INTRASEXUAL COMPETITION: EFFECTS OF HORMONAL CONTRACEPTIVES

By

Hannah Ferguson

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Committee Membership

Dr. Amanda Hahn, Committee Chair

Dr. Amber Gaffney, Committee Member

Dr. Christopher Aberson, Committee Member

Dr. Christopher Aberson, Program Graduate Coordinator

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Abstract

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Hannah Ferguson

Women's intrasexual competition has been shown to fluctuate with fertility status, and in particular, with testosterone. It's increasingly common that women take some form of hormonal contraceptives, especially the combined oral contraceptive (COC) pill which has been shown to decrease testosterone levels. Progesterone-only methods such as the implant or shot have been shown to have higher levels of free testosterone compared to the pill. The current study investigates the differences in intrasexual competition between pill users and progesterone-only users. 773 women took several surveys that obtained their information regarding menstrual cycle, contraceptive use, relationship status, and also took the Scale for Intrasexual Competition. Results show that women using the COC pill had higher levels of intrasexual competition than women using the implant or shot. However, no effect of relationship status was found. This study adds to a growing body of literature about the behavioral effects of hormonal contraceptives.

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Introduction

Intrasexual competition is an evolutionary process by which members of the same sex compete with each other for access to mates (Andersson, 1994). These mating opportunities are important for organisms to pass on their genes to offspring. Darwin (1871)'s theory of sexual selection states that characteristics that attract the opposite sex will become more prominent in the population due to the fact that members with these characteristics will more easily obtain mates and therefore pass on their genetic material, including the ones coding for that characteristic. Particular mating strategies can also become more prevalent due to their success in gaining advantage in reproductive opportunities. There are many ways in which intrasexual competition presents itself across culture, sex, and species. Of particular interest to evolutionary psychology, are sex differences in how individuals compete for access to mates.

How do women compete?

Research shows there are sex differences in how intrasexual competition is expressed (e.g. Buss, 1988; Buunk & Fisher, 2009; Fisher 2004); males tend to engage in more direct aggression, while females tend to engage in more indirect aggression (Benenson, Markovits, Thompson, & Wrangham, 2011; Campbell, 2004). Direct aggression is generally characterized by physical fighting behaviors such as hitting, kicking, etc. whereas indirect aggression is generally characterized by more covert behavior, often described as "bitchy behavior" (Fisher, 2004). Vaillancourt (2013) reviews potential reasons why females are more likely to use indirect aggression than

direct aggression including minimizing harm, parental investment, and sexual fidelity. Although women can, and do, engage in both direct and indirect aggression, most studies of female intrasexual competition have focused more on the latter (e.g., Cobey, Kippling, & Buunk, 2013; Durante, Li, & Haselton, 2008; Hahn, Fisher, Cobey, DeBruine, & Jones, 2016; Vaillancourt & Sharma, 2011). These studies have identified two primary methods of female competition, self-promotion and competitor derogation. Self-promotion is defined as behaviors to enhance one's fitness, particularly in the realm of attractiveness such as wearing makeup or revealing clothing (Fisher & Cox, 2010). Competitor derogation refers to the behaviors enacted to reduce the appeal of another woman, such as gossip and "slut shaming" (Buss & Dedden, 1990).

Because intrasexual competition is an evolutionary process by which members of the same sex compete with each other for access to mates, women should compete with one another based on qualities that men find attractive in potential mates (Fisher & Cox, 2010). Previous research has shown that men generally rate physical attractiveness highly on a list of important mate qualities (Buss, 1989; Buss & Barnes, 1986; Feingold, 1990; Shackelford, Schmitt, & Buss, 2005). This suggests that women should compete with one another in terms of physical attractiveness. Generally this strategy presents itself in the form of using makeup (Mafra, Varella, Defelipe, Anchieta, de Almeida, & Valentova, 2020), ornamentation (e.g., jewelry or clothing; Durante, Griskevicius, Hill, Perilloux, & Li, 2010; Durante & Haselton, 2008; Zhuang & Wang, 2014), and body language (Grammer, Renninger, & Fisher, 2004). Thus, researchers tend to focus on how women manipulate their appearance in different competitive situations as a proxy for intrasexual

competition. Studies that have focused on these self-promotion tactics have often assessed what clothing women wear, demonstrating that women may "dress to impress" (i.e., dress more "sexily" or reveal more skin; Durante et al., 2010; Haselton, Mortezaie, Pillsworth, Bleske-Rechek, & Frederick, 2007), as well as what clothing/accessories women purchase, demonstrating that women may spend more on attractiveness-enhancing goods (Hudders, De Backer, Fisher, & Vyncke, 2014), during times of heightened competition.

