, $SD = 9.3$, in condition A = 97, B = 103). Participants were split by age category into three age groups following the age groups of the stimuli: 16–25 ($M = 20.5$, $SD = 2.9$, $N = 121$), 26–32 ($M = 28.8$, $SD = 1.9$, $N = 39$), 32+ ($M = 41.6$, $SD = 8.1$, $N = 40$). Participants were recruited and selected as in Experiment 1.

Stimuli

The stimuli were photographs of real people downloaded from www.hotornot.com. These were 4 men and 4 women for each age category (18–25, 26–32, 33–40). Age categories were derived from the age categories under which the images were listed on the original website. Images were formed into male–female pairs and were matched as closely as possible for expression and background. For Experiment 3, the manipulation was rated popularity applied to female partners and was identical to that used in Experiment 1 above. Final images were then 12 original couples with high popularity/low popularity versions making 24 pairs. The male target appeared on the left and the female model on the right.

Procedure

The procedure was identical to Experiment 1 and participants saw each male face only once, with partner popularity varying by condition. In order to dissociate image from popularity manipulation, the 12 unique target/model image pairs were split into two sets containing 6 images each: Set A (images 1–6) and Set B (images 7–12). Participants were randomly allocated to one of two conditions, condition A in which participants saw the

partners were of high popularity in set A and low popularity in set B and condition B in which participants saw partners were of high popularity in set B and low popularity in set A. This meant participants rated 12 male faces in total 6 of which were paired with women of high popularity and 6 of which were paired with women of low popularity.

Results

In Experiment 3, we calculated the average rating scores given to male targets paired with popular and unpopular models for each age set of faces. To do this we ignored condition as in Experiment 1. We recoded participant's ages into categories along the same lines to those dividing the stimuli (see participants section).

A mixed model ANOVA with model popularity (high popularity/low popularity) and age of face (18–25/26–32/33–40) as within-participant factors and age of participant (≤25/26–32/33+) as a between-participant factors revealed a significant interaction between model popularity and age of participant, $F(2,197) = 4.13$, $p = .018$, $\eta_p^2 = 0.040$. Other effects and interactions were significant: age of face, $F(2,394) = 13.23$, $p < .001$, $\eta_p^2 = 0.063$, and age of face X age of participant, $F(4,394) = 10.56$, $p < .001$, $\eta_p^2 = 0.097$. These latter results, however, do not relate to a social learning effect as they did not include an interaction with model popularity. The age of face effect reflects that younger targets were rated as more attractive than older targets and the interaction between age of face and age of participant reflected that older participants found older targets as more attractive than younger targets compared to younger participants. No other effects or interactions were significant (all $F < 1.79$, all $p > .168$, all $\eta_p^2 < 0.009$). Mean scores collapsing across age of face can be seen in Figure 6.

To parse the interaction between model popularity and age of participant above we ran separate mixed model ANOVAs for each participant age group which were identical to the above analysis except that age of participant was not entered as a factor. These revealed a significant effect of model popularity for the <26 group, $F(1,120) = 11.02$, $p = .001$, $\eta p^2 = 0.084$, but this effect was not significant for the 26–32 group, $F(1,38) = 0.38$, $p = .540$, $\eta p^2 = 0.010$, nor the 33+ group, $F(1,39) = 0.59$, $p = .448$, $\eta_p^2 = 0.015$. Age of face did not significantly interact with model popularity in any of the three tests (all $F < 1.76$, all $p > .179$, all $\eta_p^2 < 0.043$).

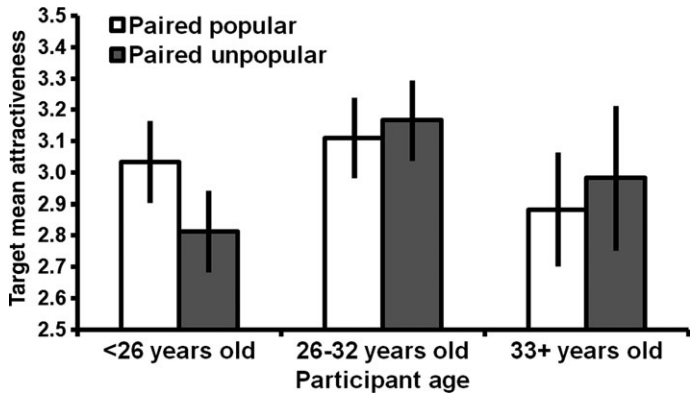

Figure 6. Attractiveness scores for targets paired with more popular or less popular models in Experiment 3 split by age of participant (±1SE of mean).

