



Hormonal contraceptive congruency: Implications for relationship jealousy

Kelly D. Cobey^{a,*}, S. Craig Roberts^b, Abraham P. Buunk^{a,c}

^a University of Groningen, Department of Psychology, Groningen 9712 TS, The Netherlands

^b University of Stirling, Department of Psychology, Stirling FK9 4LA, Scotland

^c The Royal Netherlands Academy of Arts and Sciences, Amsterdam 1011 JV, The Netherlands

ARTICLE INFO

Article history:

Received 19 February 2013

Received in revised form 19 April 2013

Accepted 25 April 2013

Available online 3 June 2013

Keywords:

Romantic relationships

Birth control pill

Mate choice

Congruency

Relationship initiation

ABSTRACT

Research shows that women who use hormonal contraceptives (HCs) differ in their mate preferences from women who have regular cycles. It has been proposed that when a partnered woman either begins to use or ceases to use HCs, she may experience changes in her relationship since her preferences become incongruent with those prevalent at the time of her partner choice. This has not yet been directly tested. Here, in doing this, we aim to specifically test whether current and past HC use contributes to present levels of relationship jealousy. We find a significant interaction in levels of jealousy based on current HC use and HC use at the start of the relationship. When current HC use is incongruent with that at the start of the relationship, women report significantly higher levels of jealousy. Results are among the first to suggest that both current and past HC use may influence relationship dynamics.

Crown Copyright © 2013 Published by Elsevier Ltd. All rights reserved.

1. Introduction

A number of divergent factors influence female partner preferences at the initiation of a romantic relationship. Research from an evolutionary perspective, for example, has shown that women experience shifts in mating preferences across the menstrual cycle (reviewed in Gangestad & Thornhill, 2008). When fertile as compared to non-fertile, women have been shown to prefer increased levels of relative masculinity in faces (Penton-Voak et al., 1999), bodies (Little, Jones, & Burriss, 2007), voices (Feinberg et al., 2006; Puts, 2005), scents (Grammer, 1993; Havlíček, Roberts, & Flegr, 2005) and behaviors (Gangestad, Garver-Apgar, Simpson, & Cousins, 2007; Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004). Likewise, women are known to increase their preference for men with bilaterally symmetric traits when fertile (e.g., Gangestad & Thornhill, 1998; Rikowski & Grammer, 1999; Thornhill et al., 2003). Masculinity and symmetry are argued to be 'costly traits', which are difficult to maintain, and therefore are thought to index physical quality (e.g., Scheib, Gangestad, & Thornhill, 1999). Cyclical shifts in female mating psychology may therefore function, in part, to aid women in choosing a partner of high physical quality when conception risk is highest (Gangestad & Thornhill, 2008; Little & Jones, 2012).

In contemporary populations however, the use of HCs among young women desiring reliable and reversible contraception is widespread. At present, more than 100 million women worldwide

are currently using "the pill" for contraceptive purposes (Trussell, 2007). Recent evidence suggests that use of HCs interferes with the aforementioned cyclical shifts in female mating preferences (reviewed in Alvergne & Lummaa, 2010). This is because HCs suppress female fertility and flatten hormonal shifts which occur across the cycle (Frye, 2006). This may suggest that women who use HCs may be less attuned to indicators of male physical quality than women who have regular cycles and therefore that they may subsequently actually choose partners of lower physical quality than they otherwise would. This concept is best supported by evidence obtained from studies examining preferences for genetic dissimilarity at the Major Histocompatibility Complex (MHC). The MHC codes for proteins involved in immune self/non-self recognition, and increasing consensus for a link between overall MHC-heterozygosity and fitness has been established across a range of species including humans (e.g., Penn, Damjanovich, & Potts, 2002; Penn & Potts, 1999; Roberts et al., 2005). MHC-dissimilarity may be assessed via odor, and women who have regular cycles appear to prefer the scent of MHC-dissimilar men, and relatively more often find that these odors remind them of their actual or former real-life partners (Wedekind, Seebeck, Bettens, & Paepke, 1995). However, on initiation of HCs, women show a shift in preference towards the scent of men who are MHC-similar, suggesting that such use may interfere with adaptive mate choice (Roberts, Gosling, Carter, & Petrie, 2008).