Female intrasexual competition via competitor derogation has been studied in both the laboratory and real-world settings in a variety of ways. Some studies have used economic games in which participants are able to share or withold money from others; these studies have shown that women donate less money to other women when the other women are more attractive (Lucas & Koff, 2013). They have also found that during the high-fertility phase of the menstrual cycle, women tend to demand more money from other women, demonstrating a lack of intrasexual *cooperation* which may be interpreted as increased *competition* (Eisenbruch & Roney, 2016). Other studies have investigated how women react to other attractive women, measuring the negitave comments they make about attractive women (i.e., intolerance of sexy peers as a form of competitor derogation; Vaillancourt et al., 2011) and how their ratings of other women's attractiveness fluctuate across the menstrual cycle (i.e., decreasing ratings as a form of competitor derogation; Fisher, 2004).

When do women compete?

Given that the goal of intrasexual competition is gaining access to mates, it's important to engage in this behavior when it would be maximally successful. For women, a successful mating encounter (i.e., one that results in conception) can only occur during a limited fertile window each month due to fluctuating fertility levels across the menstrual cycle. This is a time in which females would particularly benefit from engaging in more intrasexually competitive behaviors. In light of this fact, several studies have explored fluctuations in female intrasexual competition as a function of fertility by studying how women express intrasexually competitive behaviors across the menstural cycle. For example, Durante and colleagues (2008) had women draw an outfit they would wear to a party and took photographs of women's actual outfit choices during periods of high fertility and low fertility. They found that women preferred more revealing and "sexy" clothing for both measures, especially for social events, closer to ovulation suggesting that women are more likely to engage in self-promotion tactics when fertile. Other studies have found similar results regarding these self-promotion behaviors - women tend to reveal more skin in their choice of dress when fertile (Haselton et al., 2007) and report wanting to buy more sexy clothing (Durante et al., 2010) and more luxurious clothing (Hudders et al., 2014) when fertile.

Women have also been found to engage in competitor derogation tactics when fertile. For example, women tend to rate other female faces as less attractive when fertile compared to when not fertile (Fisher, 2004). Lucas and Koff (2013) have investigated the extent to which women compete or cooperate in economic games across the menstrual

cycle. They found that when women were fertile, they withheld more money from attractive women than when not fertile. Together, these results suggest women's intrasexually competitive behavior, both derogation other females and self-promotion tactics, fluctuate with fertility.

Hormonal modulation of competition

Linking changes in female intrasexual competitiveness to fluctuating fertility is useful for testing hypotheses about the potential adaptive function of intrasexual competition, but it does not offer insight into the potential proximate mechanisms through which these changes occur. Given that the menstrual cycle is regulated by the hypothalamic-pituitary-ovarian axis (HPO axis), research has turned to investigating potential hormonal mechanisms to explain these observed differences.

The female menstrual cycle (see Figure 1) typically lasts about 28 days (Hall, 2010) and is divided into three stages: the menstrual phase (or menses, day 1 to 5), the follicular phase (or proliferative stage, day 6 to 14), and the luteal phase (or secretory stage, day 15 to 28). The primary hormones involved in regulating this cycle are follicle stimulating hormone (FSH), lutenizing hormone (LH), estradiol (E), and progesterone (P). During menstruation, circulating levels of all of these hormones are relatively low. Following the menstrual phase, the follicular phase begins as follicles inside the ovary begin developing in preparation for implantation. This process is triggered by an increase in follicle stimulating hormone (FSH) and lutenizing hormone (LH) In the late-follicular phase, LH levels surge triggering ovulation (i.e., the release of the dominant follicule).

This typically occurs 24 to 48 hours after the LH surge and signifies the end of the follicular phase. Near ovulation, women experience a surge in LH, have high levels of estrogen, and have a high estrogen-to-progesterone (E:P) ratio (Bao, Liu, Someren, Van, Hofman, Cao, & Zhou, 2003). During the subsequent luteal phase, women experience rising levels of progesterone, decreasing estrogen levels (though still higher levels than those during the menstrual phase), and a relatively low E:P ratio (as a result of the increasing progesterone and decreasing estrogen). If fertilization of the egg does not occur, estrogen and progesterone levels drop rapidly at the end of the luteal phase. This sudden drop triggers the shedding of the endometrial lining (i.e., menstruation), and the cycle begins again (Jabbour, Kelly, Fraser, & Critchley, 2006). See Figure 1 for a visual representation of relative hormonal levels across the menstrual cycle.