Discussion

Experiment 3 replicated the effects of model popularity and observer age seen in Experiment 1. Using a wide range of target and model ages, ensuring age appropriate target and model images were seen, manipulated popularity only significantly impacted on the youngest group's ratings of target attractiveness. This finding demonstrated that age of observer rather than a match between observer and target or model is important in the social learning of attractiveness. We also note that Experiment 3 demonstrated the effect of age on social learning in attractiveness, which does not simply reflect lower interest in mate choice by some post-menopausal women in the oldest age group because no effect of model popularity was also observed in the pre-menopausal 26–32-year-old group.

EXPERIMENT 4

In the introduction, we suggested that our manipulation of popularity may impact on prestige and this may result in a bias in social learning towards popular/prestigious models. In order to validate the link between our popularity manipulation and prestige we conducted Experiment 4. Our manipulation could also change the attractiveness of the models as popular models may be seen as more attractive than less popular models. In Experiment 4, we addressed the impact of our popular and less popular labels on ratings of prestige and attractiveness.

Method

Participants

Participants in Experiment 4 were 42 women (aged 16–54, $M = 23.9$, $SD = 9.2$, in condition A = 21, B = 21). Participants were recruited and selected as in Experiment 1.

Stimuli

Female model stimuli as used in Experiment 1 (20 images, 10 labelled with high popularity and 10 labelled with low popularity) and Experiment 3 (24 images, 12 labelled with high popularity and 12 labelled with low popularity) were used. Total stimuli were 44 female face images.

Procedure

The procedure was identical to Experiment 1 except that participants saw only female model faces to rate for both prestige and attractiveness. Face images were presented individually in a random order along with a 7-point scale (1 = low, 7 = high). Order of rating prestige and attractiveness was also random. Participants saw each female face only once when rating each trait, with popularity (high/low) varying by condition. In order to dissociate image from popularity manipulation, the 22 original images were split into two sets containing 11 images each: Set A (images 1–11) and Set B (images 12–22). Images from Experiment 1 and Experiment 3 were divided equally into these sets.

Participants were randomly allocated to one of two conditions, condition A in which participants saw high popularity ratings for set A and low popularity for set B and condition B in which participants saw high popularity ratings for set B and low popularity for set A. This meant participants rated 22 female faces in total 11 of which were rated of high popularity and 11 of which were rated of low popularity.

Results

We calculated the mean score given to female faces labelled as high popularity and the mean score given to female faces labelled as low popularity separately for stimuli from Experiment 1 and Experiment 3. We ignored condition as in Experiment 1.

Stimuli for Experiment 1

A repeated measures ANOVA with model popularity (high popularity/low popularity) and trait (prestige/attractive) as within-participant factors revealed a significant main effect of model popularity, $F(1,41) = 8.16$, $p = .007$, $\eta_p^2 = 0.166$, and a significant interaction between model popularity and trait, $F(1,41) = 4.82$, $p = .034$, $\eta_p^2 = 0.105$. There was a close to significant main effect of trait, $F(1,41) = 3.75$, $p = .060$, $\eta_p^2 = 0.084$.

Follow-up paired samples t-tests revealed a significant difference in rated prestige between high and low popularity images – high mean = 4.2, $SD = 0.8$, low mean = 3.8, $SD = 1.0$, $t(41) = 3.01$, $p = .004$ – and a non-significant difference for rated attractiveness – high mean = 3.7, $SD = 1.1$, low mean = 3.6, $SD = 1.2$, $t(41) = 1.41$, $p = .166$.

Stimuli for Experiment 3

A repeated measures ANOVA with model popularity (high popularity/low popularity) and trait (prestige/attractive) as within-participant factors revealed a significant main effect of model popularity, $F(1,41) = 9.31$, $p = .004$, $\eta_p^2 = 0.185$, and a close to significant interaction between model popularity and trait, $F(1,41) = 4.06$, $p = .051$, $\eta_p^2 = 0.090$. There was no main effect of trait, $F(1,41) = 0.71$, $p = .405$, $\eta_p^2 = 0.017$.

