She's Not One of Us: Group Membership Moderates the Effect of Fertility Cues on Attractiveness Ratings

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Abstract

The ability to differentiate ingroup from outgroup members on the basis of symbolic cues may be unique to Homo sapiens. The current research examined whether meaningful cues of ingroup status moderate ovulatory shifts—a psychological adaptation that likely evolved earlier in humans' evolutionary timeline. Four studies demonstrated that men were more attracted to fertile than nonfertile women's voices only when men were evaluating ingroup members. In Study 1, the fertility of Caucasian, but not Hispanic, women's voices positively predicted 92 Caucasian male students' attraction ratings. Study 2a (N=56) replicated this effect among older participants, and Study 2b (N=233) included a public preregistration and replicated it again. Study 3 replicated the effect in a sample of 47 Caucasian male students, and an experimental manipulation of the targets' school membership produced a conceptual replication. These results stress the utility of considering the phylogeny of human evolution when testing evolutionary hypotheses.

Keywords: phylogeny, ovulation, ingroup preferences, attraction, evolution

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All animals have mental adaptations designed for mating, and humans are no exception. Indeed, an extensive corpus of research suggests that ancient evolutionary influences have left an imprint on modern human mate preferences and behaviors (Buss, 2015). However, unlike other animals, humans must engage in mating behaviors within an ever-changing cultural milieu with complex rules about mating (Eastwick, 2013; Tidwell & Eastwick, 2013; Wood & Eagly, 2002). In order to integrate these perspectives, many psychologists advocate for a phylogenetic approach in evaluating evolutionary hypotheses (Eastwick, 2009; Fraley, Brumbaugh, & Marks, 2005; Gosling & Graybeal, 2007). The phylogenetic perspective maintains that when examining a particular evolved adaptation, researchers should consider the timing of its evolution in relation to other adaptations. One particularly helpful concept emerging from this theoretical orientation is the *adaptive workaround*: When adaptations conflict with one another, those that evolved later in a species' evolutionary history will mute or refocus the function of those that evolved earlier (Eastwick & Durante, 2015). The present research provides evidence for an adaptive workaround by demonstrating that ingroup membership on the basis of symbolic cues (i.e., a recent human adaptation) moderates ovulatory shift effects (i.e., an older adaptation).

The Phylogeny of Ingroup Preferences

The tendency for people to prefer members of their ingroups and disfavor outgroup members are two of the most pervasive and well-researched phenomena in social psychology (Allport, 1954). Brewer (2007) suggests that humans' highly developed preference for ingroup members is a relatively recent development in our evolutionary history. Although many primates are dependent on their social groups, humans rely on ingroup members for survival to a greater

extent than any of our other primate relatives (Baumeister, Ainsworth, & Vohs, 2015; Brewer & Caporael, 2006). Additionally, evidence for ingroup preference exists in all known human cultures, which suggests that this adaptation could be universal (Brewer, 1979; Kurzban, Tooby, & Cosmides, 2001).

This perspective does not suggest that ingroup preferences are unique to humans. Indeed, a great deal of evidence indicates that group distinctions are also present in other primates (e.g., New World monkeys; Pokorny & de Waal, 2009). However, the mechanisms that primates use to determine group membership are qualitatively distinct from those used by humans. Current evidence suggests that Homo sapiens is the only primate that displays prosocial behavior toward anonymous group members (Burkart, Hrdy, & van Schaik, 2009). That is, humans do not need to have previously encountered an individual in order to identify them as an ingroup or outgroup member; instead, humans often use symbols and other visual markers to elicit favoritism toward ingroup members and derogation of outgroup members (Kurzban et al., 2001; Sherif et al., 1961; Tajfel, 1970). Therefore, the ability to identify an unfamiliar target as an outgroup member based on *symbolic* cues such as ethnicity or other group designations is likely unique among humans and probably evolved quite recently in the human lineage alongside the emergence of symbolic culture (i.e., 50,000-100,000 years ago; Mithen, 1996). Thus, ingroup membership could operate as an adaptive workaround that mutes or refocuses older adaptations, including those relevant to the mating domain (Eastwick, 2009).

Ovulatory Shifts in Men's Desire for Women

Some evidence suggests that men exhibit ovulatory shift effects: They find women's odors, voices, and behaviors more appealing when women are fertile (Miller & Maner, 2010b, 2011; Pipitone & Gallup, 2008). Men's adaptations to detect ovulation in women likely first

appeared several million years ago alongside the evolution of ovulatory shift effects in women's desires, long before the emergence of modern Homo sapiens (Gangestad & Garver-Apgar, 2013). Yet humans' recently evolved adaptations that facilitate group living and preferences for ingroup members can provide context for the motivation to avoid outgroup members, and no studies of ovulatory shifts in men's perceptions of women have examined outgroup contexts. Mating with an unknown, untrusted outgroup member poses the risk of introducing disease and other pathogens into one's familial group (Schaller & Murray, 2008; Schaller & Park, 2011). Therefore, not only are men likely to prefer mating with ingroup than outgroup women, but the adaptive workaround concept suggests that any adaptations facilitating the pursuit of fertile women may be refocused under these circumstances to coincide with obligations to group well-being. That is, human males might not show the typical preference for fertile than nonfertile women when evaluating outgroup, as opposed to ingroup, members.[1]

