Original Article

The Self-Regulation Effect of Fertility Status on Inbreeding Aversion: When Fertile, Disgust Increases more in Response to Descriptions of One’s Own than of Others’ Inbreeding

Jan Antfolk, Department of Psychology and Logopedics, Åbo Akademi University, Turku, Finland. Email: jantfolk@abo.fi (Corresponding author).

Debra Lieberman, Department of Psychology, University of Miami, Coral Gables, FL, USA.

Anna Albrecht, Department of Psychology and Logopedics, Åbo Akademi University, Turku, Finland.

Pekka Santtila, Department of Psychology and Logopedics, Åbo Akademi University, Turku, Finland.

Abstract: The ovulatory shift modulates emotions related to female sexuality. Because fertility status only affects the individual’s own opportunity cost, the adaptive value of this shift is expected to stem from self-regulation. To test this assumption we asked women to contemplate various inbreeding descriptions: 1) they themselves having sex with male relatives; 2) their sister having sex with their common male relatives; and 3) an unrelated woman having sex with her male relatives (in 1, but not 2 and 3, negative fitness consequences are affected by the participant’s fertility). We dichotomized the dependent variable disgust (ceiling vs. non-ceiling) and analyzed the interaction between fertility status and description type. The ovulatory shift was stronger in descriptions where they themselves were described as engaging in inbreeding. A smaller increase was also found in reactions to others engaging in inbreeding. We explain the latter effect as due to self-reflection.

Keywords: fertility, inbreeding, mate choice, incest, disgust, ovulatory-shift

Introduction

During the menstrual cycle, with an average length of 29 days (Fehring, Schneider, and Raviele, 2006), women’s most fertile phase—the time period during which likelihood of conception is highest—takes place mid-cycle around the day of ovulation (Mihm, Gangoooly, and Muttukrishna, 2011; Wilcox, Weinberg, and Baird, 1995). Given the narrow window of fertility, researchers have hypothesized that evolution crafted female sexual psychology to take advantage of sexual opportunities when fertile. For example, it has been suggested that women are more willing to engage in sexual activity during peak fertility.
Indeed, general sexual willingness does seem to increase during the late follicular phase as evidenced by, for example, an increase in partnered sexual behavior (Burleson, Trevathan, and Gregory, 2002; Matteo and Rissman, 1984).

However, as pointed out by Thornhill and Gangestad (2008), the function of female estrus is not to indiscriminately obtain sperm for fertilization, but to obtain sperm from men, who, relative to other men, may offer increased genetic fitness in offspring. Hence, women in the fertile phase should have an increased propensity to take advantage of opportunities to obtain high quality offspring. Supporting this, women in the late follicular phase have an increased preference for indicators of genetic quality in men. This has been shown across a variety of measures, such as preferring the scent of dominant (Havlicek, Roberts, and Flegr, 2005) and symmetric men (Gangestad and Tornhill, 1998), preferring masculine faces (Penton-Voak et al., 1999), and preferring behaviors such as dominance, male intrasexual competitiveness (Gangestad, Simpson, Cousins, Garver-Apgar, and Christensen, 2004), and creativity (Haselton and Miller, 2006).

Conversely, women in the fertile phase should have a decreased propensity to engage in sexual activities associated with an opportunity cost. Because the number of offspring an individual successfully can produce and raise is limited, producing an offspring (and raising this offspring to nutritional independence) will affect the possibility of producing and raising other offspring. If a future or simultaneous opportunity to produce optimal offspring is forsaken due to the production of fitness-compromising offspring, opportunity costs arise from engaging in fitness-compromising sexual behavior, such as inbreeding (e.g., Dawkins, 1983; Haig, 1999). These opportunity costs are, in turn, affected by fertility status. The likelihood of conception should therefore also modulate the propensity to engage in fitness-compromising reproductive strategies. There is indeed evidence that while fertile women show increased sensitivity toward stimuli and sexual behaviors associated with an opportunity cost. For instance, women in the follicular phase show increased handgrip strength after contemplating sexual assault scenarios (Petralia and Gallup Jr, 2002), suggesting increased defensive responsiveness to potential rape-situations during the fertile period. Interestingly, Lieberman and colleagues (2011) have reported that women who are fertile are less likely to associate with fathers, a behavior that can be interpreted as decreasing the likelihood of inbreeding. Taken together, the empirical literature shows that variations in fertility during the menstrual cycle moderate women’s sexuality-related cognitions and emotions, favoring behaviors and traits that are fitness-promoting, and avoiding those that are not.