Little, Burriss, Petrie, Jones, and Roberts (in press), have recently provided additional support that HC use interferes with natural female mating preferences. First, in a laboratory based study, they tracked women's facial masculinity preferences prospectively as

* Corresponding author. Tel.: +31 0 50 363 9707.

E-mail address: k.d.cobey@rug.nl (K.D. Cobey).

they initiated use of HCs. They showed that preferences for masculinity in opposite-sex, but not same-sex, faces decreased following initiation of HCs. These shifts were not observed in a control group. Further, using real-world couples, they showed that women who met their partner while using HCs were more likely to be paired with men who were rated lower in overall facial masculinity than those who met their partner when they had regular cycles. This finding is in line with other research which has shown that women who use HC show no shift, or a very weak shift, in preferences for increased masculinity across the cycle (Feinberg, DeBruine, Jones, & Little, 2008; Little, Jones, Penton-Voak, Burt, & Perrett, 2002). Somewhat less intuitively related to these findings, is the result of Jones et al. (2005) showing that women display a greater relative preference for health in the non-fertile phase of the menstrual cycle, and similarly, that HC users have higher overall preferences for health in faces than non-HC users. Taken together this suggests that masculinity and perceived health are judged distinctly from one another since preferences shift in opposite directions across the cycle and during HC use (e.g., Little et al., 2002, 2008). Finally, in contrast to women with regular cycles, women using HCs also do not exhibit mid-cycle peaks in attractiveness (e.g., Kuukasjarvi et al., 2004; Miller, Tybur, & Jordan, 2007) or changes in symmetry preferences (Gangestad & Thornhill, 1998; Thornhill & Gangestad, 1999).

In the current study, we sought to expand on previous research which has examined HC pill effects on mate preferences through investigating if there are consequences of HC use for romantic jealousy. Jealousy is a basic affect which is aroused in situations where there is a loss, or a perception of loss, of a valuable relationship (Buunk, 1991). Jealousy can be seen as adaptive in that it may help to allow an individual to control and monopolize reproductive access and investment from their partner. We examined two possible ways in which contraceptive use might influence jealousy. First, in a replication of previous work (Cobey et al., 2012, 2011; Geary, DeSoto, Hoard, Skaggs Sheldon, & Lynne Cooper, 2001) we tested the possibility that current contraceptive use increases levels of jealousy. Secondly, we tested the possibility that jealousy is mostly influenced by the congruency between current HC use status and that at the start of the relationship. This is a novel angle to approach the effects of HCs. More specifically, we propose that, because women who use hormonal contraception do not exhibit cyclical shifts in the preference for indicators of physical quality, a partnered woman who transitions either onto or off of hormonal contraception, may no longer be satisfied with her partner to the same extent. That is, the traits a woman chose in her partner at the start of the relationship may no longer satisfy her preferences when she changes her HC use status. For example, a woman who chooses a partner off of the pill may choose an individual who has outward indicators of physical quality such as a masculine facial structure; however, upon her transition to HC use she may find that her general preference shifts towards more feminine faces, and as a result, is no longer satisfied to the same degree by her partner. Herein, we will refer to this idea as the concept of contraceptive (in)congruency (see Roberts et al., *in press*). We predict that such disruption in preferences may leave women with feelings of uncertainty about their relationship which may prompt feelings of jealousy. Indeed, previous research has shown that jealousy is provoked in situations of relationship uncertainty, and that jealousy is positively related to feelings of anxiety about one's attachment to their partner (e.g., Afifi & Reichert, 1996; Dainton & Aylor, 2001; Knobloch, 2005).