Some research has examined ingroup versus outgroup influences on ovulatory shifts in women's desires, and women do show greater ingroup bias at times of high fertility, perhaps due to a fear of sexual coercion (Navarrete, Fessler, Fleichman, & Geyer, 2009; McDonald, Asher, Kerr, & Navarrete, 2011). Obviously, men do not experience a fertile period as women do and would not bear large reproductive costs if they were sexually coerced. Nevertheless, if the preference for ingroup members is an adaptation that moderates behavior across a variety of domains, its influence may not be specific to women in the sexual domain. Indeed, early human males who engaged in sexual behaviors with outgroup females could have faced risks such as disease transmission or even violent conflict, as outgroup women may be protected by their ingroup men during times of high fertility (Haselton & Gangestad, 2006; Klavina, Buunk, & Pollet, 2011). Therefore, the relatively recent development of group membership on the basis of

symbolic cues could alter the function of previously evolved sexual adaptations that might otherwise lead men to engage in potentially costly mating encounters.

The Current Research

The current article tests whether ingroup membership moderates men's preference for fertile over nonfertile women (i.e., an adaptive workaround) across four studies. We obtained vocal samples from female targets at multiple points across their menstrual cycles and asked male participants to rate the attractiveness of their voices. We hypothesized that target fertility should positively predict men's attraction to perceived ingroup members but not outgroup members. We tested a variety of ingroup manipulations (i.e., ethnicity, minimal group, and university membership) to probe the generalizability of the group moderation effect.

Study 1 Method

Participants

Voice targets. Vocal samples from 18 naturally cycling female undergraduate students served as stimuli. Nine of these women reported English as their primary language, and the remaining nine reported Spanish as their primary language. The average age of these 18 women was 18.55 years (*SD*=.80), and their average menstrual cycle length was 28.8 days (*SD*=3.10). These women were randomly selected from a larger sample of 77 women who provided vocal samples; the vocal recordings of women who reported irregular menstrual cycles, speech or hearing deficiencies, and/or smoking were excluded (*N*=14).

Voice raters. Ninety-two Caucasian male participants were recruited through the psychology department subject pool to serve as raters. Our goal for data collection (i.e., the "stopping rule") was to obtain as many participants as possible by the end of the semester. The average age of these men was 18.94 years (*SD*=1.00), and all reported American English as their

primary language. Men who reported short or long-term hearing loss, heterosexuality less than 2 on a 9-point-scale, and/or race other than Caucasian during a prescreening process were excluded from participation.

Procedure, Materials, & Measures

Female voice recordings. The 18 female participants were scheduled to attend 4 study sessions, each spaced one week apart, to ensure that each participant would provide a vocal sample at multiple points of fertility across her cycle (Pipitone & Gallup, 2008). During the first experimental session, participants reported demographics measures, including age, ethnicity, and primary language. Each of the four study sessions included a questionnaire assessing whether participants "currently use any form of hormonal contraception," the length of their menstrual cycle, and the date they began their previous menstrual period. We used this information to calculate each target's conception probability using the "forward count" method (Gangestad & Thornhill, 1998; Little, Jones, Burt, & Perrett, 2007). Participants then provided vocal recordings by reading the first 6 sentences of the "Rainbow Passage" in English (Fairbanks, 1960). Voice samples were gathered using MediaLab software.

Six of the 18 female participants only attended 3 of their 4 scheduled sessions, producing a total of 66 (instead of 72) vocal stimuli. We created 4 stimulus groups comprising 16-17 recordings, and each male participant only rated one stimulus group to keep the study within the 30-minute limit for one experimental time slot. Only 1 of each female participant's 4 recordings was included in each stimulus group, and each group consisted of roughly equivalent numbers of vocal recordings from English and Spanish primary language groups. Also, each stimulus group exhibited the full range of fertility scores.

Male raters. All ratings by male participants were provided in a single study session. Raters first completed a demographics questionnaire and then rated each stimulus on a two-item measure of vocal attractiveness using a 7-point scale: "How attractive did you find the voice you just heard?" and "How sexy did you find the voice you just heard?" (α=.94, *M*=4.57, *SD*=1.93).

