Conception Risk and the Ultimatum Game: When Fertility is High, Women Demand More

CrossMark

Adar B. Eisenbruch *, James R. Roney

Department of Psychological and Brain Sciences, University of California, Santa Barbara, CA 93106-9660, USA

A B S T R A C T

Evidence suggests that women become more intrasexually competitive in the fertile window of the menstrual cycle. Studies using the ultimatum game have extended this to economic decisions, finding that women in the fertile window are less generous towards and more likely to punish other women. In the present study, we used continuous estimates of conception risk to test replication of these findings in a sample of women who played the ultimatum game with same-sex partners. We found that women at higher conception risk made higher demands of their partners, indicating less inclination to cooperate and perhaps greater willingness to engage in costly punishment. Possible functions of cycle-phase shifts in intrasexual competition are discussed, and directions for future research on the psychology of cooperation are suggested.

© 2016 Elsevier Ltd. All rights reserved.

Mounting evidence suggests a positive relationship in women between fertility and intrasexual competitiveness. Women within the fertile window describe other women as less attractive (Fisher, 2004), and work harder to make themselves more attractive (e.g. Durante, Griskevicius, Hill, Perilloux, & Li, 2011; Durante, Li, & Haselton, 2008), compared to women at other points in the menstrual cycle. Reproductive-age women show a weaker preference for femininity in the faces of other women than do post-menopausal women, an effect not found for male faces, suggesting a response to mating rivals (Vukovic et al., 2009). Conception risk within the menstrual cycle positively predicts self-reported feelings of intra-sexual competitiveness, and the choice of dehumanizing words (e.g. "snout") to describe women, but not men or elderly people (Piccoli, Foroni, & Carnaghi, 2013). Finally, women's estradiol levels positively predict the degree to which they identify ovulatory (as compared to luteal-phase) women as mating rivals (Lobmaier, Bobst, & Probst, 2016).

Economic games have also been used to illuminate the relationship between conception risk and female intrasexual competition. The ultimatum game (UG) is commonly used to study cooperation and bargaining (see Güth & Kocher, 2014 for review). In the UG, the Proposer decides how much of an endowment to offer to the Responder. If the Responder accepts the offer, then the Responder receives the amount of the offer and the Proposer keeps the remainder of the endowment; if the Responder rejects the offer, then neither player gets anything at all. Women in the fertile window make lower UG offers to and are more likely to reject offers from other women, compared to women at other points in the menstrual cycle (Lucas, Koff, & Skeath, 2007). Lucas and Koff (2013) found that women generally make higher UG offers to more attractive male and female partners, except for women in the fertile window, who make lower offers specifically to more attractive female partners. These findings suggest that women in the fertile window are less motivated to cooperate with other women, are more willing to engage in costly punishment of women who give low offers, and that these effects are targeted towards mating rivals. (Anderl et al., 2015 found that women's estimated estradiol levels negatively predicted prosociality in a different monetary distribution task, but they did not specify the beneficiary of this prosociality.)

These results suggest a positive relationship between fertility and multiple modes of female intrasexual competition (e.g. derogation of attractiveness, dehumanization, costly non-cooperation), perhaps undergirded by a general sense of dislike towards other women. The precise function of these fertility effects is unclear, however, and there have been methodological limitations. Previous studies of the UG have used counting methods to identify a discrete fertile window within the menstrual cycle, which is less accurate than continuous estimates of conception risk (Gangestad et al., 2016). As such, replication in this area is especially important. We therefore used data available from a broader study (Eisenbruch, Grillot, Maestripieri, & Roney, in press) to

* Corresponding author.
E-mail addresses: Eisenbruch@psych.ucsb.edu (A.B. Eisenbruch),
Roney@psych.ucsb.edu (J.R. Roney).

attempt to replicate the relationship between conception risk and behavior in the UG.

1. Methods

1.1. Design

Female participants played one-shot UGs with a series of same-sex partners who were represented by facial photographs, using a $10 endowment. Participants were shown a photograph of a woman's face, and were then asked how much of the $10 endowment they would like to offer to that partner (or how much they would have to be offered in order to accept an offer from that partner – their "demand"), before moving on to the next face and then repeating the process until they had played games with every partner. Participants were randomly assigned to either first make offers to all of the partners and then state demands for all of the partners, or vice versa. Within each role, the order of the partners was randomized. Participants made only one offer and one demand towards each partner, and did not have any other interaction with the pictured women. Participants were informed that some of the partners had previously played the UG, but that they would be unable to identify which, and that one of their decisions towards a partner who had previously recorded UG decisions might be paid out for real money. When participants returned for a second lab session, they rolled a die; if the die came up six, one of their decisions towards a partner who had previously played the UG was chosen at random, and they were paid for the outcome of that decision. Therefore, no deception was used, participants played one-shot UGs with real partners, and all participant decisions were incentive-compatible.