There is some recent evidence that contraceptive congruency, the correspondence between current HC use status and that at the initiation of a romantic relationship, may influence relationship dynamics. Roberts et al., (2012) showed that HC use versus non-use at the time of meeting one's partner plays an important role in future relationship satisfaction, both emotionally and

sexually. They showed that women who met their partners when using the pill reported greater emotional satisfaction within their relationship, but lower levels of sexual satisfaction than women who had met their partner off the pill. This represents an unrecognized consequence of contraceptive pill use that, until recently, had not been considered. Moreover, this study was the first to show that these subtle shifts have consequences for the quality of actual romantic relationships meaning that HC use could have long-term downstream consequences for relationships. Based on this finding, if contraceptive use changes or becomes incongruent to the start of the relationship, it may be that the dynamics of the relationship, and therefore potentially the expression of jealousy, are altered.

To summarize, we predicted that (1) current HC users will report higher levels of jealousy than women not currently using the contraceptive pill, and that (2) incongruency between current HC use and contraceptive use at the time of meeting one's partner will produce higher levels of overall jealousy than congruency between these times.

2. Methods

2.1. Measures

This experiment was approved by the University of Groningen Psychology Ethics Review Board. Participants completed an online questionnaire in their native language which contained basic demographic items and a 15-item scale to assess jealousy (Buunk, 1997). Responses to the jealousy scale items were recorded on a 1–9 point scale, with higher scores indicating higher levels of jealousy (Cronbach's $\alpha = 0.87$). Examples of items from this scale include: "I don't want my partner to have too much contact with persons of the opposite sex"; and "How would you feel when your partner would dance intimately with someone of the opposite sex?". Scores on the jealousy items were summed to obtain an overall measure on the scale. Participants also indicated how long they had been in their current relationship, if they were currently using HCs and whether at the time they started their relationship with their partner they were using HCs or not (or if they "could not remember"). Responses to these last questions served as our key independent variables. Participants were also asked to report on general satisfaction within their relationship. This was captured by a single item question which asked "Overall, how satisfied are you in your relationship?", answers being recorded on a 0–100 point scale with higher scores indicating greater levels of satisfaction.

2.2. Participants

Participants were 129 female undergraduate students from a large European University who received course credit for their participation. All participants indicated that they were presently in a romantic relationship at the time of survey. They were told that we were conducting a study on relationship satisfaction. We excluded eight individuals from the analyses because they indicated that they were not exclusively heterosexual. This exclusion was made due, in part, to the fact that some jealousy scale items specifically asked for participants to imagine one's partner interacting with an opposite sex individual. No participant indicated that they did not remember whether they were using HCs at the time they started their relationship. A final sample of 121 participants was used for analysis, of which current HC use status was congruent with that when they started their relationship for 87 women. Among these 'congruent users' 71 were using HCs and 16 had

regular cycles. The remaining 34 participants were ‘incongruent users’, and the vast majority had switch onto as opposed to off of HC since starting their relationship ($N = 30$). Participants reported to be born between 1961 and 1995 ($N = 111$ due to missing cases, Mean = 1990.59 (~22 years), S.D. = 3.65) and had dated their current partner on average for approximately one year (5 categories; 1 = 0–6 months, 2 = 6–12 months, 3 = 12–18 months, 4 = 18–24 months, 5 = >24 months; $M = 2.79$, S.D. = 1.34).

3. Results

We first conducted a univariate ANOVA with jealousy as the dependent variable and current contraceptive use as a fixed-factor (without considering congruency effects). This revealed a significant effect of contraceptive use ($F = 3.94$, $p = 0.049$), with women currently using HCs reporting higher levels of jealousy than those not currently using HCs (mean difference \pm S.E. = 9.11 ± 4.59), a finding which is consistent with previous research (e.g., Cobey et al., 2012; Geary et al., 2001).

