Women's behavioural engagement with a masculine male heightens during the fertile window: evidence for the cycle shift hypothesis ☆

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Abstract

Previous research suggests that women may alter their behaviour during the fertile window of the menstrual cycle to attract a mate who has traits that indicate high-quality genes. We tested whether fertile women demonstrate greater behavioural engagement with a masculine compared to a less masculine male. The test was performed using a quiz show paradigm, in which a male host asked female participants general knowledge questions. The masculinity of the host was varied between participants. Women's performance on the quiz, as well as their romantic attraction to the host, was examined in relation to women's estimated cycle phase and host masculinity. Fertile compared to nonfertile women were more romantically attracted to the host and were faster to answer his questions, but only when he was portrayed as masculine. The results of the study are interpreted as being in keeping with Gangestad and Thornhill's cycle shift hypothesis (Menstrual cycle variation in women's preferences for the scent of symmetrical men. *Proceedings of the Royal Society of London B: Biological Sciences*, 1998;265:727–733. doi:10.1098/rspb.1998.03801998).
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1. Introduction

Estrus, or a period of heightened sexual receptivity in females, was once thought to be lost in women (see Thornhill & Gangestad, 2008 for a historical review). Physical markers of estrus are visually apparent in other animals—swelling and engorgement of the external genitalia are seen in lemurs and chimpanzees, and a blistering chest patch is displayed by gelda gibbons, as examples. Accumulating evidence, however, indicates that women's behaviour also varies across the menstrual cycle. Fertile women are more likely than their counterparts to shop for items to enhance their physical attractiveness (Hill & Durante, 2009), prefer sexually provocative clothing (Durante, Li, & Haselton, 2008), and accept a romantic overture from a man whom they have just met (Gueguen, 2009a, 2009b). Findings such as these results raise the following question: What purpose do these fertility-associated behavioural changes serve?

According to the cycle shift hypothesis, women have evolved psychological tendencies to prefer, particularly during the fertile phase of the menstrual cycle, men who have traits that indicate high-quality genes (Gangestad & Thornhill, 1998; Thornhill & Gangestad, 1999; also see Thornhill & Gangestad, 2008 for a review). When fertile, women should be especially attracted to men who have traits that indicate ostensibly genetic benefits for offspring. Thornhill and Gangestad (2008) maintain that extant research findings support the cycle shift hypothesis. Fertile compared to nonfertile women are more likely to prefer the scent of symmetrical men (Gangestad &Thornhill, 1998) as well as the scent of socially dominant men (Havlicek, Roberts, & Flegr, 2005). Fertile women compared to their counterparts also show stronger preferences for masculine faces (Penton-Voak & Perret, 2000), taller men (Pawłowski & Jasien ska, 2005), and men who behave dominantly (Gangestad, Garver-Apgar, Simpson, & Cousins, 2007; Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004; Lukaszewski & Roney, 2009). These traits may indicate

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genetic quality. For instance, facial symmetry is associated with better genetic, physical, and mental health (Furlow et al., 1997; Thornhill and Møller, 1997; Yeo et al., 2000). Therefore, Thornhill and Gangestad (2008) argue, shifts in women's mate preferences across the menstrual cycle are adaptations that function to increase women's attraction to men who have traits that indicate good genetic quality.

One limitation of previous studies is that women's mate preferences have been measured using women's self-report ratings rather than their actual behaviour toward the opposite sex. The two studies that we know of that looked at women's actual behaviour in relation to menstrual cycle phase found that fertile women compared to their counterparts are more likely to comply with a romantic overture from a man (Gueguen, 2009a, 2009b). However, since the features of the male were not varied systematically in this study, it is currently not known whether fertile women behaviourally engage differently with a man depending on whether he has traits that are indicative of high-quality genes.

The current study examined whether women's behavioural engagement with a male varied in relation to their fertility and the male's level of masculinity. A quiz show paradigm was employed, in which a male host asked the participant general knowledge questions. The quiz show paradigm was utilized because it enabled us to measure behavioural engagement in an unobtrusive and circumspect manner. The masculinity of the host was varied between participants. Behavioural engagement with the host was measured by determining the speed with which women responded to the host's questions and the number of answers that they got correct. If response speed indexes level of behavioural engagement with the host, then ovulating women should answer the quiz show questions faster and more accurately than their counterparts if the host is portrayed in more masculine terms.