Specific self-regulation and egocentric empathy

The aforementioned studies show that, across the menstrual cycle, women regulate their own individual propensity to engage in various sexual behaviors. However, some studies also suggest that the variations in fertility during the menstrual cycle moderate judgments of other individuals’ sexual behavior. For example, in a study where women, amongst other prompts, were asked to consider an adult woman having sex with her father, Fessler and Navarrete (2003; see also Antfolk, Lindqvist, Albrecht, and Santtila, 2014) showed that fertile women reacted with increased disgust towards others engaging in fitness-compromising sexual behavior. The reason why an individual’s own likelihood of
conception should modulate reactions to other individuals engaging in inbreeding – the cost of which is not affected by this likelihood – is obscure. It is unclear whether there is any adaptive value of fertility status regulating third-party judgments: Even in the case that third-party inbreeding involves our own relatives (e.g., inbreeding between our sister and our brother) and the inbreeding thus implies inclusive costs to us, our own likelihood of conception does not have any effect on that particular cost. In this example, the particular cost is affected by the fertility status of our sister.

If, however, third-party judgments are based on self-reflection, as suggested by, for example, Westermarck (1906), an increased aversion at the thought of oneself engaging in fitness-compromising sexual behavior might influence the judgment of others. Studies in moral psychology suggest this to be the case: It has, for instance, been found that smelling a disgusting odor (Schnall et al., 2008), or experiencing disgusting tastes (Eskine, Kacinik, and Prinz, 2011) affect third-party judgments.

Should the adaptive value of the ovulatory shift stem from self-regulation, its effect is expected to be stronger in situations where one’s own behavioral propensity – and thereby fitness – can be affected than in situations where one’s own fertility does not affect the costs to the self, such as in third-party judgments. To the best of our knowledge, no study has been designed to robustly address whether the ovulatory-shift is mainly self-regulatory or whether its effect equally extends to third-party judgments.

The present study
To test whether the variation in fertility during the menstrual cycle primarily moderates cognitions and emotions pertaining to self-regulation, or whether the effect extends to include reactions to the behavior of others, we used a method described by Antfolk, Lieberman, and Santtila (2012). In this study participants read three different types of descriptions involving fitness-compromising sexual behavior: 1) Participant Descriptions, in which participants themselves were described as engaging in fitness-compromising sexual behavior; in these scenarios there are potential negative fitness consequences to the participant and their likelihood is affected by the participant’s fertility; 2) Related Third-Party Descriptions, in which participants’ actual same-sex siblings were described as engaging in fitness-compromising sexual behavior; in these scenarios there are again potential negative fitness consequences to the participant (via her relatedness to both parties) but these are not affected by the participant’s fertility; and 3) Unrelated Third-Party Descriptions, in which individuals of the same sex as the participant but unrelated to them were described as engaging in fitness-compromising sexual behavior; in these scenarios there are no negative fitness consequences to the participant. This method provides a possibility to test whether the shifts in attitudes toward fitness jeopardizing sexual behaviors caused by fertility status are mainly self-regulatory or whether the effect extends to include reactions to the behavior of others.

In accordance with the logic reviewed above, we hypothesized that the ovulatory shift during the menstrual cycle is mainly self-regulatory. Thus, our prediction was that women in the fertile phase of the menstrual cycle would show increased aversion to inbreeding descriptions including themselves as participants, but show a less increased aversion to related or unrelated third-party descriptions, in which they themselves were not
Materials and Methods

Participants

The analyses are based on responses from 200 female graduate and postgraduate students, ages 19-45 (\(M = 24.98, SD = 5.21\)), from Åbo Akademi University. We originally surveyed 443 female but excluded women who had given birth within the last year, currently used hormonal contraceptives, reported cycle lengths over 45 or under 15 days, reported the prior onset of menses to be more than 40 days ago, reported an age above 45, or failed to provide responses to one or more of the questions used in the present study.