We then conducted a univariate ANOVA with jealousy as the dependent variable and initial contraceptive use at the start of the relationship and current contraceptive use status as fixed factors. The results of this analysis revealed a significant interaction between contraceptive use status when starting the relationship and present contraceptive use status ($F = 3.94$, $p = 0.050$) (Fig. 1). In this instance current HC use ($F = 0.89$, $p = 0.35$) as well as HC use at the start of the relationship ($F = 0.98$, $p = 0.32$) did not have a significant influence on the model.

Adding age to the model also did not influence the significance of the interaction ($F = 4.04$, $p = 0.047$) and age did not have a significant influence overall ($F = 0.001$, $p = 0.98$). As stated above, there were fewer cases for this analysis due to missing data for age. The same pattern of results was found when relationship satisfaction was added to the model: the interaction remained significant ($F = 4.89$, $p = 0.029$) but relationship satisfaction was non-significant ($F = 2.18$, $p = 0.14$). Adding relationship length to the model as a fixed factor (mean split) influenced the overall effect of the interaction such that it became marginally significant ($F = 3.48$, $p = 0.065$); however, relationship length did not have a statistically significant effect on the model ($F = 1.68$, $p = 0.20$) and again current use ($F = 1.14$, $p = 0.29$) and use at the start of the relationship ($F = 0.64$, $p = 0.43$) were non-significant in this model.

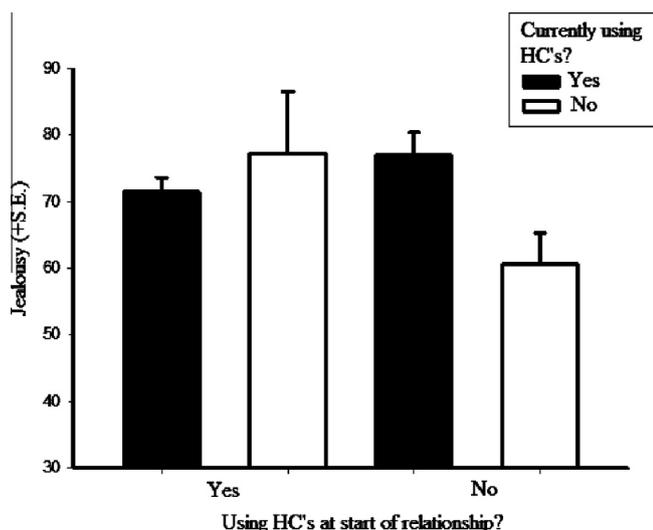


Fig. 1. The interaction of current contraceptive use status and contraceptive use status at the time of starting one's relationship on participant's jealousy scores.

Based on these results we conducted a univariate analysis with jealousy as the dependent variable and present HC congruency with that at the time of initiating the relationship (congruent versus incongruent) as a fixed factor to test our congruency hypothesis. Results from this analysis indicated that women whose contraceptive use status was incongruent with when they met their partner were significantly more jealous than those women whose status was congruent (mean difference \pm S.E. = 7.55 ± 3.79 , $F = 3.96$, $p = 0.049$) (Fig. 2). As above, we then controlled for participant age and relationship satisfaction by separately adding these items to the model as covariates. Neither of these variables had a statistically significant effect on the model (all $F < 1.93$, all $p > 0.17$) and in all cases the congruency factor remained significant. We also added relationship length to the model as a fixed factor, but it did not have a significant effect on the model ($F = 1.90$, $p = 0.17$) and the congruency factor remained significant ($F = 4.12$, $p = 0.045$).