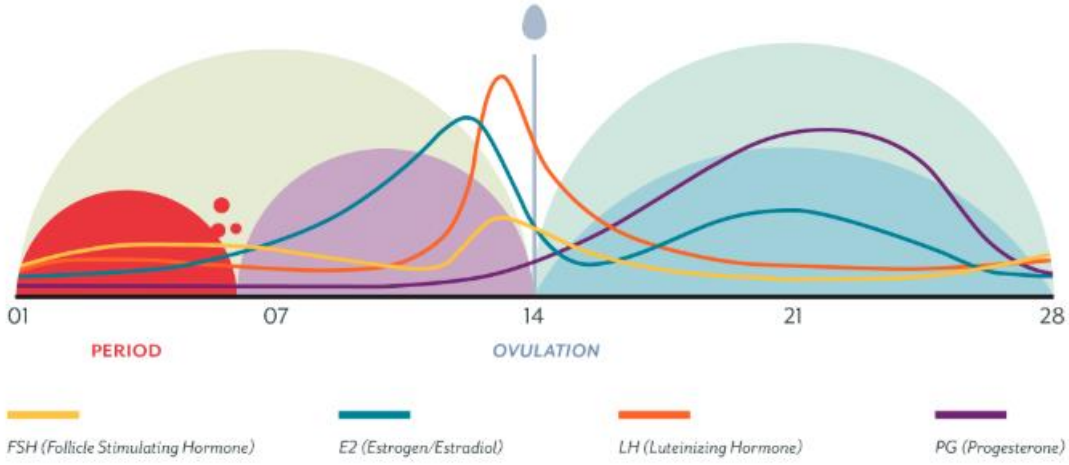

Figure 1. Major hormonal fluctuations across the menstrual cycle.

Because of their important role in governing the menstrual cycle, the majority of menstrual cycle research has speculated that the potential hormonal mechanisms underlying the observed fertility-linked changes in female intrasexual competition may be fluctuating levels of estrogen, progesterone and/or their ratio (because E:P ratio is considered a proxy for fertility; Lipson & Ellison, 1996).

Research in non-human animals has supported the notion that estrogen may modulate intrasexual competition. For example, studies in female macaques have shown that noncontact aggression toward other members of the group is positively related to circulating estrogen levels (Mallow, 1981; Walker, Wilson, & Gordon, 1983). Research on female rodents has found that intrasexual competition, in the form of scent-marking behaviors, increases with estrogen administration providing evidence of a more causal relationship between estrogen and competition (Takahashi, 1990). However, ovariectomized female rats given exogenous estrogen do not demonstrate increased aggression toward unfamiliar conspecifics (van der Poll, van Zanten, & de Jonge, 1986) and research on castrated male rats found that estrogen administration had no effect on aggressive behaviors (Work & Rogers, 1972), potentially calling into question the assumed link between estrogen and competition.

Interestingly, research on humans has generally failed to show this link between estrogen and female intrasexual competition. Studies that directly measured hormone levels in women have shown that there is no effect of estrogen or progesterone on self-reported intrasexual competition (Hahn et al., 2016) or the likelihood of wearing red (a

potential self-promotion behavior according to the authors, Blake, Dixson, O'Dean, & Denson, 2017; Eisenbruch, Simmons, & Roney, 2015).

While the human literature does not support a role of estrogen alone, there is some evidence that E:P ratio may be linked to fluctuations in female intrasexual competition. Eisenbruch, Simmons, & Roney (2015) examined the relationship between hormone levels, fertility, and likelihood of wearing red clothing as a form of intrasexual competition. Some researchers argue that women tend to choose to wear red clothing as opposed to other colors as a sexual signal, particularly in courtship situations in which they interact with an attractive male (Elliot, Greitemeyer, & Pazda, 2012). Eisenbruch and colleagues (2015) found that young women were more likely to wear red clothing when fertile than when non-fertile, and this relationship was mediated by a high E:P ratio. However, Blake, Dixson, O'Dean, & Denson (2017) attempted to replicate Eisenbruch's finding but did not find any relationship between E:P ratio and likelihood of wearing red clothing overall (note: when splitting their sample by age, the E:P effect was replicated in young women age 18-22 but not older women age 23-27). Additionally, Hahn et al. (2016) did not find any effect of E:P ratio on female intrasexual competition as assessed by a questionnaire. Overall, literature regarding the potential role of E, P, and the E:P ratio has provided equivocal results.