We also tested whether women demonstrated higher levels of behavioural engagement when they were romantically attracted to the host, regardless of cycle phase. Towards this end, women rated their romantic attraction to the host following the quiz show. When women are ovulating, they should be more romantically attracted to the host if he is portrayed as masculine rather than less masculine.

2. Method

2.1. Participants

Prior to their enrolment in the study, women were prescreened using an online questionnaire, which contained items for measuring menstrual cycle phase (please see below). Participants were told that the purpose of the prescreening questionnaire was to obtain information about their "general health and well-being" to generate questions for a quiz show that would be hosted by the University. The real purpose of the prescreening, however, was to ensure that

there would be an adequate number of fertile women across the experimental conditions. To support the cover story that participants were told, the questionnaire had 10 filler items (e.g., How many hours a night on average do you sleep? Do you ever have headaches? How often do you feel stressed?). When feasible, given the experimenters' and participant's schedules, women were scheduled to complete the study during the fertile phase of their cycle. Women who reported irregular menstrual cycles or who were using hormone-based contraceptives were not enrolled.

The recruitment procedure resulted in a total of 106 female students (age M=20.32 years) from the University of Leicester. They participated for course credit. Of these women, 42.5% were in the fertile phase of their menstrual cycle.

2.2. Stimuli and procedure

The participant was told that the University was auditioning a male actor to host a quiz show to promote student health and safety awareness. Her role was to help the University select the show's host. The participant was randomly assigned to read one of two curriculum vitas (CVs) that had been purportedly submitted by the male actor as part of his audition. The "Hobbies and Personal Interests" section was used to describe the host in more or less masculine terms, and this section varied between the two versions of the CV. In the masculine version, the male actor played rugby, lifted weights, and danced for a male dance troupe. In the less masculine version, the male actor played the flute, designed clothes, and danced for a male ballet company. The two CVs were otherwise identical, listing the male actor's education and acting experience. There were 25 fertile and 32 nonfertile women randomly assigned to the masculine host condition, and 20 fertile and 29 nonfertile women randomly assigned to the less masculine host condition.

The participant was then shown a video of the actor auditioning for the role of host. The host's behaviour was standardized via video presentation because previous research suggests that men's behaviour toward women may be influenced by women's fertility status (Haselton & Gangestad, 2006; Miller, Tybur, & Jordan, 2007). Participants were told that they would be playing the quiz show and rating his performance. The actor read 20 general knowledge questions. (Examples of questions included the following: True or false: Keratin is present in your mouth and helps you break to down food. What is your body's largest organ? What organ produces insulin?) After each question was read, the participant rang a bell when she knew the answer and then answered the question out loud. Her response latency was automatically recorded. If she got the answer correct, a point was assigned under her name, which was written on a white board that was displayed in front of her.

Women completed a postquiz questionnaire. As a check on the masculinity manipulation, one question asked participants to rate the host's masculinity (Do you think

the host is masculine?). The questionnaire also contained items asking the participant to rate her romantic attraction to the host (Do you think you and the presenter would make a good couple? Would you say that you and the male presenter would generally be compatible? Could you see yourself in a romantic relationship with the male presenter?). Additionally, women rated the likeability of the host as well as how attractive they found his physical appearance. All ratings were all made on a 5-point scale (anchored at 1, *strongly disagree*, and 5, *strongly agree*).