Study 1 Results & Discussion

Each male participant provided 16-17 vocal attraction ratings, which violates the ordinary least squares assumption that observations are independent; thus, we conducted linear mixed effects model and permitted the intercept to vary randomly across raters (Raudenbush & Bryk, 2002). Additionally, we controlled for which of the four groups of vocal stimuli the participant had been assigned.[2]

We hypothesized that participants would rate only ingroup targets as particularly attractive as target fertility increased. As predicted, the Target Conception Probability × Target Ethnicity interaction significantly predicted vocal attraction ratings, β= -.12, t(1424.33)= -5.68, p<.001 (Figure 1). Male participants rated the same-ethnicity target voices as significantly more attractive as the targets' fertility increased, β=.17, t(1424.33)=5.71, p<.001. Intriguingly, participants rated the other-ethnicity targets as significantly *less* attractive as the targets' conception probability increased β= -.08, t(1424.33)= -2.41, p=.016. We also examined the simple effects of target ethnicity; raters found same-ethnicity targets more attractive than the other-ethnicity targets when the target's conception probability was low (.00), β= -.31, t(1424.33)= -10.49, p<.001; medium (.04), β= -.49, t(1424.33)= -20.24, p<.001; and high (.08), β= -.67, t(1424.33)= -14.02, p<.001. In summary, results from Study 1 supported the hypothesis that target group status interacted with target fertility to predict attraction, such that male

participants found only ingroup members' vocal samples more attractive as the targets' fertility increased.

Study 2a & 2b Method

Study 2a was conducted to replicate the results of Study 1 in an older, non-student sample and to explore whether a subtle, experimentally-induced ingroup manipulation would interact with female targets' fertility to produce a similar effect. Study 2b was a preregistered direct replication of Study 2a (https://osf.io/ane7w/).

Participants

Participants were adult males recruited through Amazon's Mechanical Turk. All analyses were performed on *N*=56 (Study 2a) and *N*=233 (Study 2b) Caucasian male participants who reported English as their primary language. These numbers were reached by excluding ineligible participants based on one or more of the following criteria before any analyses were conducted: short- or long-term hearing loss (*N*=8 in Study 2a; *N*=10 in Study 2b); problems hearing the stimuli (*N*=4 in Study 2a; *N=8* in Study 2b); reported heterosexuality less than 2 on a 9-point scale (*N*=7 in Study 2a; *N*=23 in Study 2b); reported race other than Caucasian (*N*=26 in Study 2a; *N*=142 in Study 2b); reported participating in this study or a similar one previously (*N*=1 in Study 2b). After these exclusions, the 56 Caucasian participants in Study 2a were *M* = 29.38 years old (*SD*=8.52) and the 233 Caucasian participants in Study 2b were *M*=32.80 years old (*SD*=10.54).

Procedure & Materials

The ratings procedure was similar to that of Study 1; participants rated the same voice samples that were re-randomized, but we added a new minimal-group manipulation (McDonald et al., 2011). Participants first read about (bogus) research showing that people tend to

overestimate the number of objects they have seen whereas others tend to underestimate. Then, participants viewed three grids of blue and yellow squares for approximately two seconds each. They were then asked to estimate the percentage of blue squares that appeared in each grid. Participants were randomly assigned to a designation of overestimator or underestimator. This manipulation will hereafter be referred to as "Target Minimal Group."

Then, male participants rated one of the four stimulus groups. In each stimulus group, vocal stimuli were randomly assigned to be presented as either an overestimator or underestimator. This minimal-group manipulation ensured that participants perceived half of the stimuli they heard to be ingroup members and half to be outgroup members given their supposed estimation performance. Both manipulations of ethnicity and minimal-group (i.e., estimation performance) status were orthogonal, such that equivalent numbers of stimuli from both ethnic groups were assigned to each condition of the minimal group manipulation.

Participants rated each vocal sample within their assigned stimulus group on a 3-item measure of general attractiveness (i.e., "How attractive did you find the voice you just heard?", "How appealing did you find the voice you just heard?", "How sexy did you find the voice you just heard?"; α=.95, *M*=5.25, *SD*=1.96 in Study 2a; α=.95, *M*=4.99, *SD*=1.90 in Study 2b).

Study 2 Results

The 3-way interaction of Target Conception Probability × Target Ethnicity × Target Minimal Group did not significantly predict vocal attraction in either Study 2a, β= -.03, t(705.10)= -.82, p=.410, or Study 2b, β= -.00, t(3541.95)= -.04, p=.967. Therefore, we examined the two ingroup manipulations separately.

In a replication of Study 1, the Target Conception Probability × Target Ethnicity interaction significantly predicted vocal attraction ratings in both Study 2a, β= -.10, t(698.04)= -

3.38, p=.001 (Figure 2) and Study 2b β= -.11, t(3391.05)= -7.74, p=.000 (Figure 3). Specifically, as the Caucasian targets' fertility increased, Caucasian male participants rated their voices as significantly more attractive in both Study 2a, β= .09, t(698.60)=2.14, p=.033 and Study 2b, β= .13, t(3393.53)=6.33, p=.000. However, as Hispanic targets' conception probability increased, male participants judged them as significantly less attractive in both Study 2a, β= -.11, t(705.27)= -2.66, p=.008, and Study 2b, β= -.10, t(3394.78)= -4.60, p=.000. As in Study 1, simple effect analyses in Study 2a demonstrated that participants rated same-ethnicity targets as significantly more attractive than other-ethnicity targets at times of low (.00), β= -.11, t(701.29)= -2.81, p=.005; medium (.04), β= -.27, t(699.64)= -7.24, p=.000; and high (.08), β= -.42, t(700.39)= -5.76, p=.000 conception probability. The same pattern of results held for Study 2b across low β= -.12, t(3393.89)= -6.21, p=.000; medium (.04), β= -.29, t(3394.02)= -17.83, p=.000; and high (.08), β= -.45, t(3394.11) = -14.14, p=.000 conception probability.