4. Discussion

Our results indicate that the congruency between current HC use and HC use at the start of a relationship has consequences for the expression of romantic jealousy within that partnership. Specifically, we find that, when controlling for a variety of potentially relevant factors, women report higher levels of jealousy if their HC use status is incongruent (as opposed to congruent) from when they initiated their relationship. This finding complements existing literature which suggests that use of HCs, which suppress cyclical variation in hormones, may interfere with adaptive preferences for indicators of physical quality which occur among women with regular cycles (e.g., Gangestad et al., 2004; Havlíček et al., 2005; Puts, 2005). Accordingly, switching use of HCs within an existing relationship may shift female preferences, and this may change the way that women perceive their partners. This suggests that transitioning from non-use to use of HCs can be disruptive for a relationship, but that so long as a woman uses HCs throughout the whole relationship, while her preferences differ from when having regular cycles, her preferences are stable. Newfound uncertainty in one's partner, or one's shifted view on how their partner satisfies them when switching use status, may explain the feelings of jealousy documented herein (e.g., Afifi & Reichert, 1996; Dainton & Aylor, 2001; Knobloch, 2005).

Our data also showed that when not considering effects of use at the start of the relationship, at baseline, jealousy levels were

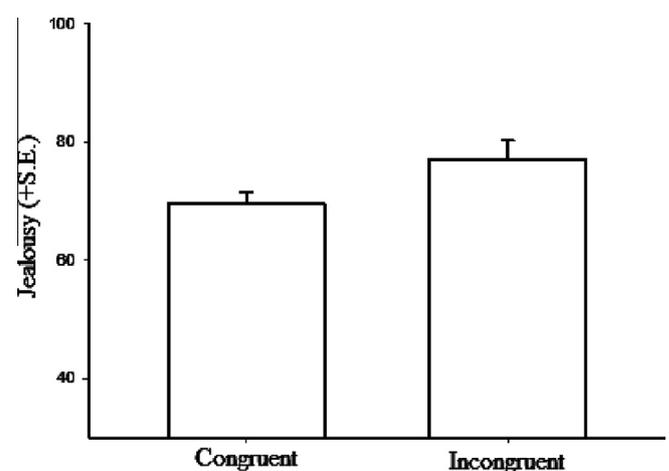


Fig. 2. Mean jealousy scores (+S.E.) of women whose present hormonal contraceptive use status is congruent with the time they started their relationship versus those whose present status is incongruent.

significantly higher among women who currently use HCs than those who have regular cycles. This result is consistent with previous research (Cobey et al., 2012; Geary et al., 2001). However, it should be acknowledged that an even better test of this effect would have considered menstrual cycle stage of those women with regular cycles since it is known that jealousy levels increase during the fertile phase (Cobey et al., 2012; Geary et al., 2001).

Future research should seek to test an additional possible influence of HC pill effects, namely differences in behavior based on ever having used HCs versus never having used HCs. It may be that there is a selection bias in the types of women who choose, at any point in their life, to use HCs. Such differences may be driven, for example, by religiosity or personality characteristics. However, in The Netherlands where the current study was conducted, such a strong selection bias is unlikely. The Dutch have a very open discussion on sexuality within the mass media, with sex education beginning at a young age, and educational campaigns on contraceptive use which target hard to reach groups. Moreover, previous research exists which suggests the HC pills containing higher doses of synthetic estrogen are associated with higher levels of jealousy and mate guarding behavior (Cobey, Pollet, Roberts, & Buunk, 2011; Welling, Puts, Roberts, Little, & Burriss, 2012). Unfortunately, information with respect to contraceptive pill brand was unavailable in the present sample. This however, presents an interesting further possibility which can be examined in future studies, namely, how one's relative degree of HC congruency affects romantic jealousy. That is, women who met their partner on one form of HC and then subsequently switched to an alternative brand, can be considered to be 'more congruent' than those who changed HC use status altogether. Future research recruiting larger samples with information on current and past brand use should aim to investigate this possibility.