Procedure

An e-mail inviting graduate and postgraduate students at Åbo Akademi University to participate in the study was sent in April, 2011. A reminder was sent one week later. Both e-mails contained information of the survey, an assurance of participants’ anonymity, and a link to the survey web-site. To recompense participants, we offered them optional participation in a lottery of a 200€ gift-card to a travel bureau. To ensure participants’ anonymity, e-mail addresses were obtained at another web-site.

In the survey, participants were asked to report the number of same-sex siblings, opposite-sex siblings, opposite-sex half siblings via mother, opposite-sex half siblings via father, opposite-sex first cousins via maternal aunt, opposite-sex first cousins via maternal uncle, opposite-sex first cousins via paternal aunt, and opposite-sex first cousins via maternal uncle. If a participant reported having more than one relative in any of these categories, then one of these individuals was randomly selected for subsequent questioning. This was done by asking the respondent to think about their “[third] oldest same-sex sibling” or their “[second] oldest opposite-sex sibling”, where the ordinal identifier was randomly chosen between 1 [oldest] and the actual number of relatives reported for each kinship category of interest. If a respondent reported having zero relatives in any of the kinship categories, they were not asked any further questions including kin of this type. To facilitate subsequent information gathering, the respondent was asked to provide the first name of each of the randomly selected relatives. The names were not saved in the data file and therefore this procedure did not endanger anonymity. Each participant was subsequently presented with three different types of inbreeding descriptions: Participant Descriptions, in which the participants themselves were described as having sex with their actual male relatives; Related Third-Party Descriptions, in which the participants’ actual same-sex sibling was described as having sex with the participants’ male relatives; and Unrelated Third-Party Descriptions, in which a same-sex individual unrelated to the participant was described as having sex with male relatives. The number of Participant and Related Third-Party Descriptions was determined by the number of relationships reported by each participant. This meant that participation in the various descriptions required reporting having actual male relatives (Participant Descriptions) and both an actual same-sex sibling and actual male relatives (Related Third-Party Descriptions). For all participants, Unrelated Third-Party Descriptions included all possible relationships. We

Evolutionary Psychology – ISSN 1474-7049 – Volume 12(3). 2014. -624-
counterbalanced the presentation of description types across respondents and set a randomized order for each level of relatedness in the description for each description type and experiment version.

Menstrual-cycle position

Because women’s self-estimated menstrual-cycle length compares favorably to actual cycle length (Creinin, Keverline, and Meyn, 2004), the questionnaire contained drop-down menus through which participants provided the dates of the onsets of the two prior menses and the expected onset of the next menses. We averaged menstrual-cycle length between these two cycles to obtain an estimate of cycle-length. The average menstrual-cycle length was 30.2 days ($SD = 5.09$). This is comparable to the estimated population average of 29 days (Fehring et al., 2006), suggesting validity of the self-reports. After this we estimated current menstrual-cycle position by counting forward from the onset of the prior menses. A dichotomous variable was based on Wilcox and colleagues (2001) benchmark values of the likelihood of conception for each day during the menstrual cycle. Because no precise cut-off can be established between low and high fertility, we opted for a cut-off likely to be sensitive (include many highly fertile women in the fertile group) given between-individual variation in the menstrual cycle. Women ($n = 85$) within a time-frame of days eight to 19 where the likelihood of conception is 2.9% or higher were therefore coded as fertile. Other women ($n = 115$) were coded as non-fertile. Based on the data provided by the aforementioned study (Wilcox et al., 2001), mean estimated fertility in the non-fertile group, 1.0% ($SD = .06$), was significantly lower than in the fertile group, 6.0% ($SD = .02$, $t[38] = 12.048$, $p < .001$, Cohen’s $d = 3.91$). The mean estimated fertility in the non-fertile group was thus well below and in the fertile group well above the estimated mean likelihood of conception (3.1%) across the complete menstrual cycle (Wilcox et al., 2001).