Although much of the menstrual cycle literature speculates about the role of estrogen and progesterone, given their central role in the cycle, the non-human animal literature has predominantly focused on the role of testosterone in governing competitive behavior (Wingfield, 1987; Smith, Raouf, Brown, Wingfield, & Brown, 2005). For

example, fluctuating levels of testosterone in red wing blackbirds have been linked to increased aggressive interactions (Cristol & Johnson, 1994), while the administration of exogenous testosterone has been shown to increase aggression in female rats (Pinna, Costa, & Guidotti, 2004). Brain and Haug (1993) give a review of testosterone's effect on different forms of aggression indicating overall that testosterone has a correlational and causal relationship with aggression. Given the well-established relationship between testosterone and competition in the non-human animal literature, it is possible that fluctuating levels of testosterone may explain previously observed fluctuations in intrasexual competition among human females, although there is some debate regarding how testosterone may fluctuate across the menstrual cycle. Some research shows that testosterone levels remain relatively constant across the menstrual cycle, with no significant peaks around ovulation (Dabbs, 1990), however other research shows a peak in testosterone levels near ovulation (Dabbs & de la Rue, 1991). Many researchers suggest that testosterone does slightly increase around ovulation and that this is the hormonal mechanism underlying increased competition around fertility, when conception is most likely to be successful. However, many of these studies do not actually measure hormones, but simply rely on the counting method (i.e. counting back/forward from last menstruation period to roughly gauge fertility) and assume a peak in testosterone around this time. The studies that have actually measured hormones across the cycle have not found conclusive evidence for a peak in testosterone around ovulation so this remains a point of contention in the literature.

In the human literature, many studies have looked at the relationship between testosterone levels and competition more broadly (e.g. sports, where the competition is not over access to potential mates) in women. Across the literature and in many different types of competition, from non-aggressive competition like chess to intensely aggressive rugby and soccer, women show a pre-game anticipatory rise in testosterone levels along with a post-game decline, with winners of competition showing higher post-game testosterone than losers (Booth, Shelley, Mazur, Tharp, & Kittok, 1989; Mazur, Booth, & Dabbs, 1992; Bateup, Booth, Shirtcliff, & Granger, 2002; Oliveira, Gourveia, & Oliveira, 2009; Edwards, Wetzel, & Wyner, 2005).

Booth, Shelley, Mazur, Tharp, and Kittok (1989) investigated testosterone fluctuations in tennis players in relation to competition and the effect of winning or losing in singles and doubles matches. They showed that losing in a singles match led to decreased testosterone levels across the match while winning led to increased testosterone, however this effect was not as pronounced in the doubles matches. Additionally, other research in rugby players has shown that women experience a smaller anticipatory increase in testosterone, but a larger increase across competition than do male counterparts (Bateup et al., 2002).

Relatively less work has been done investigating the link between testosterone and intrasexual competition among women. Hahn, Fisher, Cobey, DeBruine, and Jones (2016) measured naturally cycling women's hormone levels on a weekly basis for 5 weeks, using Buunk and Fisher's (2009) intrasexual competition 12-item scale to assess women's self-reported intrasexual competitiveness. They found that women reported

higher levels of intrasexual competition when they had higher levels of endogenous testosterone. Similarly, Cobey, Kippling, and Buunk (2013) found that initiation of the combined oral contraceptive pill, which has been shown to suppress endogenous testosterone (Zimmerman, Eijkemans, Coelingh Bennink, Blankenstein, & Fauser, 2014), reduces reported intrasexual competition. Their study assessed intrasexual competition among women before (assessed at high and low fertility) and after initiating use of "the pill", using the same 12-item scale as Hahn et al. (2016). They found that pair-bonded, but not single, women had lower levels of reported intrasexual competition when taking the pill compared to when naturally cycling, with no difference as a result of high vs low fertility (note that Hahn et al., 2016 did not find that partnership status moderated the observed relationship with testosterone levels). The claim that testosterone may modulate female intrasexual competition is further supported by findings that show women experience increases in testosterone in response to imagining another woman flirting with their partner (Ritchie & van Anders, 2014) and as a result of viewing attractive men (Lopez, Hay, & Conklin, 2009). Taken together, these studies suggest that testosterone levels play an important role in intrasexual competition in human females.

With the use of a clinical trial sample, Cobey et al (2013) provide causal evidence for the link between testosterone and female intrasexual competition; initiation of the pill, which suppresses endogenous testosterone levels, results in decreased reporting of intrasexual competition (at least in pair-bonded women). This study also highlights that hormonal contraceptives have the potential to modulate natural processes through a hormonal mechanism.