We also examined the effect of the new minimal group manipulation. The interaction of Target Conception Probability × Target Minimal Group did not predict vocal attraction ratings in either Study 2a, β= -.01, t(708.68)= -.22, p=.824 or Study 2b, β=.00, t(3501.47)= -.08, p=.935. Also, the main effect of group status was not significant in either Study 2a, β= .03, t(698.64)= .83, p=.407, or Study 2b, β= -.01, t(3394.09)= -.50, p=.619, which could suggest that novel group membership information is not meaningful enough to elicit the predicted effect.

Studies 2a and 2b replicated the Study 1 ethnicity-moderation effect using Mechanical Turk samples, but our hypothesis that a minimal group manipulation would elicit a similar result was not supported. On the one hand, the fact that significant interactions with fertility emerged for ethnicity but not minimal group status could suggest that the moderating effect we documented in Studies 1 and 2 was due to ethnicity (or accented speech) rather than group status

per se. On the other hand, the minimal group manipulation may not have been personally relevant enough to produce an effect for participants; indeed, the main effect of this manipulation was extremely small and not in the predicted direction. Study 3 provided yet another replication of the ethnicity moderation effect and examined a highly personally relevant manipulation of group status: rival university membership. If this alternative manipulation significantly moderates the effect of fertility on men's attraction, it would suggest that the group membership adaptive workaround documented in this article extends beyond ethnic groups to encompass personally chosen, highly self-relevant groups.

Study 3 Method

Participants

Participants were 47 Caucasian male college students whose primary language was American English. They ranged from 18 to 22 years of age (M=19.13, SD=0.88). All raters were recruited through a university subject pool for course credit. Men who reported short or long-term hearing loss, heterosexuality less than 2 on a 9-point-scale, and/or race other than Caucasian during a prescreening process were not eligible to participate. Our goal before data collection began was to collect as many participants as possible before the end of the semester.

Procedure and Materials

The ratings procedure was very similar to that of Study 1 and 2. Participants were assigned to 1 of 4 stimulus groups (re-randomized again) and rated 16 or 17 vocal samples on a one-item measure of vocal attraction (i.e., "How attractive did you find the voice you just heard?"; M=4.95, SD=1.94). As in Study 2, participants were exposed to an additional ingroup manipulation task. In this study, however, participants initially were told that half of the voice samples they would hear were gathered from students currently attending their own university

(Texas A&M University), and the other half were gathered from students attending a rival school (the University of Texas). From the perspective of Texas A&M University students, this rivalry is particularly contentious; for example, students routinely "hiss" when professors mention the University of Texas in the classroom. As participants listened to each vocal sample, one of the two school logos was displayed on the computer screen, indicating whether the target was from the participant's ingroup (same-school) or outgroup (other-school); school assignment was in fact random. Equivalent numbers of both same-ethnicity and other-ethnicity samples were designated as same-school and other-school within each of the 4 stimulus groups. Thus, just as in Studies 2a and 2b, these two ingroup/outgroup manipulations (i.e., ethnicity and school) were orthogonal.

Study 3 Results

First, the 3-way interaction of Target Conception Probability × Target Ethnicity × Target School did not significantly predict vocal attraction, β=.05, t(729.13)=1.43, p=.153. Thus, we then examined the two ingroup vs. outgroup effects separately.

Replicating Studies 1, 2a, and 2b, the Target Conception Probability × Target Ethnicity interaction significantly predicted vocal attraction ratings, β= -.11, t(729.10)= -3.52, p=.001 (Figure 4). Again, as same-ethnicity targets' conception probability increased, male participants rated their voices as significantly more attractive, β=.13, t(729.20)=3.01, p=.003. Additionally, raters judged the other-ethnicity targets as significantly less attractive as their conception probability increased, β= -.09, t(729.02)= -2.01, p=.045. We also replicated the simple effects from Studies 1, 2a, and 2b such that raters found same-ethnicity targets more attractive than the other-ethnicity targets when the target's conception probability was low (.00), β= -.27,

t(729.05)= -6.15, *p*<.001; medium (.04), *β*= -.43, *t*(729.04) = -12.14, *p*<.001; and high (.08) *β*= -.59, *t*(729.09)= -8.48, *p*<.001.

The interaction of Target Conception Probability × Target School significantly predicted vocal attraction ratings, *β*= -.08, *t*(729.13)= -2.28, *p*=.023 (Figure 5). Male participants rated the same-school target voices as significantly more attractive as the targets' conception probability increased *β*=.10, *t*(729.04)=2.05, *p*=.040. However, participants did not rate the other-school targets as significantly more or less attractive as targets' conception probability increased, *β*= -.06, *t*(729.23)= -1.21, *p*=.226. Raters found the same-school targets significantly more attractive than the other-school targets when targets' conception probability levels were medium (.04), *β*= -.08, *t*(729.04)= -2.01, *p*=.036; and high (.08), *β*= -.20, *t*(729.12)= -2.57, *p*=.01. However, participants did not evidence a significant effect of school when conception probability was low (.00), *β*=.04, *t*(729.08)=.78, *p*=.437.