Aversion to inbreeding

Descriptions of other individuals engaging in inbreeding (i.e., third-party descriptions) have been found to elicit disgust (e.g., Antfolk, Karlsson, Bäckström, and Santtila, 2012) and disgust rather than other negative emotions, such as fear, sadness, shame, confusion, or guilt (Ackerman, Kenrick, and Schaller, 2007). Hence, for each inbreeding description, the participants were asked to self-report their level of disgust on a Likert-type scale with the anchors 0 (not at all disgusting) and 9 (extremely disgusting).

Statistical analyses

For statistical analyses, SPSS 19 was used. In data sets with repeated observations from individual participants, observations are generally clustered (i.e., positively correlated) and this should be taken into account when analyzing data (Agresti, 2007). Because each respondent gave between nine and 21 responses (depending on their number of actual relationships), we analyzed the data using Generalized Estimation Equations (GEE). GEE fits a generalized linear model to observations with an unknown correlation structure (Gardiner, Luo, and Roman, 2009). Because the disgust variable was non-normally distributed, we decided to dichotomize it for the analyses to maximum disgust.
responses (response alternative ‘9’ on the Likert scale) and non-maximum disgust responses (response alternatives ‘1-8’ on the Likert scale). To analyze the dichotomous dependent variable, we used the binary logistic model in the GEE.

As an estimate of the effect sizes we used the Exp(\(B\)) and the confidence intervals from the GEE as Odds Ratios (\(OR\)). We also tested whether the magnitude of the effect of fertility status differed between description types, comparing two \(OR\)s using formula 2.8.5. in Cohen and Cohen (1983). First, the \(OR\) values were transformed into log \(OR\) values. We then calculated the difference between these values (\(\delta = \log OR_1 - \log OR_2\)) and its standard error following the variance sum law (\(SE_\delta = \sqrt{(SE_1^2 + SE_2^2)}\)). Following this, \(p\)-values were obtained from the \(z\)-value (\(z = \delta/SE_\delta\)).

**Preliminary analysis**

Because each participant responded to descriptions involving inbreeding between individuals of various degree of relatedness (full brother \([r = .05]\), half-brothers \([r = .25]\), and male first cousins \([r = .125]\)), we first investigated the effect of degree of relatedness on disgust. We found a strong effect of relatedness (Wald \(\chi^2[2] = 329.70, p < .001\)), so that inbreeding between full siblings elicited more maximum responses of disgust (92%), than inbreeding between half siblings (64%) and first cousins (43%) (see Antfolk, Lieberman, & Santtila, 2012). There was, however, no interaction effect between fertility status and relatedness within any of the description types \(p_{\text{Participant}} = .886, p_{\text{Related}} = .798, \text{and } p_{\text{Unrelated}} = .728\). We thus found it feasible to collapse our data combining observations regarding each male relative within each description-type. Hence, we analyzed the specificity of the effect of fertility status on inbreeding aversion as a 2 x 3 mixed-model with the between-individuals factor Fertility (Fertile vs. Non-Fertile) and the within-individual-variable Description Type (Participant vs. Related Third-Party vs. Unrelated Third-Party) and the dichotomized disgust variable as a dependent variable.

In a final step we conducted planned comparisons to estimate the effect of fertility in each description type. To account for multiple testing, we altered the significance level (\(a\)) using Bonferroni-corrections.

**Results**

Women were more disgusted by the inbreeding descriptions when fertile (75% maximum disgust responses) compared to when infertile (63%, Wald \(\chi^2[1] = 20.54, p < .001, OR = 1.23 [1.02, 1.48]\)), suggesting an overall effect of fertility status.

The levels of disgust elicited by the different description types were also significantly different (Wald \(\chi^2[2] = 281.90, p < .001\)). In both Participant Descriptions (82%, \(p < .001, OR = 9.09 [5.88, 14.02]\)) and Related Third-Party Descriptions (77%, \(p < .001, OR = 5.70 [3.70, 8.78]\)) maximum responses were more common than in Unrelated Third-Party Descriptions (42%). There was no difference between Participant- and Related Third-Party descriptions (\(p = .133\)).

Further, the expected interaction between the between-individuals variable Fertile Period (Fertile vs. Not-Fertile) and the within-individuals variable Description Type (Participant, Related and Unrelated Third-Party Descriptions) was also significant (Wald
χ²[2] = 8.01, p = .018, one-tailed). (See figure 1).