While there are now decades of research exploring potential health and behavioral side effects of hormonal contraceptives, the vast majority of these studies focus on the combined oral contraceptive pill ("the pill", contains synthetic estrogen and synthetic progesterone), but there are now many other forms of hormonal contraceptives available to and used by women world-wide that have received very limited attention in behavioral research. These additional hormonal contraceptives include progesterone-only contraceptives such as the implant or shot, and intrauterine device (IUD). The IUD acts locally in the uterus and fallopian tubes and so does not affect overall hormone levels throughout the body. However, the pill, implant, and shot act systemically (i.e., use exogenous hormones throughout the entire body to achieve the desired effect of keeping an egg from being released for fertilization). This systemic activity has the potential to affect the brain as well as the target organs, which may lead to behavioral effects. With different hormonal compositions (namely the presence or absence of estrogen), it is plausible that these various contraceptive options may differently affect women's behavior. One potential mechanism for such differences could be the effect of these contraceptive methods on testosterone levels. Studies have shown that the pill reduces testosterone levels by increasing sex hormone-binding globulin (SHBG) levels (Panzer, Wise, Fantini, Kang, Munarriz, Guay, & Goldstein, 2006; Zimmerman et al., 2014). SHBG acts by inactivating testosterone so it cannot bind to other receptors to exert its effects. On the contrary, progesterone-only methods evidently decrease overall testosterone levels. However, some research shows they also decrease SHBG levels (Merki-Feld, Imthurn, Rosselli, & Spanaus, 2011; Panzer et al., 2006). This indicates that

the levels of free testosterone are possibly a better indicator of effects on behavior as opposed to overall testosterone levels. Some research highlights this difference by showing that progesterone-only contraceptives have no effect on free testosterone levels (Barbosa, Coutinho, Athayde, Ladipo, Olsson, & Ulmsten, 1996; Segall-Gutierrez, Du, Niu, Ge, Tilley, Mizraji, & Stanczyk, 2012). Studies explicitly comparing COC users to P-only contraceptive users indicate that COC users have no differences in overall testosterone levels, but higher levels of SHBG-bound testosterone and lower levels of bioavailable free testosterone (Schaffir, Isley, & Woodward, 2010).

These studies indicate that the pill likely reduces the levels of bioavailable testosterone to a greater degree than progesterone-only methods, suggesting that there may be behavioral differences among users of these two contraceptive categories if the behavior in question is influenced by testosterone, as is the case with female intrasexual competition. Since the free bioavailable testosterone is the active isoform that would be able to actually exert its effects in the body and this form of testosterone differs among contraceptive categories, I hypothesize that pill users and P-only users will differ in behaviors related to testosterone (i.e. competition). Specifically, pill users will have lower levels of intrasexual competition than P-only users.

Method

Data collection for this study was done in the Behavioral Endocrinology Research Lab at HSU and online (note that the same survey presentation was used regardless of testing location). Participants completed a brief demographic survey (age, sex, sexual

orientation) when creating a user account. They were then asked to report if they currently use hormonal contraceptives (yes/no), and if so which type of contraceptive they use (e.g., pill, patch, shot, etc. along with the exact brand name of their contraceptive). Participants were also asked about their current relationship status.

Data for 773 heterosexual women who reported currently using the combined oral contraceptive pill or a systemic progesterone-only hormonal contraceptive (either the implant or shot) was available for analysis. Of these, 665 women reported currently taking the combined oral contraceptive pill (M_{age} = 21.20, SD = 3.90) and 108 women reported taking a systemic progesterone-only contraceptive (M_{age} = 21.06, SD = 2.59). Within this sample, 198 women reported that they were single or unpartnered at the time of testing, 384 reported that they were partnered, and 191 declined to answer. A sensitivity test (using the *pwr2ppl* package in R) indicated that a sample of 773 gives a power of .80 to detect effects as small as d = 0.30 and a power of .95 to detect effects as small as d = 0.40.

To assess intrasexual competition, women completed Buunk's (1997) Scale for Intrasexual Competition. This is a 12-item survey that asks women to report how much each of a series of statements applies to them, using a 1 (not at all applicable) to 7 (completely applicable). Example items include "when I go out I can't stand it when men pay more attention to a same-sex friend of mine than to me" and "I wouldn't hire an attractive woman as a colleague" (see Appendix A for the full Scale for Intrasexual Competition). This scale has been used in many previous studies of female intrasexual competition, including those that previously have shown hormonal variation in

intrasexual competition (e.g., Cobey et al., 2013; Hahn et al., 2016), and has been shown to have high validity (Buunk & Fisher, 2009). The 12 items on this scale were presented in a fully randomized order.

Results

Data was analyzed using a Welch's independent samples t-test to account for unequal sample sizes due to the fact that the pill is a much more common form of hormonal contraception (*N* pill users = 665, *N* other = 108). Contrary to the predicted results, this test showed that pill users ($M = 2.92$, $SD = 1.17$) reported significantly *higher* levels of intrasexual competition than did progesterone-only contraceptive users ($M = 2.60$, $SD = 1.02$), $t(157) = 2.98$, $p = .003$, *95% CI* [0.11, 0.54], $d = 0.28$. This is illustrated in Figure 1.