General Discussion

Together, these studies suggest the existence of an adaptive workaround such that group membership refocuses ovulatory shift effects. Although some previous research has examined how group membership cues and ovulatory shifts interact to predict women's ratings of male targets (e.g., McDonald et al., 2011; Navarette, et al., 2009), the current four studies are—in our laboratory and (to our knowledge) beyond—the only tests of this phenomenon in men's ratings of women. We also conducted a fixed effect meta-analysis of the four ethnicity × fertility moderation effects across studies, which are the only four studies we conducted on this topic (i.e., there is nothing in the file drawer). Results revealed a significant interaction, *β*=-.11, 95%CI(-.13, -.09), *z*=10.75, *p*<.001, a significant positive fertility effect on attraction for men rating ingroup women, *β*=.13, 95%CI(.10, .16), *z*=9.15, *p*<.001, and a significant negative

fertility effect on attraction for men rating outgroup women, β=-.09, 95%CI(-.12, -.06), z=6.13, p<.001.

Study 1 demonstrated the proposed effect using a very salient form of group membership, ethnicity, as evidenced by foreign accented speech. Studies 2a and 2b suggested that this effect is generalizable to an older sample and again replicated the basic finding that target ethnicity and target fertility interact to predict Caucasian men's enhanced attraction to fertile targets who share their ethnicity. Study 3 replicated the basic effect of Studies 1, 2a, and 2b but also provided evidence that another salient form of group membership (selected university) produces a similar effect. However, Studies 2a and 2b showed that a subtle manipulation of group status—a minimal group manipulation—did not produce the effect, indicating a boundary condition. Perhaps only meaningful cues of group status, such as ethnicity and chosen groups, elicit these effects. Therefore, these results could suggest that only subjectively meaningful markers of group status interact with fertility to predict attraction.

Limitations & Strengths

In the current academic climate, researchers increasingly recognize the benefits of providing full and accurate reporting of study results (Simmons, Nelson, & Simonsohn, 2011). Therefore, in the interest of scientific transparency, we would like to highlight the two "most damning results" of these studies (Vazire, 2015).

The first is that one of our hypotheses was not supported; in Studies 2a and 2b, the minimal group manipulation did not interact with fertility to predict attraction. Because the main effect of minimal group was not significant, this null effect could suggest that the manipulation was ineffective or that the ingroup moderation effect only extends to groups that are personally meaningful (e. g., personally chosen groups, ethnicity). We have no clear rationale for why

minimal group manipulations would be ineffective in this context but commonly predict ingroup preferences across other studies (e. g., McDonald et al., 2011; Tajfel, 1970).

The second concerns an auxiliary analysis conducted on Hispanic male participants' data from Study 2b (please see online Supplementary Materials). In this analysis, Hispanic male participants showed the same pattern of results as Caucasian male participants. That is, Hispanic male participants also preferred Caucasian female targets at times of high conception probability. Thus, the moderational effect documented for target ethnicity across studies is possibly not only about ingroup membership but also about perceived group status. The results of all four studies could be reinterpreted through this lens; in Study 3, men from Texas A&M may see other A&M students as higher status than University of Texas students. Importantly, the group status explanation is still an adaptive workaround effect; the evolution of the concept that some groups have more status than others would logically have evolved at the same late date (or later) as the emergence of ingroup/outgroup concepts. Alternatively, perhaps these particular vocal samples do not provide a clean test of the adaptive workaround hypothesis for Hispanic men. The Hispanic men in Study 2b were bilingual (i. e., fluent in English and Spanish) and evaluating Hispanic women speaking English, which may not be as strong an ingroup cue as for Caucasian men rating Caucasian women speaking English. A proper test of the ethnicity moderation hypothesis in Hispanic men would require vocal samples of Hispanic and Caucasian women reading in Spanish. Future studies should examine whether these effects persist in non-American and non-English speaking samples that are more representative of the population as a whole.

One possible alternative explanation for the current results is that participants may be able to process subtle fertility cues only in accents with which they are familiar and comfortable. For example, perhaps native English speakers cannot process the information communicated by

native Spanish speakers effectively, causing the subtle hints of ovulation present in the Spanish speakers' vocal samples to remain unnoticed. Future research should examine whether other methods for producing ovulatory effects (e.g., scent, facial attractiveness) can elicit similar outgroup moderation effects. Additionally, future research should include different manipulations of group status to determine the precise conditions under which this pattern of effects will emerge.

One possible direction for future research is examining the mechanisms underlying these effects. Previous researchers have suggested that fertile women are especially avoidant of outgroup men due to fears of coercion (Broder & Hohmann, 2003). However, men would not experience the same degree of reproductive costs if they were sexually coerced and therefore perhaps avoid sexual behaviors with highly fertile outgroup members in order to mitigate other risks, such as disease transmission or violent conflict with rival outgroup men (Klavina, Buunk, & Pollet, 2011; Navarrete & Fessler, 2006).