2.3. Measures and data analysis

Fertility was estimated based on women's self-reported menstrual cycle data. Previous research indicates that self-reports of menstrual cycle phase can be unreliable (Small, Manatunga, & Marcus, 2007). Therefore, to assess the validity of the fertility estimates, three measures of fertility were computed in order to cross-validate the results. If the results are robust, then the relationship between fertility and the outcome measures should be consistent across the three fertility measurement methods. First, following the procedures developed by other researchers for estimating ovulation (e.g., Gangestad & Thornhill, 1998; Miller, Tyber, & Jordan, 2007), *cycle phase* was measured by counting forward from the woman's first day of her menstrual period to the day on which the woman participated in the study. Women who were on days 9–15 of their cycle were deemed to be in the fertile phase, whilst the others were deemed to be in a nonfertile phase. Second, since previous research indicates that cycle days 16–19 may not be low-risk conception days (Wilcox, Dunson, Weinberg, Trussell, & Baird, 2001), women who were on cycle days 16–19 were dropped from the nonfertile category. That is, for the second fertility estimate, women who were on days 9–15 of the cycle were deemed to be in the fertile window, whereas women on days 1–8 and days 20–28 were deemed nonfertile, and women who were on days 16–19 of the menstrual cycle were excluded from the measure ($N=12$: $n=7$ masculine condition and $n=5$ less masculine condition). Third, the validity of the self-report menstrual cycle data would be strengthened if behavioural engagement with the host was found to increase along with conception risk. Therefore, conception risk ($M=.04$, S.D.$=.03$) was estimated based on cycle day using actuarial data from Wilcox et al. (2001).

Behavioural engagement was measured by averaging each woman's *response speed* across the 20 quiz questions as well as by her *response accuracy*, or the total number of correct answers given. *Romantic attraction* was measured by averaging across the items that assessed the participant's attraction to the host ($\alpha=.75$).

All of the outcome measures were found to be normally distributed. Hence, the hypotheses were tested using the general linear model. Each of the dependent variables was submitted to a 2 (fertility phase)×2 (host masculinity) analysis of variance. Significant interaction effects were examined further with simple effects analysis. Effects sizes were estimated using ω^2 and Cohen's d. Alpha was set to .05 in all analyses.

3. Results

3.1. Preliminary analyses

The masculinity manipulation worked as intended. The actor was rated as significantly more masculine in the masculine host condition compared to the less masculine host condition ($M=3.20$ and $M=2.63$, respectively), $t(104)=3.16$, $p<.01$, two-tailed ($d=.63$). The masculinity manipulation, however, did not significantly affect his physical appearance ratings (masculine $M=3.14$ and less masculine $M=3.20$) or women's ratings regarding his likeability (the mean values were identical in the masculine and less masculine conditions: Ms$=3.18$).

3.2. Romantic attraction to the host

Cycle phase and masculinity had an interactive effect on romantic attraction scores, $F(1, 102)=14.48$, $p<.01$, $\omega^2=.11$. A simple effects analysis indicated that when the host was masculine, women tended to report that they were more attracted to him if they were fertile rather than nonfertile ($M=3.12$ and $M=2.43$, respectively), $F(1, 102)=11.55$, $p<.01$ ($d=.96$). If the host was described in less masculine terms, nonfertile women reported greater attraction to the host on average compared to fertile women ($M=2.95$ and $M=2.50$, respectively), $F(1, 102)=5.25$, $p<.01$ ($d=.56$). These results provide a conceptual replication of previous work finding that fertile women prefer men who have more masculine traits (e.g., Lukaszewski & Roney, 2009; Pawłowski & Jasienska, 2005; Penton-Voak & Perret, 2000).

3.3. Behavioural engagement with the host

The results for mean response speed as a function of cycle phase and host masculinity are presented in Fig. 1. Cycle
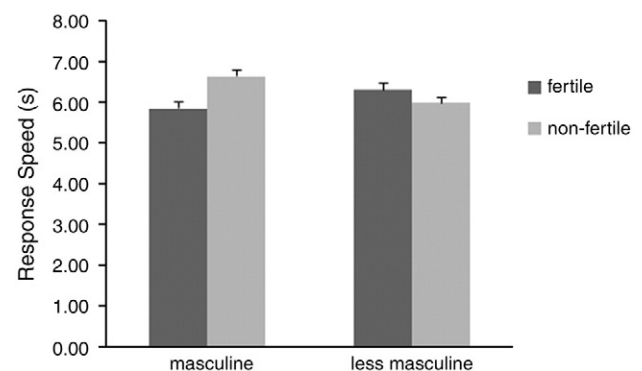