**Figure 1.** Difference in disgust between women in the more fertile phase of the menstrual cycle compared to women in the less fertile phase of the menstrual cycle across the description types: Participant Descriptions, in which participants themselves are described as engaging in fitness-compromising sexual behavior; Related Third-Party Descriptions, in which participants’ actual same-sex siblings were described as engaging in fitness-compromising sexual behavior; and Unrelated Third-Party Descriptions, in which individuals of the same sex as the participant but unrelated to them are described as engaging in fitness-compromising sexual behavior. Error bars represent two standard errors of the mean.

Planned pairwise comparisons showed that for Participant Descriptions, women in the fertile phase reported significantly more disgust than women not in the fertile phase (88% vs 75% maximum disgust responses, p = .001, OR = 2.48 [1.20, 5.14]). For Related Third-Party Descriptions (82 vs. 72%, p = .337, OR = 1.79 [0.83, 3.90]) and for Unrelated Third-Party Descriptions (45% vs. 39%, p = .508, OR = 1.23 [0.92, 1.63]) women in the fertile phase did not report significantly more disgust than women in the fertile phase. As the effect of fertility status was in the same direction for all description types, we proceeded by comparing the magnitude of these effects. There was a difference in the magnitude between Participant- and Unrelated Third-Party Descriptions (LogORδ = .70, SEδ = .27, p = .008). There was however no difference between Participant- and Related Third-Party Descriptions (p = .371) or between Related- and Unrelated Third Party Descriptions (p = .176).
Discussion

In a study of 200 Finnish women, we examined whether the effect of fertility status changes over the menstrual cycle on reactions to fitness-compromising behaviors is limited to only self-regulation or whether the effect is extended to include reactions to the behavior of others. We asked participants to respond to three different types of descriptions of fitness-compromising sexual behavior: 1) Participant descriptions, in which participants themselves were described as engaging in inbreeding; 2) Related third-party descriptions, in which participants’ actual same-sex siblings were described as engaging in inbreeding; and 3) Unrelated third-party descriptions, in which individuals of the same sex as the participant but unrelated to them were described as engaging in inbreeding.

We found that fertility status moderated inbreeding aversion only in participant descriptions. However, although not statistically significant, our results suggested small increases also in the Related and Unrelated Third-Party inbreeding descriptions. Because fertility increased disgust also in Related- and Unrelated Third-Party Descriptions, we also compared the magnitude of the effects-sizes between each description type. We found that the effect was larger in Participant- than Unrelated Third-Party Descriptions. We found, however, no significant differences between Participant- and Related Third-Party or between Related- and Unrelated Third Party Descriptions.

Although we did not find any significant effect of Fertility in Related Third-Party Descriptions, the effect was not significantly smaller than in the Participant Descriptions. One possible explanation for this is that earlier studies have showed that fitness costs are positively associated with the strength of inbreeding aversion (e.g., Antfolk, Lieberman, & Santtila, 2012). This implies that the distribution of responses in Participant Description were more likely than the Related Third-Party Description to suffer a restricted range. Thus, it is possible that the effect of fertility in Participant Descriptions was more restricted than in the Related Third-Party Descriptions. However, we cannot rule out the possibility that reactions to Related Third-Party Descriptions do not differ from Participant Descriptions, and with increased power an effect in Related Third-Party Descriptions would have been detectable.

Similarly to Fessler and Navarrete (2003), we also observed non-significant increases in disgust reactions to both related and unrelated third-party descriptions as a function of fertility status. Because an individual’s likelihood of conception does not affect the costs these third-party inbreedings imply, this effect cannot be parsimoniously explained as a consequence of the variation in opportunity costs to the individual. It has been argued that reactions to third-party inbreeding may rely on egocentric empathy (Fessler and Navarrete, 2004; Westermarck, 1906). The egocentric empathy model suggests that third-party judgments rely on an as-if process, in which the internal emotional reaction at the thought of oneself engaging in the observed third-party behavior is extended and used as emotional input in the third-party judgment. This would mean that the disgust felt at self-reflecting influenced participants’ reactions to third-party descriptions. As fertile women felt more disgusted at themselves engaging in inbreeding, they also, although somewhat less pronouncedly, felt increased disgust to third-party inbreeding. It should also be pointed out that in the related third-party descriptions, the male relatives were the same...
relatives as presented in the participant descriptions. The difference between these two description-types was whether the respondent herself was described as engaging in inbreeding or whether her sister was described as participating in inbreeding. Although the inclusive fitness costs are attenuated in related third-party descriptions compared to participant descriptions, self-reflection is likely to be facilitated. This could explain the similarly high disgust reported by women in response to both description types.