Follow-up paired samples t-tests revealed a significant difference in rated prestige between high and low popularity images – high mean = 3.8, $SD = 0.9$, low mean = 3.2, $SD = 0.9$, $t(41) = 3.59$, $p = .001$ – and a non-significant difference for rated attractiveness – high mean = 3.7, $SD = 1.1$, low mean = 3.4, $SD = 1.0$, $t(41) = 1.61$, $p = .115$.

Discussion

Experiment 4 demonstrated that our manipulation of popularity led to significant changes in perceived prestige in the images used as models. This result validates the link between our popularity manipulation and the perception of prestige. These data also demonstrated that the popularity manipulation had larger effects on ratings of prestige than on attractiveness which is suggestive that the social learning effect in Experiment 1 and Experiment 3 reflects attraction to the male partners of prestigious women. A larger sample size may have revealed an effect of our manipulation on attractiveness and so we do not discount that model attractiveness could also play a role.

GENERAL DISCUSSION

We examined biased social learning of attractiveness and the effect of observer age on such learning. Experiment 1 demonstrated that women rated target males as more attractive when paired with female models of high popularity compared to models with low popularity. We additionally found that younger women were more likely to be biased by the choices of popular female models than older women. In contrast, in Experiment 2

in which target and model sex were reversed, no effects of model popularity or of observer age were seen. This difference indicated that social learning effects were most apparent in mate relevant judgements and that demand characteristics are unlikely to account for the pattern of results in Experiment 1, given the equivalent demands in Experiment 2. In Experiment 3, a wider range of target and model ages was used to allow for age appropriate target and model images to be seen and the results were in line with Experiment 1. Experiment 3 also suggested that women rated target males as more attractive when paired with female models of high popularity compared to models with low popularity but that this was true of only younger women. Experiment 3 also used more naturalistic photo images demonstrating that comparable results are present when changing stimulus type. Finally, Experiment 4 confirmed that our manipulation of popularity changed perceptions of model prestige and had a more limited impact on perceived attractiveness.

Our data are consistent with a large volume of research on mate-choice copying among females in a number of different non-human species (Brown & Fawcett, 2005; Dugatkin, 2000; Galef & Laland, 2005; White, 2004) as well as work on social transmission and learning in human mate preferences (Eva & Wood, 2006; Hill & Buss, 2008; Jones *et al.*, 2007). These results are most closely related to previous studies that have shown that men and women are influenced in their judgements of attractiveness by the apparent choice of attractive members of the same sex (Little *et al.*, 2008; Sigall & Landy, 1973; Waynforth, 2007). Previous studies have suggested that social learning of attractiveness is most evident for mate-choice relevant judgements. For example, men and women appear to be relatively uninfluenced by model attractiveness when rating same-sex target images (Little, Caldwell, *et al.*, 2011). We demonstrated a similar effect here in Experiment 2, in which women were not influenced in their ratings of target women which were paired with popular and unpopular male models. Age also was unrelated to the effect of model popularity in Experiment 2. Together, the absence of effects in Experiment 2 suggests that social learning of attractiveness is most apparent for opposite-sex judgements in heterosexual women and also suggests that low level effects or demand characteristics cannot explain the pattern of results in Experiment 1 because the same low level effects and demands were present in Experiment 2.

As noted in the introduction, there are potential mechanisms that promote differential attention to particular models (Boyd & Richerson, 1985; Henrich & McElreath, 2007). Learners should preferentially pay attention to people in possession of certain cues because selective social learners have an advantage over those who are not selective. In Experiment 1 and 3, we observed a bias towards learning from more popular individuals. It has been argued that prestige evolved from social learning strategies to identify appropriate models to learn from (Henrich & Gil-White, 2001). Here, we used popularity as a marker for prestige as popular individuals have implied access to large networks and seem most likely to be preferentially listened to by others. Again this appears to be a sophisticated bias as prestige must be inferred from popularity, but nonetheless this appears to have a significant influence on inferred partner characteristics. One possibility is that our findings are more akin to previous work on attractiveness and that our manipulations of popularity simply change attractiveness of the models. We examined this in Experiment 4, which demonstrated that manipulations of popularity impacted significantly on ratings of prestige but not on ratings of attractiveness. However, the direction was in the predicted direction for attractiveness and so a larger sample may have revealed an effect of popularity on attractiveness. While we cannot exclude that changes in attractiveness may play a role, the effect on attractiveness appears smaller than that of