1.2. Participants

Seventy-four female participants played the UG with the pictured female partners. This sample size was determined based on the needs of the larger study from which the present data are drawn (Eisenbruch, Grillot, Maestripieri and Roney, in press). We neglected to record demographic information on the participants, but they were drawn from the same subject pool as the partners, so we expect a similar age distribution (see below). In addition, a broad prescreening survey revealed that 63% of the women in the subject pool from which our participants were drawn have had sexual intercourse, and 32% reported being in a committed romantic relationship.

1.3. Stimuli

Pictures of 100 females were used to represent UG partners. These women ranged in age from 18-23 years old (mean = 18.6, s.d. = 0.96). Pictures were taken from a standard distance under standardized lighting conditions, were rotated so that faces were level, and were cropped with an oval around the face.

1.4. Measures

The mean offers and mean demands made by each participant were analyzed as measures of their desire to cooperate with other women in the UG. A greater desire to cooperate is represented by higher offers and lower demands, while higher demands indicate a greater willingness to engage in costly punishment of Proposers who make low offers.

After playing the UG, participants were asked whether they were using any hormonal birth control (or had in the past 6 months), when their last menstrual period began, and the length of their typical menstrual cycle. This information allowed us to estimate fertility based on published conception risk estimates for each day of the cycle, counting forward from last menstrual onset (Wilcox, Dunson, Weinberg, Trussell, & Baird, 2001). In the absence of hormonal measurements, continuous estimates of fertility such as these are recommended over comparing

discrete sections of the cycle (Gangestad et al., 2016; Gildersleeve, Haselton, & Fales, 2014), and use of these estimates does not require a report of next menstrual onset.

1.5. Analyses

Analyses were restricted to women who were not using hormonal birth control, reported a typical cycle length of 40 days or less, and were on a cycle day for which conception risk estimates were available (Wilcox et al., 2001). We computed bivariate correlations to test the effects of estimated conception risk on mean offers and demands made.

Lucas & Koff (2013) observed an interaction whereby women at low fertility made higher UG offers to more attractive female partners, while women at high fertility made lower UG offers to more attractive female partners. In the present study, the face photographs of UG partners were rated by 13 men for physical attractiveness (3-item composite: attractiveness, attractiveness as a short-term mate, attractiveness as a long-term mate; alpha = .979; see Eisenbruch, Grillot, Maestripieri and Roney, in press for additional details). For each woman who played the UG with these faces, then, we could compute regression slopes testing the relationships between partner attractiveness and offers and demands made to those partners, and then assess whether these slopes varied depending on participants' conception risk. This was done using multi-level regression models that tested whether a level 2 variable (participant conception risk) moderated the relationship between partner attractiveness and offers and demands made to those partners (level 1 variables). A negative interaction between conception risk and partner attractiveness in predicting offers made would represent a replication of the finding from Lucas and Koff (2013).

2. Results

Forty-three women met the inclusion criteria. The mean offer made was $4.93 (s.d. = $1.01) and the mean demand was $4.03 (s.d. = $1.33). There was no relationship between conception risk and mean offers made, $r(43) = .06$, $p = .705$. There was a significant, positive correlation between conception risk and mean demands made, $r(43) = .35$, $p = .023$, such that women at higher conception risk demanded more money in order to accept an offer (see Fig. 1).

There was not a significant interaction between participant conception risk and partner attractiveness in predicting either offers ($b = 0.22$, $p = .783$) or demands ($b = .57$, $p = .478$), thereby failing to replicate this finding from Lucas & Koff (2013).
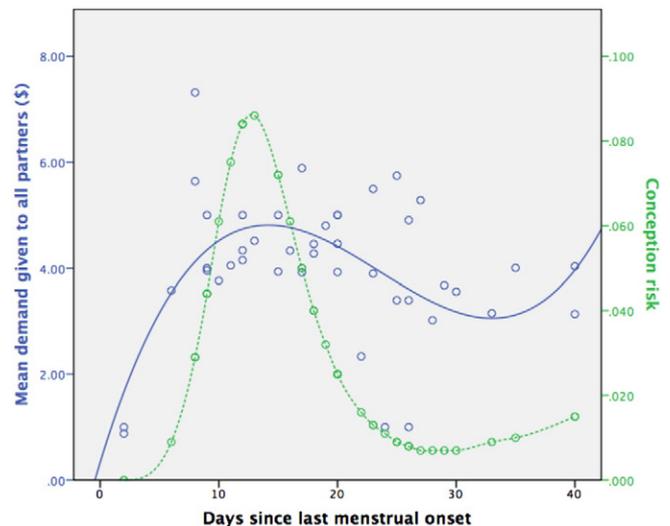