In the present study we used self-reported onsets of menstruation to estimate the menstrual-cycle position of each participant. As the mean menstrual-cycle length reported by our participants was comparable to other studies (Fehring et al., 2006) and a number of studies have successfully used similar methods (e.g. Fessler and Navarrete, 2003; Haselton and Gangestad, 2006), we can assume that the method employed in the present study does not risk its internal validity. Women who participated in the study within days eight to 19 of their menstrual cycle were considered highly fertile. This operationalization risks including women who are at base-line fertility in the fertile group. A more specific (but less sensitive) operationalization, where fewer women would be included in the fertile group, would inevitably include some highly fertile women in the non-fertile group. In this trade-off between sensitivity and specificity we opted for a dichotomization that would yield comparable group-sizes to minimize the risk of violating assumptions in the statistical tests (e.g., Boneu, 1960).

With these limitations in mind, we conclude that the present study suggests that ovulatory-shift is stronger in self-regulatory situations than in reactions to third-party observations. This, in turn, can be interpreted as evidence of the ovulatory-shift being shaped by the adaptive value of self-regulation so as to maximize the use of reproductive assets and minimize the risk of fitness-compromising sexual behavior.

Finally, the methodology used in this study could be employed to investigate the specificity of other phenomena, in which expectations differ depending on whether the self is included or not. Such phenomena are not limited to evolutionary psychology, but may, for example, include social and emotional psychology as well. For example, studies on moral indignation following unjust action may depend on whether an individual suffers directly or indirectly from this action.

Acknowledgements: This study was funded by the Academy of Finland (260298). The first and third authors also received funding from the MiKADO project, funded by the German Federal Ministry of Family Affairs, Senior Citizens, Women and Youth. The authors wish to thank Fabiana Alegrio for constructing the web-administered study, and Helena Lindqvist and Alexandra Elsing for piloting the study.

Received 28 November 2013; Revision submitted 10 February 2014; Revision submitted 26 February 2014; Accepted 1 March 2014

References

Ackerman, J., Kenrick, D., and Schaller, M. (2007). Is friendship akin to kinship? *Evolution and Human Behavior*, 28, 365-374.
Agresti, A. (2007). *An introduction to categorical data analysis*. Hoboken: John Wiley & Sons.

Antfolk, J., Karlsson, M., Bäckström, A., and Santtila, P. (2012). Disgust elicited by third-party incest: The roles of biological relatedness, co-residence, and family relationship. *Evolution and Human Behavior, 33*, 217-223.

Antfolk, J., Lieberman, D., and Santtila, P. (2012). Fitness costs predict inbreeding aversion irrespective of self-involvement: Support for hypotheses derived from evolutionary theory. *PLoS ONE, 7*, 1-8.

Antfolk, J., Lindqvist, H., Albrecht, A., and Santtila, P. (2014). Self-reported availability of kinship cues during childhood is associated with kin-directed behavior to parents in adulthood. *Evolutionary Psychology, 12*, 148-166.

Boneu, C. A. (1960). The effect of violations of assumptions underlying the t test. *Psychological Bulletin, 57*, 49-64.

Burleson, M. H., Trevathan, W. R., and Gregory, W. L. (2002). Sexual behavior in lesbian and heterosexual women: Relations with menstrual cycle phase and partner availability. *Psychoneuroendocrinology, 27*, 489-503.

Cohen, J., and Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences*. Hillside, NJ: Erlbaum.

Creinin, M. D., Keverline, S., and Meyn, L. A. (2004). How regular is regular? An analysis of menstrual cycle regularity. *Contraception, 70*, 289-92.