Fig. 1. Mean response speed (+1 S.E.M.) plotted as a function of cycle phase and host masculinity.

phase and host masculinity had an interactive effect on response speed, $F(1, 102)=11.80$, $p<.01$, $\omega^2=.09$. A simple effects analysis indicated that when the host was masculine, women in the fertile phase responded faster compared to nonfertile women ($M=5.87$ s and $M=6.66$ s, respectively), $F(1, 102)=14.17$, $p<.01$ ($d=.88$). In the less masculine condition, response speed did not significantly vary with cycle phase (fertile $M=6.31$ and nonfertile $M=6.00$). Therefore, fertile women compared to their counterparts appeared to be more engaged with the host, but only when he was portrayed as masculine.

Since cycle phase was estimated from self-report data, we checked whether the interactive effect of cycle phase and host masculinity on response speed was robust across the other measures of masculinity. First, the interaction between cycle phase and host masculinity should remain significant if women who are on cycle days 16 to 19 are removed from the analysis. Indeed, the interaction between cycle phase and host masculinity remained statistically significant when these women were removed [$F(1, 90)=9.32$, $p<.01$, $\omega^2=.08$], and a simple effects analysis again indicated that when the host was masculine, the average response speed was faster for fertile compared to nonfertile women [$F(1, 90)=9.87$, $p<.01$, $d=.82$]; when the host was less masculine, response speed did not vary depending on cycle phase ($F<1$). Second, if fertility is influencing behavioural engagement, then women should demonstrate greater behavioural engagement as their risk of conception increases. In keeping with this, response speed significantly decreased as conception risk increased in the masculine host condition, $r=-.35$, $p<.01$, two-tailed. In the less masculine condition, response speed was not significantly associated with conception risk, $r=.18$, $p=.22$, two-tailed. Taken together, these findings provide strong support for the assertion that women's behavioural engagement was covarying with their fertility and host masculinity.

Response accuracy was separately analysed with a 2 (phase)×2 (masculinity of host) between-subjects analysis of variance (ANOVA). Results indicated that the number of correct answers ($M=16.52$, S.D.=2.16) did not vary significantly across conditions.

3.4. Mediated moderation analysis

To determine whether the interactive effects of fertility and host masculinity on behavioural engagement were mediated by romantic attraction, we tested for mediated moderation by following the procedures recommended by Muller, Judd, and Yzerbyt (2005). The results indicated that romantic attraction did not mediate the interactive effect of fertility and host masculinity on behavioural engagement and thereby suggest that fertility status combined with host masculinity were directly affecting behavioural engagement level. The analysis is presented in the Appendix, available on the journal's website at www.ehbonline.org.

4. Discussion

Previous research has found that women's preferences for masculine features covary with menstrual cycle phase. However, this past research has relied on women's self-reported preferences rather than their actual behaviour toward the opposite sex. Consistent with previous research, the present study found that fertile compared to nonfertile women viewed themselves as more romantically attracted to the host, but only if he was portrayed as masculine.

The obtained results are in keeping with Gangestad and Thornhill's (1998) cycle shift hypothesis. Women were not simply more engaged with the host when they were more romantically attracted to him. Rather, masculine traits on the part of the male elicited behavioural engagement, and this result occurred only in fertile women. The pattern of results suggests that fertility-associated behavioural shifts arise as adaptations for finding a mate who possesses good genes during the fertile window. There are other possible explanations for the results, however. Women's mate preferences have been shown to fluctuate with estrogen level, both within cycle and between cycles (Lukaszewski & Roney, 2009; Roney, 2009; Roney & Simmons, 2008). It has been argued that within- and between-cycle shifts in estrogen function to indicate when effort should be preferentially allocated to mate selection over solving other survival problems, such as foraging for food, avoiding predators, finding shelter, and the like (Roney, 2009). As such, women in early ancestral environments evolved to experience down-regulated sexual attraction via reduced estrogen levels during periods when it was more crucial to solve other adaptive problems. One could argue based on this perspective that the results we obtained might be moderated by variables that previous research has linked to reduced estrogen levels, such as reductions in caloric intake and engaging in moderate to high exercise (Lager & Ellison, 1990). Another possible explanation for our results is that behavioural engagement is a by-product of fertile women having an increased sex drive around ovulation. Therefore, perhaps the fertile women in our study were more sexually aroused, and hence, they were more motivated to behaviourally engage with the male. However, as others have pointed out, there is ample evidence to indicate that women are not just interested in engaging with any male. Rather, women seem to target specific types of partners during the fertile window, namely, men who demonstrate traits that are associated with good genes (see Gangestad, Thornhill, & Garver-Apgar, 2010). Additionally, research regarding variation in sex drive across the menstrual cycle has produced mixed findings (see Thornhill & Gangestad, 2008 for a review of this literature).