A limitation to this research is that it did not consider how feelings of jealousy might translate into or prompt actual behavioral change. The extent to which differences in jealousy influence differences in behavioral outcomes between women whose contraceptive use status is congruent versus incongruent to when they met their partner therefore remains to be determined. However, it is worthwhile to note that the systematic study of jealousy may be difficult in that its expression can take many forms, and more importantly, it is often only displayed privately. Indeed, feelings of shame are often reported for expressing jealousy, therefore individuals may attempt to conceal or disguise such feelings (Clanton & Smith, 1977). Based on this, the differences in self-reported upset reported on the jealousy scale we used are therefore likely to reflect observable differences. Moreover, the finding of Welling and colleagues (2012) which showed that women on HCs, particularly those higher in synthetic estrogen dose, display heightened levels of mate guarding suggests that behavioral changes are occurring.

Finally, on average our participants had only been dating their partner for slightly more than a year and relatively new relationships may differ tremendously from longer ones. Expression of jealousy in a new relationship may alienate the partner (Bringle & Buunk, 1985) and jealousy may become more likely after passing through the initial passionate stage of the relationship. Nevertheless, the difference in jealousy levels depending on congruency of HC use was evident even in this sample of relatively young relationships and remained so after controlling for relationship length. This difference is consistent with, and is therefore likely to be a precursor to, differences in relationship satisfaction experienced among older women as a consequence of pill use during initial partner choice (Roberts et al., 2012). Furthermore, future work recruiting larger samples of women, particularly those who transition off of the pill, is necessary to confirm these results since our interaction was driven by women transitioning onto the pill. This

might be accomplished by recruiting samples of older women who may no longer be using HCs, perhaps because their partner has had a vasectomy, but who still have regular cycles. While it is clear that jealousy is higher among women using HCs, we have presented preliminary evidence to suggest congruency matters too. The theoretical concepts presented in this paper might also serve to prompt researchers to examine other social and relationship factors which contraceptive congruency may influence. In summary, our results suggest that changes in HC use over the course of a relationship may have a robust influence. Given the potential important social implications of increased jealousy within romantic relationships, improving our understanding of the mechanism that mediates changes during the transition to or away from using HCs, is of great importance.

Acknowledgement

A.P. Buunk is supported by a Royal Netherlands Academy of Arts and Sciences grant. S.C. Roberts is supported by a British Academy Mid-Career Fellowship.