Dawkins, R. (1983). Opportunity costs of inbreeding. *Behavioral and Brain Sciences, 6*, 105-106.

Eskine, K. J., Kacinik, N. A., and Prinz, J. J. (2011). A bad taste in the mouth: Gustatory disgust influences moral judgment. *Psychological Science, 22*, 295-299.

Fehring, R. J., Schneider, M., and Raviele, K. (2006). Variability in the phases of the menstrual cycle. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 35*, 376-384.

Fessler, D. M. T., and Navarrete, C. D. (2004). Third-party attitudes toward sibling incest: Evidence for Westermarck’s hypotheses. *Evolution and Human Behavior, 25*, 277-294.

Fessler, D., and Navarrete, D. (2003). Domain-specific variation in disgust sensitivity across the menstrual cycle. *Evolution and Human Behavior, 24*, 406-417.

Gangestad, S. W., and Tornhill, R. (1998). Menstrual cycle variation in women’s preference for the scent of symmetrical men. *Proceedings of the Royal Society of London B, 265*, 927-933.

Gangestad, S. W., Simpson, J. A., Cousins, A. J., Garver-Apgar, C. E., and Christensen, J. N. (2004). Women’s preferences for male behavioral displays change across the menstrual cycle. *Psychological Science, 15*, 203-207.

Gardiner, J. C., Luo, Z., and Roman, L. A. (2009). Fixed effects, random effects and GEE: What are the differences? *Statistics in Medicine, 28*, 221-239.

Haig, D. (1999). Asymmetric relations: Internal conflicts and the horror of incest. *Evolution and Human Behavior, 20*, 83-98.

Haselton, M. G., and Gangestad, S. W. (2006). Conditional expression of women’s desires and men's mate guarding across the ovulatory cycle. *Hormones and behavior, 49*(4),
509-18.
Haselton, M. G., and Miller, G. E. (2006). Women’s fertility across the cycle increases the short-term attractiveness of creative intelligence. *Human Nature, 17*, 50-73.
Havlicek, J., Roberts, S. C., and Flegr, J. (2005). Women’s preference for dominant male odour: Effects of menstrual cycle and relationship status. *Biology Letters, 1*, 256-259.
Lieberman, D., Pillsworth, E. G., and Haselton, M. G. (2011). Kin affiliation across the ovulatory cycle: Females avoid fathers when fertile. *Psychological Science, 22*, 13-18.
Matteo, S., and Rissman, E. F. (1984). Increased sexual activity during the midcycle portion of the human menstrual cycle. *Hormones and Behavior, 18*, 249-255.
Mihm, M., Gangooly, S., and Muttukrishna, S. (2011). The normal menstrual cycle in women. *Animal reproduction science, 124*, 229-36.
Penton-Voak, I. S., Perrett, D. I., Castles, D. L., Kobayashi, D. M., Burt, D. M., Murray, L. K., and Minamisawa, R. (1999). Menstrual cycle alters face preference. *Nature, 399*, 741-742.
Petralia, S. M., and Gallup Jr, G. G. (2002). Effects of a sexual assault scenario on handgrip strength across the menstrual cycle. *Evolution and Human Behavior, 23*, 3-10.
Schnall, S., Haidt, J., Clore, G. L., Jordan, A. H., Clore, G. L., and Jordan, A. H. (2008). Disgust as embodied moral judgment. *Personality and Social Psychology Bulletin, 34*, 1096-1108.
Thornhill, R., and Gangestad, S. W. (2008). *The evolutionary biology of human female sexuality*. New York: Oxford University Press.
Westermarck, E. (1906). *The origin and development of the moral ideas*. London: Macmillan.
Wilcox, A. J., Dunson, D. B., Weinberg, C. R., Trussell, J., and Day, D. (2001). Likelihood of conception with a single act of intercourse: Providing benchmark rates for assessment of post-coital contraceptives. *Contraception, 63*, 211-215.
Wilcox, A. J., Weinberg, C. R., and Baird, D. D. (1995). Timing of sexual intercourse in relation to ovulation. *The New England Journal of Medicine, 333*, 1517-1521.