Despite their shortcomings, these studies have several strengths. Although previous research has examined the influence of conception probability on vocal attraction, this set of studies is the first to examine how variations in language and accents can affect vocal preferences. Also, the participants selected for Studies 2a and 2b were relatively diverse (i.e., in terms of age and location within the U.S.) compared to many studies within this area of research. Additionally, the vocal samples used in all four studies were gathered from each vocal target over the course of four weeks, which is more intensive than the typical technique of comparing preferences of target samples taken either at high or low fertility (i.e., one of two possible time points; Feinberg et al., 2006). This method allowed for a more detailed assessment of preference variations due to fertility by collecting evaluations of each target at multiple time points instead

of relying on a strictly between-subjects design (Pipitone & Gallup, 2008). Finally, all analyses remained significant when controlling for men's judgments of the targets' assumed education level, career achievements, income levels, social class, speech errors, and recording quality; please see supplemental online analyses for further detail.

Conclusions

By documenting moderators of sexual adaptations (e.g., ovulatory shifts), researchers can gain a fuller understanding of the range of circumstances in which these features influence behavior and preferences. Some researchers have posited that the ovulatory adaptations that originally facilitated mating may since have been repurposed for use by other systems (Diamond & Wallen, 2011; Eastwick & Finkel, 2012). In men, the reproductive benefit of detecting ovulation in women is clear (Gangestad & Thornhill, 2008). However, the current finding that higher fertility is not always associated with increased attraction suggests that ovulation may not simply function as a straightforward mating cue for men. One additional study found support for this idea, showing that partnered men had a decreased preference for fertile (vs. nonfertile) potential partners (Miller & Maner, 2010a). Similarly, in all four of the current studies, fertility *negatively* predicted attraction to other-ethnicity outgroup members; these findings collectively suggest that, consistent with the adaptive workaround concept, ovulatory shift detection in men actually serves an avoidance function under certain circumstances.

In summary, these results illustrate how evolved characteristics that are not inherently unique to mating can affect sexual adaptations, which suggests the utility of the phylogenetic approach to understanding human evolution (i.e., that newly evolved adaptations for human culture can moderate earlier adaptations; Eastwick, 2009). Importantly, these findings could also have potentially meaningful implications for real-world settings: Although social psychologists

have long been concerned with detecting subtle forms of outgroup derogation (e.g., Allport, 1954), relatively little work seeks to identify potential biological moderators of this effect in the mating domain. By continuing to apply evolutionary perspectives to the study of ingroup vs. outgroup preferences, researchers can potentially identify solutions that help mitigate prejudice and discrimination within mating contexts (Gaines & Leaver, 2002).

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Footnotes

[1] The prediction that human males would avoid mating with outgroup members runs counter to some current views, which suggest that men should find outgroup women particularly appealing at times of high fertility to reap the genetic benefits of mating with a nonfamily member (Garver-Apgar, Gangestad, Thornhill, Miller, & Olp, 2006).

[2] Conclusions were identical when this control variable was deleted.