popularity on prestige and therefore it appears parsimonious to conclude that increases in target attractiveness were related to changes in model prestige rather than attractiveness. Of course, the mechanism via which popularity or prestige changes target attractiveness may be similar to that proposed for attractiveness. It can be inferred, consciously or unconsciously, that popular or attractive women have more available options in the mating market and so can choose higher quality mates than less popular or less attractive women. This in turn can lead to inferences, again consciously or unconsciously, about their partner's traits such that an observer may assume a partner chosen by a popular or attractive woman has more positive qualities than one chosen by a less popular or attractive woman. In this way our experiments show an effect beyond model physical characteristics, and therefore, whether or not prestige had a direct effect on social learning in this context, this likely reflects, at the very least, a similar mechanism at work.

In Experiment 1 and 3, we found that younger women were more likely to be influenced by the preferences of the model women in the images. In Experiment 1, we used young target and model stimuli. While it is possible that observers pay more attention to similarly aged models, which would also account for the finding that older women were less likely to be influenced by our young models, Experiment 3 specifically addressed the issue of participant age and model age. In Experiment 3 we found that model age did not influence the tendency to prefer men with popular partners but that participant age did. Only younger women demonstrated an effect of model popularity on target attractiveness. Together these results indicate sophisticated biases in social transmission. Again this is in line with findings from the non-human animal literature demonstrating that older guppies are also less likely to be influenced by the choices of younger females (Dugatkin & Godin, 1993). It is likely that as women get older they have a greater store of knowledge about the quality of potential mates. This greater experience means that older individuals should be less susceptible to social influences, relying more heavily on their own knowledge rather than the choices of younger, less experienced women. This suggests that the balance of social learning is not stable across the lifespan and social learning effects may have their greatest influence when observers are young and relatively inexperienced. In learning about mates humans may use a strategy of socially learning when uncertain but using individual knowledge when they have relevant experience (see Kendal *et al.*, 2005; Laland, 2004). Of course, there may be other explanations for why older women did not follow the choices of popular models, such as a difference in perceived status between observer and model.

We focused here on age as a proxy for experience because it appears an appropriate assumption that older women will have more experience of successful and unsuccessful mate choice both in terms of their own choices and those they observe in others than younger women will. The association of other measures of experience with relationships, such as number and length of previous relationships, would be useful to address in future studies of social learning of attractiveness. One biological factor that could impact on social learning of attractiveness associated with age is menopause, which generally occurs in women during their 40s. It is unlikely that menopause, and any subsequent change in interest in male partners, drive this pattern of results because post-menopausal women are likely to still be interested in mate choice, although they may have less focus on physical traits associated with genetic benefits to offspring (Little *et al.*, 2010). Indeed, pre-menopausal participants between 26 and 32 years old did not show a social learning effect compared to younger women demonstrating that even if menopause does play a role in reducing social learning of attractiveness in the oldest age group other factors also contribute to a lack of effect in older pre-menopausal women.

Mate-choice copying (usually in females) has been proposed to be adaptive when there is a cost, such as energy or time, to evaluating the quality of potential mates or when discriminating between the quality of potential mates is difficult (Wade & Pruett-Jones, 1990). In this way, social transmission may allow individuals to assess a potential mate quickly and efficiently and perhaps teaches individuals what to look for in a male. Acquiring accurate behavioural information via individual learning is costly (see, e.g., Richerson & Boyd, 2005). Getting to know individuals can take time and there are certainly potentially very large costs if individuals choose their mates badly and this may be the selective pressure behind learning from another's mate choice. In humans, there are many aspects to a partner other than their physical traits, and potentially the influence of others' choices can be used to infer positive or negative traits, such as behaviour, resources, or intelligence, that are difficult to judge just from their physical appearance. Learning from others may then be a short-cut to the more costly individual learning of how someone behaves in the long-term.

In conclusion, the experiments presented here extend work on the social transmission of mate preference in humans, demonstrating that women differentially pay attention to the choices of certain individuals to inform their own judgements of attractiveness. Importantly, the degree to which preferences change according to model partner popularity was found to be related to the age of the observer. Younger observers were more likely to have their preferences influenced by model information than older observers (Experiments 1 and 3). The social transmission of mate preference highlights the flexibility of human mate-choice decisions, and model-based bias potentially means that a small number of influential individuals may act as models for large numbers of observers.