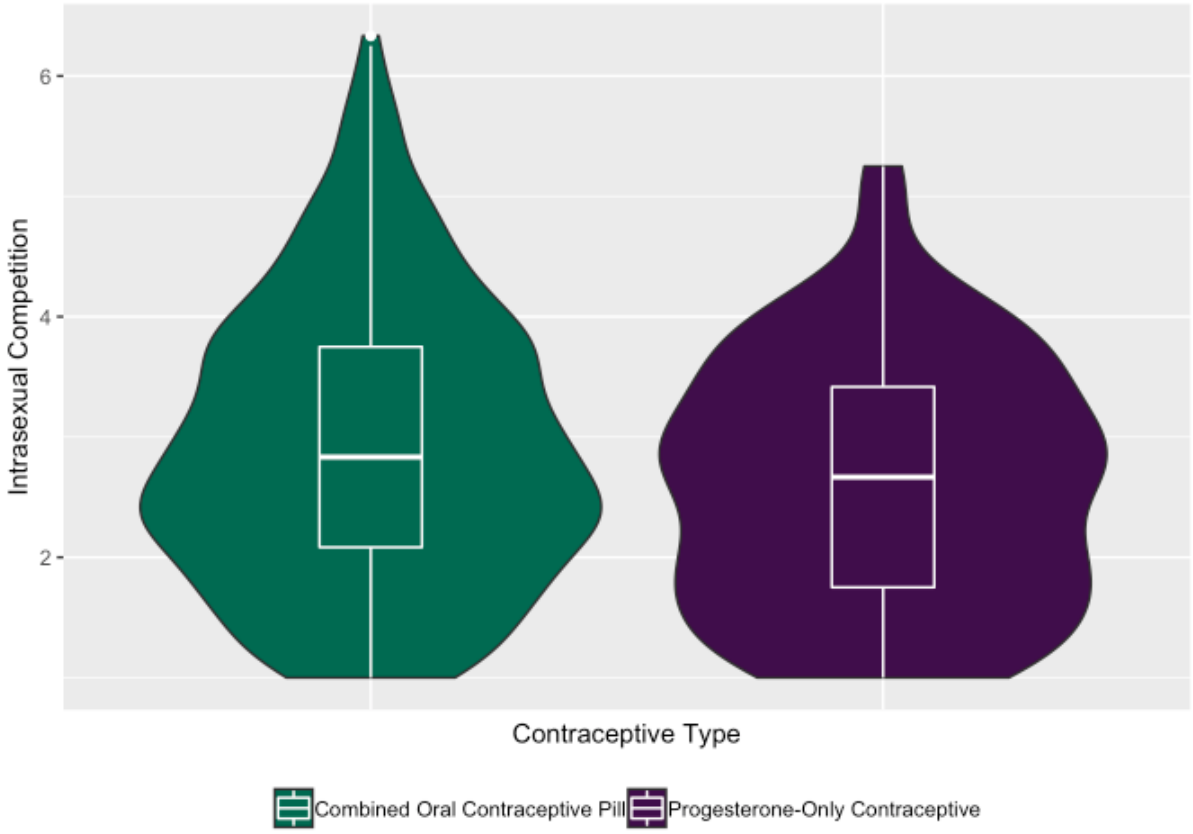

Figure 2. Violin plot comparing intrasexual competition between pill users and progesterone-only (implant/shot) users

Although the primary research question was regarding differences between women using combined versus progesterone-only hormonal contraceptives, previous research has suggested that partnership status may impact the potential effect of hormonal contraceptives on women's reported intrasexual competition (Cobey et al., 2013, but see Hahn et al., 2016). To explore the potential effect of partnership status in the current sample, a 2x2 anova was run using contraceptive type and relationship status as between subject factors for the subset of women who reported their partnership status (N = 582).

Because these data violated the normality assumption (large positive skew observed), a log transformation was used which met normality assumptions. An anova with transformed values showed no significant main effect for contraceptive type, $F(1, 578) = 2.70$, $p = .101$, partial $\eta^2 = .007$, or relationship status, $F(1, 578) = 2.39$, $p = .123$, partial $\eta^2 = .002$. There was also no interaction between relationship status and contraceptive type $F(1, 578) = 1.86$, $p = .174$, partial $\eta^2 = .003$, as illustrated in Figure 2. Women on the pill that were single (N = 169, M = 2.80, SD = 1.17) or partnered (N = 321, M = 2.68, SD = 1.05) did not have significantly different levels of intrasexual competition compared to women using progesterone-only methods that were single (N = 63, M = 2.82, SD = 1.09) or partnered (N = 29, M = 2.38, SD = 0.99).