References

- Affif, W. A., & Reichert, T. (1996). Understanding the role of uncertainty in jealousy experience and expression. *Communication Reports*, 9, 93–103.
- Alvergne, A., & Lummaa, V. (2010). Does the contraceptive pill alter mate choice in humans? *Trends in Ecology & Evolution*, 25, 171–179.
- Bringle, R. G., & Buunk, A. P. (1985). Jealousy and social behavior: A review of person, relationship and situational determinants. In P. Shaver (Ed.), *Review of personality and social psychology. Self, situations, and social behavior* (Vol. 6, pp. 214–264). Beverly Hills: Sage.
- Buunk, A. P. (1991). Jealousy in close relationships: An exchange theoretical perspective. In P. Salovey (Ed.), *Psychological perspectives on jealousy and envy* (pp. 148–177). New York: Guilford Publications.
- Buunk, B. P. (1997). Birth order and attachment as related to various types of jealousy. *Personality and Individual Differences*, 23, 997–1006.
- Clanton, G., & Smith, L. G. (1977). *Jealousy*. Englewood Cliffs, NJ: Prentice-Hall.
- Cobey, K. D., Buunk, A. P., Roberts, S. C., Klipping, C., Appels, N., Zimmerman, Y., et al. (2012). Reported jealousy differs as a function of menstrual cycle stage and contraceptive pill use: A within-subjects investigation. *Evolution and Human Behavior*, 33, 395–401.
- Cobey, K. D., Pollet, T. V., Roberts, S. C., & Buunk, A. P. (2011). Hormonal birth control use and relationship jealousy: Evidence for estrogen dosage effects. *Personality and Individual Differences*, 50, 315–317.
- Dainton, M., & Aylor, B. (2001). A relational uncertainty analysis of jealousy, trust, and maintenance in long-distance versus geographically close relationships. *Communication Quarterly*, 49, 172–188.
- Feinberg, D. R., DeBruine, L. M., Jones, B. C., & Little, A. C. (2008). Correlated preferences for men's facial and vocal masculinity. *Evolution and Human Behavior*, 29, 233–241.
- Feinberg, D. R., Jones, B. C., Law Smith, M. J., Moore, F. R., DeBruine, L. M., Cornwell, R. E., et al. (2006). Menstrual cycle, trait estrogen level, and masculinity preferences in the human voice. *Hormones and Behavior*, 49, 215–222.
- Frye, C. A. (2006). An overview of oral contraceptives: Mechanisms of action and clinical use. *Neurology*, 66, S29–S36.
- Gangestad, S. W., Garver-Apgar, C. E., Simpson, J. A., & Cousins, A. J. (2007). Changes in woman's mate preferences across the ovulatory cycle. *Journal of Personality and Social Psychology*, 92, 151–163.
- Gangestad, S. W., Simpson, J. A., Cousins, A. J., Garver-Apgar, C. E., & Christensen, P. N. (2004). Women's preference for male behavioral displays change across the menstrual cycle. *Psychological Science*, 15, 203–207.
- Gangestad, S. W., & Thornhill, R. (1998). Menstrual cycle variation in women's preferences for the scent of symmetrical men. *Proceedings of the Royal Society Biological Sciences*, 262, 727–733.
- Gangestad, S. W., & Thornhill, R. (2008). Human oestrus. *Proceedings of the Royal Society Biological Sciences*, 275, 991–1000.
- Geary, D. C., DeSoto, C. M., Hoard, M. K., Skaggs Sheldon, M., & Lynne Cooper, M. (2001). Estrogens and relationship jealousy. *Human Nature*, 12, 299–320.
- Grammer, K. (1993). 5- α -androst-16-en-3 α -on: A male pheromone? A brief report. *Ethology and Sociobiology*, 14, 201–214.
- Havlíček, J., Roberts, S. C., & Flegr, J. (2005). Women's preference for dominant male odour: Effects of menstrual cycle and relationship status. *Biology Letters*, 256–259.
- Jones, B. C., Perrett, D. I., Little, A. C., Boothroyd, L., Cornwell, R. E., Feinberg, D. R., et al. (2005). Menstrual cycle, pregnancy and oral contraceptive use alter attraction to apparent health in faces. *Proceedings of the Royal Society Biological Sciences*, 272, 347–354.
- Knobloch, L. K. (2005). Relational uncertainty and relational information processing: Questions without answers? *Communication Research*, 32, 349–388.