Previous research has found that women rate traits that are indicative of good genes as more valuable when they are fertile, whereas their preferences for traits that would characterize a mate as a good long-term partner (e.g., successful financially, intelligent, or kind and warm) do not fluctuate across the course of the menstrual cycle

(Gangestad et al., 2007). If romantic attraction as measured in the current study reflected women's interest in the host in the short term, then it is not surprising that increased levels of romantic attraction were associated with greater behavioural engagement in fertile but not nonfertile women when the host was masculine. On the other hand, we did not directly measure women's interest in the host as a short- versus long-term partner; therefore, additional research on the issue is warranted.

The research reported here suggests that women's behaviour toward a male in a relatively mundane context (i.e., one that is devoid of overt romantic attraction cues) can be influenced by menstrual cycle phase. The topic of romantic attraction was not raised (via questionnaire) until after the quiz show; hence, women were not primed by the researchers to evaluate the suitability of the host as a romantic prospect whilst playing the quiz. Nevertheless, women differentially engaged with the host depending on cycle phase and the masculinity of the host. In our view, these results suggest that masculinity cues elicit in fertile women a psychological readiness to engage with a prospective mate. The functional significance of the behavioural engagement that we observed is yet to be determined. On the one hand, behavioural engagement may be used to indicate to a prospective partner that one is potentially interested in mating. Alternatively, increased engagement may encourage the prospective partner to notice her or to pay increased attention to her. Further research is needed to examine these and other possibilities.

As with any study, there are a number of potential limitations. First, menstrual cycle phase was estimated using self-report data, which raises the possibility that the phase estimates were not reliable. The reliability of the reports, however, is strengthened by the fact that we replicated previous research that has found that women's overt (i.e., self-reported) preference for masculine features is heightened during the fertile window. Additionally, women with irregular menstrual cycles were not included in the sample, which should have reduced the error of the estimates. Moreover, the pattern of results was consistent across the three fertility estimates that we computed. The negative association between conception risk and response speed that we found would not be expected unless women's menstrual cycle self-reports were reliable. Taken together, the results strongly suggest that the variation seen in behavioural engagement was fluctuating in relation to women's fertility. Second, another limitation concerns the manner in which masculinity was varied. Masculinity was operationalized by controlling women's expectations, and hence their perceptions, of the host by providing participants with stereotypic information about his interests and hobbies. The behavioural engagement effects that were obtained in relation to the predictors may have been larger had the physical appearance of the host been altered as a means of varying masculinity. Third, accuracy on the quiz, which was another measure of behavioural engagement, did not vary in relation to any of the predictors. Perhaps the sensitivity of the measure was weak, as women were fairly accurate, typically answering about 16 of the 20 questions correctly. Finally, additional research is needed to determine whether women consciously regulate their behaviour. The masculine host could have elicited the observed differences in behavioural engagement without women having been aware that their behaviour was being affected by the masculinity of the host.

In sum, the results of the present study suggest that women's behavioural engagement with a male varies in relation to the fertile window and the masculinity level of the male. We found that women were more likely to behaviourally engage with a male if they were fertile and he was masculine, thereby lending support to the notion that there are fertility-associated behavioural changes in women that may function to enable women to find a mate with strong genetic potential (Thornhill et al., 2003).

Supplementary Materials

Supplementary data to this article can be found online at doi:10.1016/j.evolhumbehav.2011.10.006.

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