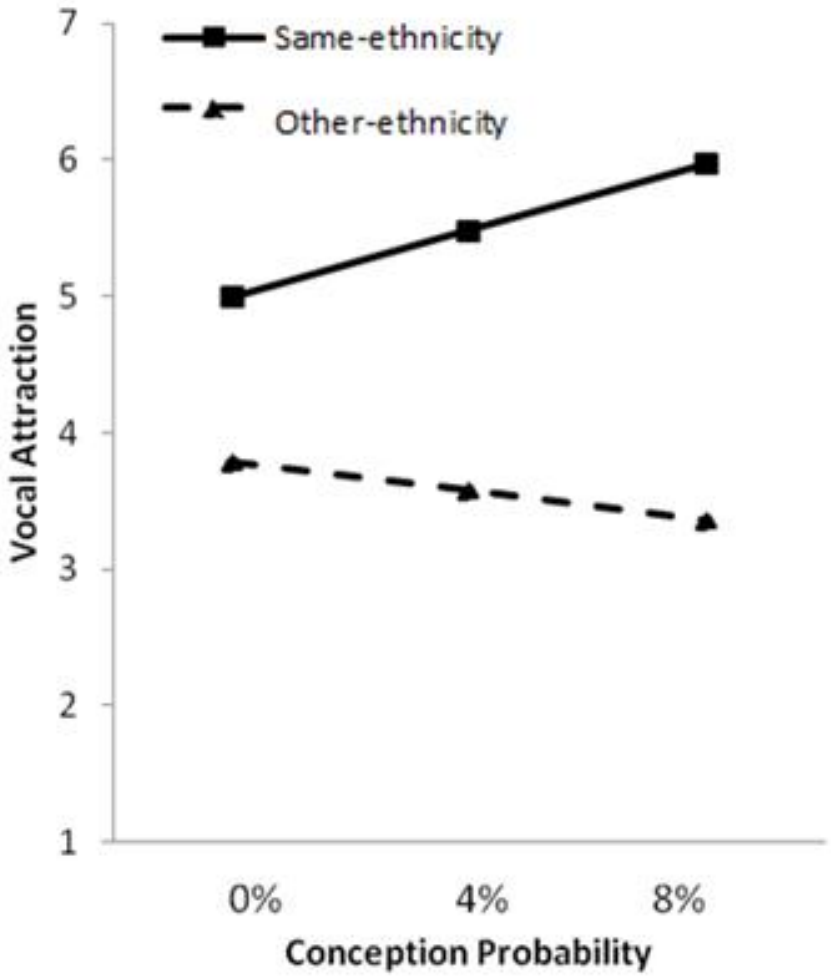

Figure 1. Vocal attractiveness ratings as a function of targets' ethnicity and probability of conception in Study 1. Conception probability percentage is an estimate of the likelihood of conception following one instance of sexual intercourse; see Wilcox et al., 2001.

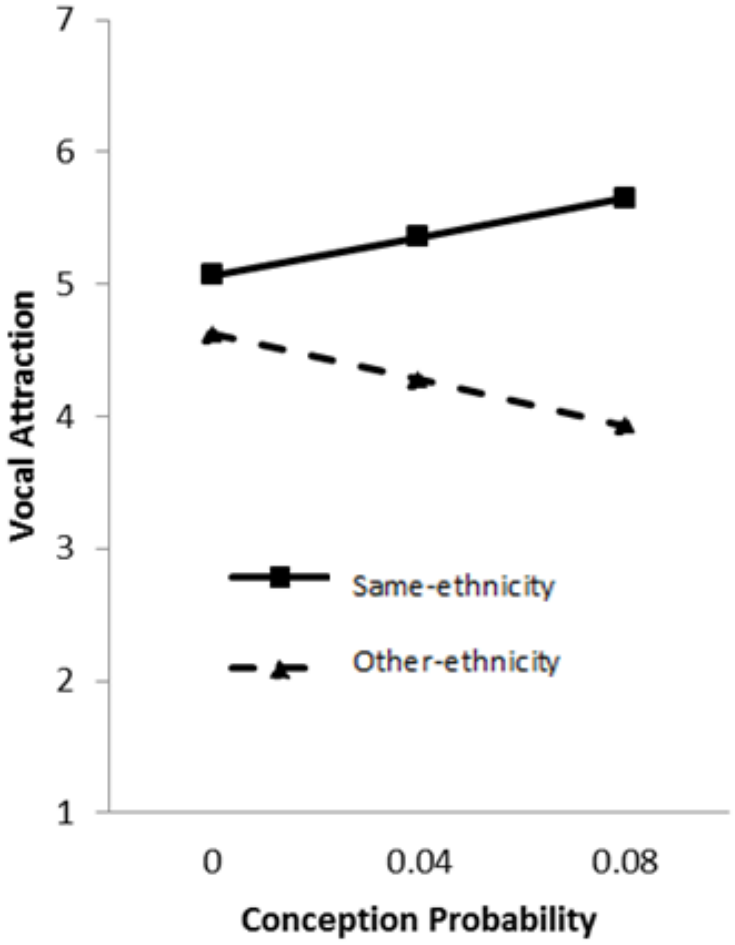

Figure 2. Vocal attractiveness ratings as a function of targets' ethnicity and probability of conception in Study 2a. Conception probability percentage is an estimate of the likelihood of conception following one instance of sexual intercourse; see Wilcox et al., 2001.

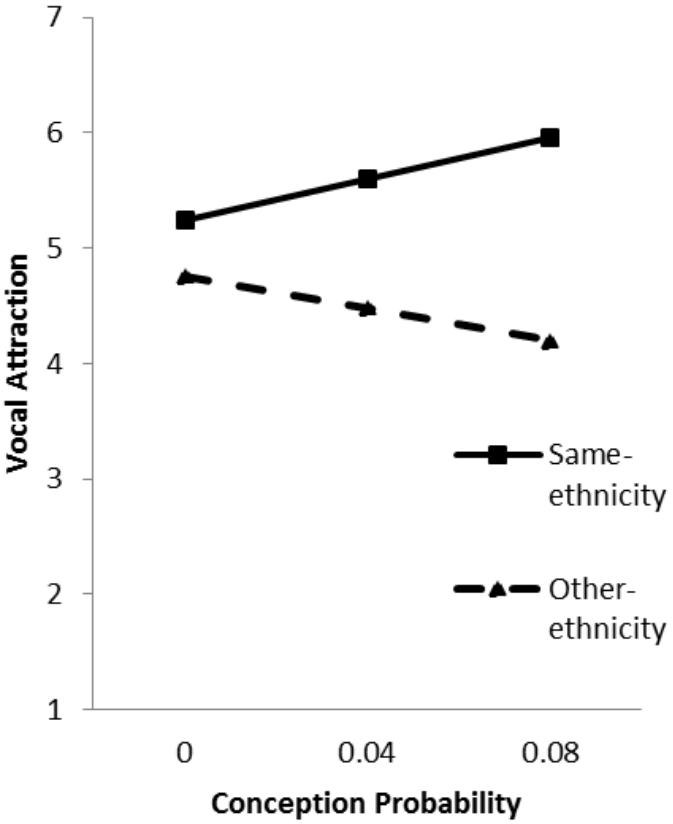

Figure 3. Caucasian participants' vocal attractiveness ratings as a function of targets' ethnicity and probability of conception in Study 2b. Conception probability percentage is an estimate of the likelihood of conception following one instance of sexual intercourse; see Wilcox et al., 2001.