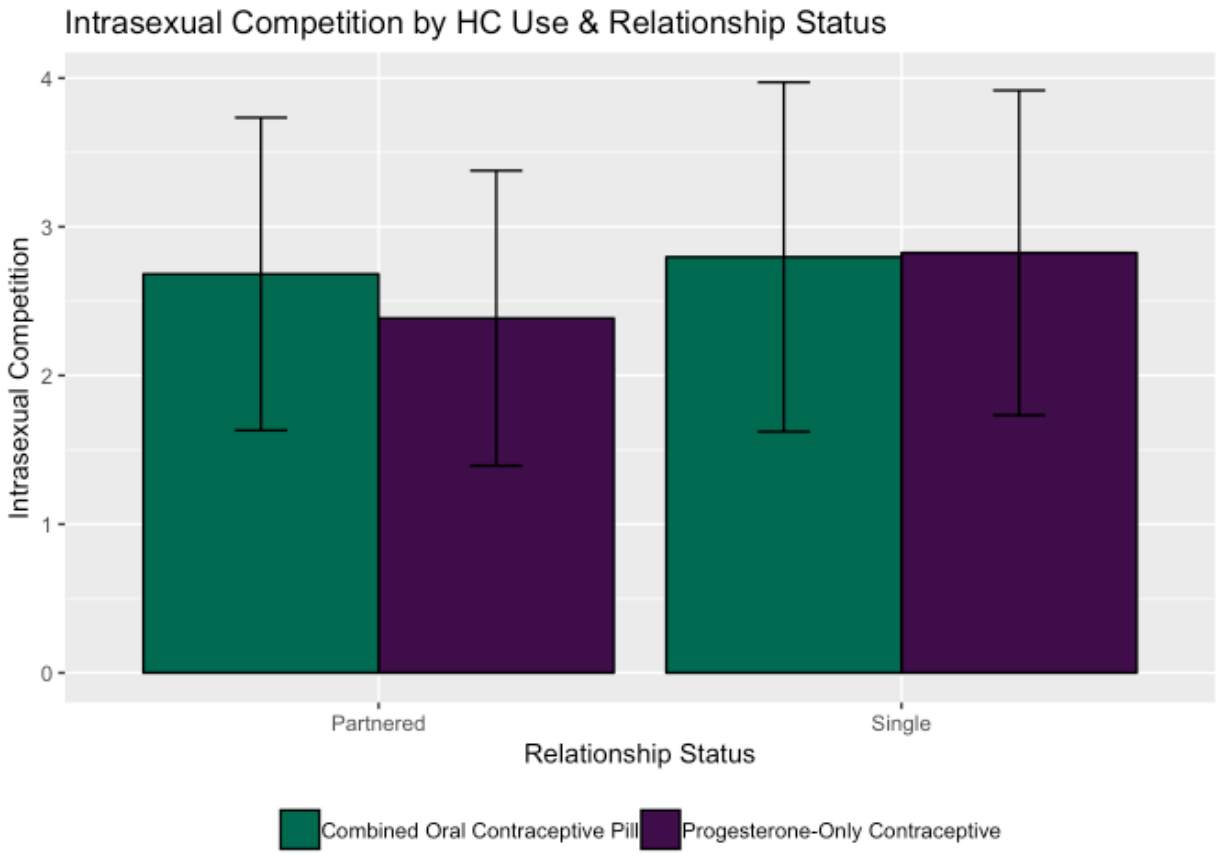

Figure 3. Boxplot showing no interaction between contraceptive type and relationship status on levels of intrasexual competition.

Discussion

The current study aimed to investigate potential differences in intrasexual competition between women using combined oral contraceptives and progesterone-only contraceptives. Participants answered a series of questionnaires related to their contraceptive use, relationship status, and menstrual cycle information. They also took the Scale for Intrasexual Competition (Buunk & Fisher, 2009) which measures self-reported intrasexual competitiveness.

Because previous research has suggested that testosterone may upregulate women's intrasexual competition (Cobey et al., 2013; Hahn et al., 2016) and because the combined oral contraceptive pill has been found to lower bioavailable, free testosterone levels more so than progesterone-only methods do (Schaffir, Isley, & Woodward, 2010), we predicted that women using the combined oral contraceptive pill would report lower levels of intrasexual competition than women using progesterone-only methods. However, our results did not support this hypothesis; in fact, the opposite pattern was detected whereby women using the combined oral contraceptive pill reported higher levels of intrasexual competition than women using progesterone-only methods.

There are a number of potential explanations for this finding. Firstly, it's notable that our sample had almost six times more women using the pill (N = 665) compared to women using a progesterone-only contraceptive (N = 108). With these extremely unequal sample sizes, it's very likely that the pill group simply has more variability in the data. Taking a look at the violin plot in Figure 1, we see that this is in fact the case that the pill

group has a much more positive skew, including a few potential outliers, compared to the progesterone-only group.