References

Amlacher, J., & Dugatkin, L. A. (2005). Preference for older over younger models during mate-choice copying in young guppies. *Ethology, Ecology and Evolution*, *17*, 161–169. doi:10.1080/08927014.2005.9522605

Bauer, G. P., Schlottmann, R. S., Bates, J. V., & Masters, M. A. (1983). Effect of state and trait anxiety and prestige of model on imitation. *Psychological Reports*, *52*, 375–382. doi:10.2466/pr0.1983.52.2.375

Bayliss, A. P., Frischen, A., Fenske, M. J., & Tipper, S. P. (2007). Affective evaluations of objects are influenced by observed gaze direction and emotional expression. *Cognition*, *104*, 644–653. doi:10.1016/j.cognition.2006.07.012

Benson, P. J., & Perrett, D. I. (1993). Extracting prototypical facial images from exemplars. *Perception*, *22*, 257–262. doi:10.1068/p220257

Boyd, R., & Richerson, P. J. (1985). *Culture and the Evolutionary Process*. Chicago, IL: University of Chicago Press.

Brown, G. R., & Fawcett, T. W. (2005). Sexual selection: Copycat mating in birds. *Current Biology*, *15*, R626–R628. doi:10.1016/j.cub.2005.08.005

Dugatkin, L. A. (2000). *The imitation factor: Evolution beyond the gene*. New York: Free Press.

Dugatkin, L. A., & Godin, J. G. J. (1992). Reversal of female mate choice by copying in the guppy (Poecilia-Reticulata). *Proceedings of the Royal Society of London Series B-Biological Sciences*, *249* (1325), 179–184. doi:10.1098/rspb.1992.0101

Dugatkin, L. A., & Godin, J. G. J. (1993). Female mate copying in the guppy (Poecilia-Reticulata)-Age-dependent effects. *Behavioral Ecology*, *4*, 289–292. doi:10.1093/beheco/4.4.289

Eckel, C. C., & Wilson, R. K. (2007). Social learning in coordination games: Does status matter? *Experimental Economics*, *10*, 317–329. doi:10.1007/s10683-007-9185-x

Eva, K. W., & Wood, T. J. (2006). Are all the taken men good? An indirect examination of mate-choice copying in humans. *Canadian Medical Association Journal*, *175*, 1573–1574. doi:10.1503/cmaj.061367

Galef, B. G., & Laland, K. N. (2005). Social learning in animals: Empirical studies and theoretical models. *BioScience*, *55*, 489–499. doi:10.1641/0006-3568(2005) 055[0489:SLIAES]2.0.CO;2

Galef, B. G., & White, D. J. (1998). Mate-choice copying in Japanese quail, *Coturnix coturnix japonica*. *Animal Behaviour*, *55*, 545–552.

Godin, J. G. J., Herdman, E. J. E., & Dugatkin, L. A. (2005). Social influences on female mate choice in the guppy, Poecilia reticulata: Generalized and repeatable trait-copying behaviour. *Animal Behaviour*, *69*, 999–1005. doi:10.1016/j.anbehav.2004.07.016

Henrich, J., & Gil-White, F. J. (2001). The evolution of prestige – Freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. *Evolution and Human Behavior*, *22*, 165–196. doi:10.1016/S1090-5138(00)00071-4

Henrich, J., & McElreath, R. (2003). The evolution of cultural evolution. *Evolutionary Anthropology*, *12*, 123–135. doi:10.1002/evan.10110

Henrich, J., & McElreath, R. (2007). Dual inheritance theory: The evolution of human cultural capacities and cultural evolution. In R. Dunbar & L. Barrett (Eds.), *Oxford handbook of evolutionary psychology* (pp. 555–570). Oxford, UK: Oxford University Press.

Hill, S. E., & Buss, D. M. (2008). The mere presence of opposite-sex others on judgments of sexual and romantic desirability: Opposite effects for men and women. *Personality and Social Psychology Bulletin*, *34*, 635–647. doi:10.1177/0146167207313728

Hoglund, J., Alatalo, R. V., Gibson, R. M., & Lundberg, A. (1995). Mate-choice copying in black grouse. *Animal Behaviour*, *49*, 1627–1633. doi:10.1016/0003-3472(95)90085-3

Jones, B. C., DeBruine, L. M., Little, A. C., Burriss, R. P., & Feinberg, D. R. (2007). Social transmission of face preferences among humans. *Proceedings of the Royal Society B-Biological Sciences*, *274* (1611), 899–903. doi:10.1098/rspb.2006.0205