Fig. 1. Conception risk (dashed line) and mean demand in the ultimatum game, plotted against cycle day. For ease of visualization, a cubic fit line (solid line) has been created for mean demand.

3. Discussion

We found that women at higher conception risk made higher demands of other women in the UG, thereby replicating this finding from Lucas et al. (2007). This suggests that increased conception risk reduces women's motivation to cooperate with other women and/or increases their willingness to engage in costly punishment of other women. There was no effect of conception risk on offers made, or any interaction between conception risk and partner attractiveness, thereby failing to replicate parts of Lucas et al. (2007) and Lucas & Koff (2013). However, given our small sample size, we caution against overinterpreting these null results.

There are several possible functional explanations for the relationship between fertility and female intrasexual competition. Some researchers (e.g. Lucas & Koff, 2013) have suggested that these effects reflect design for increased intrasexual competition during the fertile window of the menstrual cycle. This explanation is uncertain, however: if women were competing for long-term mates, then there is no reason why competition should be reduced in non-fertile portions of the cycle; if women were pursuing short-term mates, then competition should be minimal because men could effectively have multiple mates.

A second explanation proposes adaptations for calibrating women's motivational priorities to longer-term fluctuations in fertility (Lukaszewski & Roney, 2009; Roney, 2009; Roney & Simmons, 2013). During months or years in which women experienced suppressed fertility due to circumstances such as lactation or other energetic stress, motivational priorities may have shifted away from mate competition and toward more pressing adaptive problems such as maternal care of offspring. When high fertility cycles occurred between births (or before first birth), however, women may have up-regulated mate evaluation in order to assess mating options before the next conception, and other women may have been viewed as competitors at these times. Because hormones like estradiol that index fertility over long time-scales also fluctuate within cycles, small within-cycle shifts in competitiveness may emerge as by-products of mechanisms designed to calibrate intrasexual competitiveness over longer time-scales.

A third hypothesis is that the hormones which index fertility within and between cycles are also responsive to changes in condition (e.g. Schweiger et al., 1988). The mid-cycle peak in estradiol, for example, may therefore be a cue of good condition, which may trigger a less cooperative, more demanding behavioral strategy (see Zaatari & Trivers, 2007). This explanation is undercut, however, by the evidence that women's elevated competitiveness at midcycle is not general, but is targeted specifically at potential mating rivals (Lucas & Koff, 2013; Piccoli et al., 2013; see also Lobmaier et al., 2016). Future research should further address functional explanations for the relationship between female fertility and intrasexual competition.

It is not clear why we only found a relationship between demands in the UG and conception risk, while previous studies have also found relationships between fertility and offers made (Lucas & Koff, 2013; Lucas et al., 2007). This may have been due to idiosyncrasies in the presentation of the UG in the various studies. While we relied on estimates of conception risk due to the absence of hormonal data, future research on cycle phase effects would ideally employ direct hormone measurements, since the effects of fertility on behavior are likely due to fluctuations in ovarian hormone concentrations (e.g. Eisenbruch, Simmons, & Roney, 2015; Roney & Simmons, 2008; Roney & Simmons, 2013). Finally, future research should examine variables that may moderate the effect of fertility on intrasexual competitiveness, such as relationship status and cues of the availability of attractive mates.

The present results replicate the finding that women at higher conception risk make higher UG demands of other women, which is consistent with a broader increase in intrasexual competitiveness during times of high fertility (see Introduction). The replication of this finding suggests that cycle phase shifts in intrasexual competitiveness are robust, but further research is necessary to test possible functions of these effects. This finding also illustrates the importance of biological variables in cooperative tasks (e.g. Eisenbruch, Grillot, Maestripieri and Roney, in press; Zaatari & Trivers, 2007). Cooperation researchers should further consider ways in which cooperative behavior might be influenced by the socially-relevant biological traits of the interactants, above and beyond the structure of the task itself.

References

Anderl, C., Hahn, T., Notebaert, K., Klotz, C., Rutter, B., & Windmann, S. (2015). Cooperative preferences fluctuate across the menstrual cycle. *Judgment and Decision Making*, *10*(5), 400–406.