- Kuukasjarvi, S., Eriksson, C. J. P., Koskela, E., Mappers, T., Nissinen, K., & Rantala, M. J. (2004). Attractiveness of women's body odors over the menstrual cycle: The role of oral contraceptives and receiver sex. *Behavioral Ecology*, *15*, 579–584.
- Little, A. C., Burriss, R. P., Petrie, M., Jones, B. C., & Roberts, S. C. (in press). Oral contraceptive use in women changes preferences for male facial masculinity and is associated with partner facial masculinity. *Psychoneuroendocrinology* (in press).
- Little, A. C., & Jones, B. C. (2012). Variation in facial masculinity and symmetry preferences across the menstrual cycle is moderated by relationship context. *Psychoneuroendocrinology*, *37*(7), 999–1008.
- Little, A. C., Jones, B. C., & Burriss, R. P. (2007). Preferences for masculinity in male bodies change across the menstrual cycle. *Hormones and Behavior*, *51*, 633–639.
- Little, A. C., Jones, B. C., & DeBruine, L. M. (2008). Preferences for variation in masculinity in real male faces change across the menstrual cycle: Women prefer more masculine faces when they are more fertile. *Personality and Individual Differences*, *45*, 478–482.
- Little, A. C., Jones, B. C., Penton-Voak, I. S., Burt, D. M., & Perrett, D. I. (2002). Partnership status and the temporal context of relationships influence human female preferences for sexual dimorphism in male face shape. *Proceedings of the Royal Society Biological Sciences*, *269*, 1095–1100.
- Miller, G., Tybur, J. M., & Jordan, B. D. (2007). Ovulatory cycle effects on tip earnings by lap dancers: Economic evidence for human estrus? *Evolution and Human Behavior*, *28*, 375–381.
- Penn, D. J., Damjanovich, K., & Potts, W. K. (2002). MHC heterozygosity confers a selective advantage against multiple-strain infections. *Proceedings of the National Academy of Sciences USA*, *99*, 11260–11264.
- Penn, D. J., & Potts, W. J. (1999). The evolution of mating preferences and major histocompatibility complex genes. *American Naturalist*, *153*, 145–164.
- Penton-Voak, I. S., Perrett, D. I., Castles, D. L., Kobayashi, T., Burt, D. M., Murray, L. K., et al. (1999). Menstrual cycle alters face preference. *Nature*, *399*, 741–742.
- Puts, D. A. (2005). Mating context and menstrual phase affect women's preferences for male voice pitch. *Evolution and Human Behavior*, *26*, 388–397.
- Rikowski, A., & Grammer, K. (1999). Human body odour, symmetry and attractiveness. *Proceedings of the Royal Society Biological Sciences*, *266*, 869–874.
- Roberts, S.C., Cobey, K.D., Klapilova, K., Havlicek, J. (in press). An evolutionary approach offers a fresh perspective on the relationship between oral contraception and sexual desire. *Archives of Sexual Behavior*. <http://dx.doi.org/10.1007/s10508-013-0126-9>.
- Roberts, S. C., Gosling, L. M., Carter, V., & Petrie, M. (2008). MHC-correlated odour preferences in humans and the use of oral contraceptives. *Proceedings of the Royal Society Biological Sciences*, *275*, 2715–2722.
- Roberts, S. C., Klapilová, K., Little, A. C., Burriss, R. P., Jones, B. C., DeBruine, L. M., et al. (2012). Relationship satisfaction and outcomes in women who meet their partner while using oral contraception. *Proceedings of the Royal Society Biological Sciences*, *279*, 1430–1436.
- Roberts, S. C., Little, A. C., Gosling, L. M., Perrett, D. I., Carter, V., Jones, B. C., et al. (2005). MHC-heterozygosity and human facial attractiveness. *Evolution and Human Behavior*, *26*, 213–226.
- Scheib, J. E., Gangestad, S. W., & Thornhill, R. (1999). Facial attractiveness, symmetry and cues of good genes. *Proceedings of the Royal Society Biological Sciences*, *266*, 1913–1917.
- Thornhill, R., & Gangestad, S. W. (1999). The scent of symmetry: A human sex pheromone that signals fitness? *Evolution and Human Behavior*, *20*, 175–201.
- Thornhill, R., Gangestad, S. W., Miller, R., Scheyd, G., McCollough, J. K., & Franklin, M. (2003). Major histocompatibility complex genes, symmetry, and body scent attractiveness in men and women. *Behavioral Ecology*, *14*, 668–678.
- Trussell, J. (2007). Contraceptive efficacy. In R. A. Hatcher et al. (Eds.), *Contraceptive Technology* (19th rev. ed.). New York: Ardent Media.
- Wedekind, C., Seebeck, T., Bettens, F., & Paepke, A. J. (1995). MHC-dependent mate preferences in humans. *Proceedings of the Royal Society Biological Sciences*, *260*, 245–249.
- Welling, L. L. M., Puts, D. A., Roberts, S. C., Little, A. C., & Burriss, R. P. (2012). Hormonal contraceptive use and mate retention behavior in women and their male partners. *Hormones and Behavior*, *61*, 114–120.