Kendal, R. L., Coolen, I., van Bergen, Y., & Laland, K. N. (2005). Trade-offs in the adaptive use of social and asocial learning. *Advances in the Study of Behavior*, *35*, 333–379. doi:10.1016/S0065-3454(05)35008-X

Laland, K. N. (2004). Social learning strategies. *Learning and Behavior*, *32*, 4–14. doi:10.3758/BF03196002

Little, A. C., Burriss, R. P., Jones, B. C., DeBruine, L. M., & Caldwell, C. A. (2008). Social influence in human face preference: Men and women are influenced more for long-term than short-term attractiveness decisions. *Evolution and Human Behavior*, *29*, 140–146. doi:10.1016/j.evolhumbehav.2007.11.007

Little, A. C., Caldwell, C. A., Jones, B. C., & DeBruine, L. M. (2011). Effects of partner beauty on opposite-sex attractiveness judgments. *Archives of Sexual Behavior*, *40*, 1119–1127. doi:10.1007/s10508-011-9806-5

Little, A. C., & Hancock, P. J. B. (2002). The role of masculinity and distinctiveness in judgments of human male facial attractiveness. *British Journal of Psychology*, *93*, 451–464. doi:10.1348/000712602761381349

Little, A. C., Jones, B. C., DeBruine, L. M., & Caldwell, C. A. (2011). Social learning and human mate preferences: A potential mechanism for generating and maintaining between-population diversity in attraction. *Philosophical Transactions of the Royal Society B-Biological Sciences*, *366* (1563), 366–375. doi:10.1098/rstb.2010.0192

Little, A. C., Saxton, T. K., Roberts, S. C., Jones, B. C., DeBruine, L. M., Vukovic, J., . . . Chenore, T. (2010). Women's preferences for masculinity in male faces are highest during reproductive age range and lower around puberty and post-menopause. *Psychoneuroendocrinology*, *35*, 912–920. doi:10.1016/j.psyneuen.2009.12.006

Richerson, P. J., & Boyd, R. (2005). *Not by genes alone: How culture transformed human evolution*. Chicago, IL: University of Chicago Press.

Ryckman, R. M., Sherman, M. F., & Rodda, W. C. (1972). Locus of control and expertise relevance as determinants of changes in opinion about student activism. *Journal of Social Psychology*, *88*, 107.

Sigall, H., & Landy, D. (1973). Radiating beauty – Effects of having a physically attractive partner on person perception. *Journal of Personality and Social Psychology*, *28*, 218–224. doi:10.1037/h0035740

Swaddle, J. P., Cathey, M. G., Correll, M., & Hodkinson, B. P. (2005). Socially transmitted mate preferences in a monogamous bird: A non-genetic mechanism of sexual selection. *Proceedings of the Royal Society B-Biological Sciences*, *272*, 1053–1058. doi:10.1098/rspb.2005.3054

Tiddeman, B. P., Burt, D. M., & Perrett, D. I. (2001). Prototyping and transforming facial texture for perception research. *IEEE Computer Graphics and Applications*, *21*, 42–50. doi:10.1109/38.946630

Uller, T., & Johansson, L. C. (2003). Human mate choice and the wedding ring effect: Are married men more attractive? *Human Nature*, *14*, 267–276. doi:10.1007/s12110-003-1006-0

Wade, M. J., & Pruett-Jones, S. G. (1990). Female copying increases the variance in male mating success. *Proceedings of the National Academy of Sciences of the United States of America*, *87*, 5749–5753. doi:10.1073/pnas.87.15.5749

Waynforth, D. (2007). Mate choice copying in humans. *Human Nature*, *18*, 264–271. doi:10.1007/s12110-007-9004-2

White, D. J. (2004). Influences of social learning on mate-choice decisions. *Learning and Behavior*, *32*, 105–113. doi:10.3758/BF03196011

White, D. J., & Galef, B. G. (2000). 'Culture' in quail: Social influences on mate choices of female Coturnix japonica. *Animal Behaviour*, *59*, 975–979. doi:10.1006/anbe.1999.1402

Witte, K., & Ryan, M. J. (2002). Mate choice copying in the sailfin molly, Poecilia latipinna, in the wild. *Animal Behaviour*, *63*, 943–949. doi:10.1093/beheco/8.1.104

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