Durante, K. M., Griskevicius, V., Hill, S. E., Perilloux, C., & Li, N. P. (2011). Ovulation, female competition, and product choice: Hormonal influences on consumer behavior. *Journal of Consumer Research*, *37*(6), 921–934.

Durante, K. M., Li, N. P., & Haselton, M. G. (2008). Changes in women's choice of dress across the ovulatory cycle: Naturalistic and laboratory task-based evidence. *Personality and Social Psychology Bulletin*, *34*(11), 1451–1460.

Eisenbruch, A. B., Grillot, R. L., Maestripieri, D., & Roney, J. R. (2016). Evidence of partner choice heuristics in a one-shot bargaining game. *Evolution and Human Behavior* (in press).

Eisenbruch, A. B., Simmons, Z. L., & Roney, J. R. (2015). Lady in red: Hormonal predictors of women's clothing choices. *Psychological Science*, *26*(8), 1332–1338.

Fisher, M. L. (2004). Female intrasexual competition decreases female facial attractiveness. *Proceedings of the Royal Society of London B: Biological Sciences, 271*(Suppl. 5), S283–S285.

Gangestad, S. W., Haselton, M. G., Welling, L. L., Gildersleeve, K., Pillsworth, E. G., Burriss, R. P., ... Puts, D. A. (2016). How valid are assessments of conception probability in ovulatory cycle research? Evaluations, recommendations, and theoretical implications. *Evolution and Human Behavior, 37*, 85–96.

Gildersleeve, K., Haselton, M. G., & Fales, M. R. (2014). Do women's mate preferences change across the ovulatory cycle? A meta-analytic review. *Psychological Bulletin, 140*(5), 1205–1259.

Güth, W., & Kocher, M. G. (2014). More than thirty years of ultimatum bargaining experiments: Motives, variations, and a survey of the recent literature. *Journal of Economic Behavior & Organization, 108*, 396–409.

Lobmaier, J. S., Bobst, C., & Probst, F. (2016). Can women detect cues to ovulation in other women's faces? *Biology Letters, 12*(1), 20150638.

Lucas, M., & Koff, E. (2013). How conception risk affects competition and cooperation with attractive women and men. *Evolution and Human Behavior, 34*(1), 16–22.

Lucas, M. M., Koff, E., & Skeath, S. (2007). Pilot study of relationship between fertility risk and bargaining. *Psychological Reports, 101*(1), 302–310.

Lukaszewski, A. W., & Roney, J. R. (2009). Estimated hormones predict women's mate preferences for dominant personality traits. *Personality and Individual Differences, 47*(3), 191–196.

Piccoli, V., Foroni, F., & Carnaghi, A. (2013). Comparing group dehumanization and intrasexual competition among normally ovulating women and hormonal contraceptive users. *Personality and Social Psychology Bulletin, 39*(12), 1600–1609.

Roney, J. R. (2009). The role of sex hormones in the initiation of human mating relationships. In P. T. Ellison, & P. B. Gray (Eds.), *The Endocrinology of Social Relationships* (pp. 246–269). Cambridge, MA: Harvard University Press.

Roney, J. R., & Simmons, Z. L. (2008). Women's estradiol predicts preference for facial cues of men's testosterone. *Hormones and Behavior, 53*(1), 14–19.

Roney, J. R., & Simmons, Z. L. (2013). Hormonal predictors of sexual motivation in natural menstrual cycles. *Hormones and Behavior, 63*(4), 636–645.

Schweiger, U., Laessle, R., Schweiger, M., Herrmann, F., Riedel, W., & Pirke, K. M. (1988). Caloric intake, stress, and menstrual function in athletes. *Fertility and Sterility, 49*(3), 447–450.

Vukovic, J., Jones, B. C., DeBruine, L. M., Little, A. C., Feinberg, D. R., & Welling, L. L. (2009). Circum-menopausal effects on women's judgements of facial attractiveness. *Biology Letters, 5*(1), 62–64.

Wilcox, A. J., Dunson, D. B., Weinberg, C. R., Trussell, J., & Baird, D. D. (2001). Likelihood of conception with a single act of intercourse: providing benchmark rates for assessment of post-coital contraceptives. *Contraception, 63*(4), 211–215.

Zaatari, D., & Trivers, R. (2007). Fluctuating asymmetry and behavior in the ultimatum game in Jamaica. *Evolution and Human Behavior, 28*(4), 223–227.