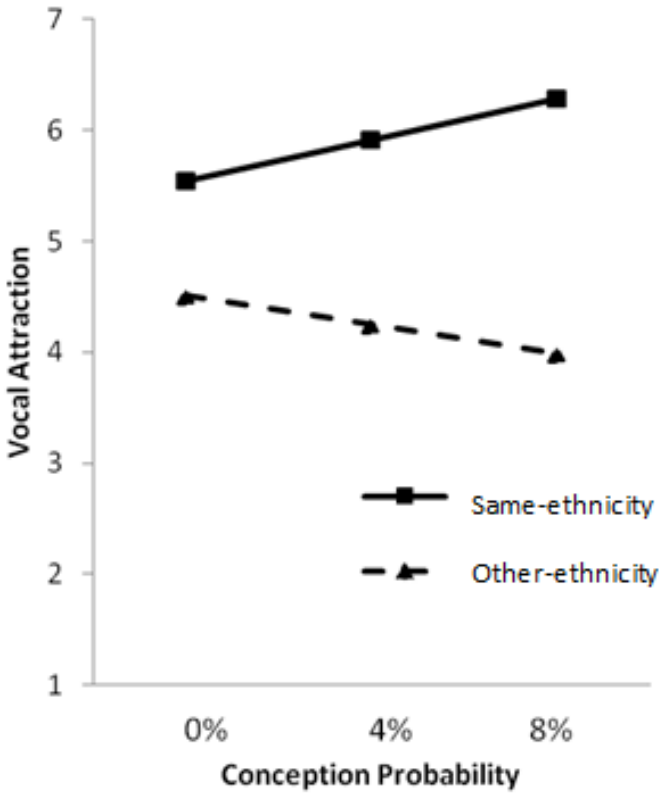

Figure 4. Vocal attractiveness ratings as a function of targets' ethnicity and probability of conception in Study 3. Conception probability percentage is an estimate of the likelihood of conception following one instance of sexual intercourse; see Wilcox et al., 2001.

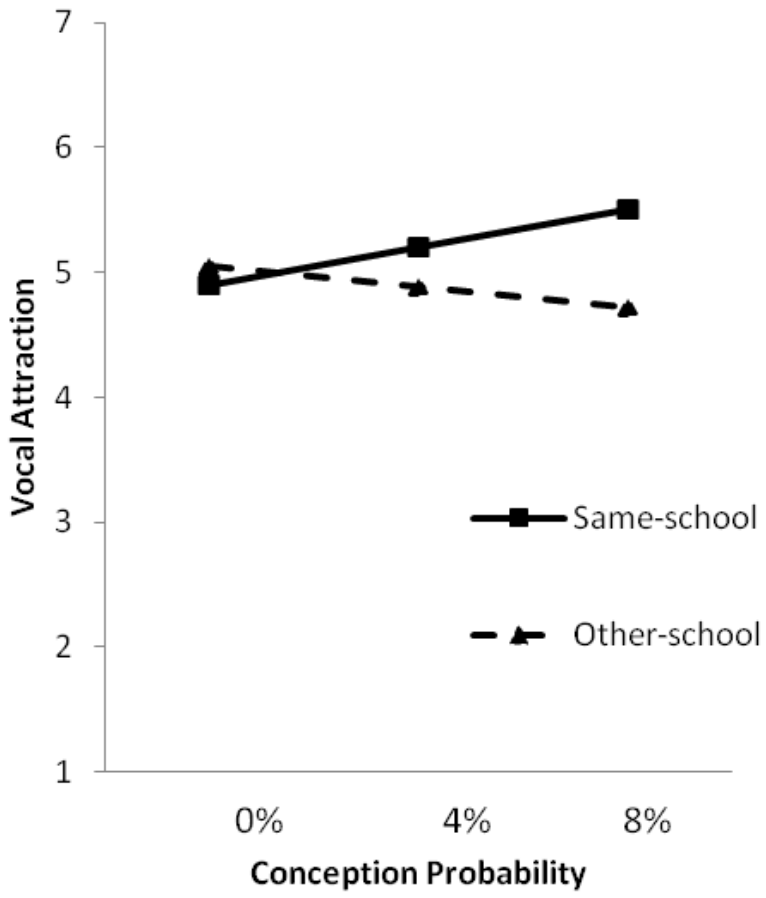

Figure 5. Vocal attractiveness ratings as a function of targets' school and probability of conception in Study 3. Conception probability percentage is an estimate of the likelihood of conception following one instance of sexual intercourse; see Wilcox et al., 2001.