It could also be the case that "lumping" hormonal contraceptive users into these two broad categories impacts the results. There are many different versions of the combined oral contraceptive pill. Most notably, these different pills contain varying dosages of synthetic estradiol. We know that the exogenous levels of estrogen plus progestins act as the mechanism to reduce endogenous testosterone levels so it may be that these different formulations of the pill impact testosterone differently. Research looking at the effects of different pill formulations has found significantly different levels of SHBG and free testosterone between pill users (van der Vange, Blankenstein, Kloosterboer, Haspels & Thijssen, 1990). Furthermore, we also grouped together progesterone methods-the implant and shot-however these methods could have slightly different effects on testosterone. Previous research that directly compared testosterone levels between the pill and progesterone-only contraceptives only included women using the shot, not the implant, in their sample (Schaffir et al., 2010). Additional research has shown the effects of varying levels of progesterone on free testosterone and SHBG levels (van der Vange et al., 1990), so it's possible that these different forms of progesterone-only methods have different effects on testosterone and/or behavior as well.

It is also possible that these results could, in part, be due the difference in circulating free testosterone levels in women using the pill versus progesterone-only methods not being enough to elicit significant differences in behavior. In line with this explanation, previous research that has explored differences among pill and p-only users

in sexual responses failed to detect any significant behavioral differences among these two groups despite observing lower free testosterone levels among pill users (Schaffir et al., 2010). However, a larger sample size would be needed to further explore this potential explanation. Though this research did show lower free testosterone in pill users, this measurement was taken peripherally using venipucture which may not be indicative of circulating testosterone levels in the brain. Additionally, even if testosterone levels were the same centrally and peripherally, testosterone receptor density can have an effect on how potent testosterone can be in the brain (and by extension, on behavior). To our knowledge, there is not much research showing the effects of hormonal contraceptive on receptor density. Thus, we can only speculate how lowered testosterone in the blood would exert its effects in the brain.

It could also be that testosterone levels were affected differently for different women depending on how prolonged their use of the contraceptive was. Research has shown that SHBG levels are only significantly lowered 2 weeks after the initiation of the shot, but return to normal levels after 12 weeks (Jeppsson, Gershagen, Johansson, & Rannevik, 1982).

The secondary aim of this study was to potentially clarify the role of partnership status. One previous study (Cobey et al., 2013) found that the combined oral contraceptive pill reduced intrasexual competition in partnered but not single women, suggesting that relationship status may impact the effects of testosterone on female intrasexual competition. A more recent study of the effects of fluctuations in endogenous testosterone on female intraseuxal competition, however, failed to replicate this finding

regarding relationship status (Hahn et al., 2016). In line with this later study, our results also did not show an effect of relationship status on intrasexual competition. Though Cobey et al. (2013) did find that partnered women (N = 14) using the pill had lower levels of intrasexual competitiveness, our analyses showed no effect of being single (N = 53) or partnered (N = 100) on intrasexual competition. Hahn et al. (2016) also did not observe this effect with 90 single and 46 partnered women. This could be further evidence that the effect found by Cobey et al. (2013) could be a false positive found within a small sample size that cannot be replicated with larger sample sizes. However it should be noted again that there were extremely unequal sample sizes for this analysis. There were much more partnered (N = 321) and single (N = 169) women on the pill than partnered (N = 63) and single (N = 29) on progesterone-only methods. With such a massive difference in sample sizes, these findings should be observed cautiously. It's also noteworthy that this study employed a between-subjects design rather than the within-subjects design used in the previous research that found an effect of testosterone on intrasexual competition (Cobey et al., 2013; Hahn et al., 2016).

Of note, the method for assessing female intrasexual competition has varied widely in the literature and it is possible that this contributes to differences in findings across studies. Some research on women's intrasexual competition has primarily focused on self-promotion tactics (mainly in the form of clothing choice, e.g., Durante et al., 2008; Eisenbruch et al., 2015; Haselton et al., 2007), while other research has focused on more observable behavior through competitor derogation (Vaillancourt et al., 2011; Fisher, 2004; Lucas et al., 2013). The current study as well as the Cobey et al., (2013)

and Hahn et al., (2016) studies utilized a self-report questionnaire to determine women's intrasexual competition tendencies. This questionnaire was selected for the current study in order to keep a high level of methodological consistency with the previous work that has measured hormone levels directly (Hahn et al., 2016) or assessed the impact of hormonal contraceptive use (Cobey et al., 2013). While this questionnaire does touch on both self-promotion and competitor derogation tactics to some degree, it is possible that researchers may find more observable differences in actual behavior as opposed to self-reported behaviors. Observing women's intrasexual behaviors in a courtship style setting would be more ideal than a self-report of behaviors in a laboratory setting. This is especially true given the nature of the Intrasexual Competition Scale, which can potentially show lack of cooperation. Agreeing with these statements has the potential to damage a female's reputation for not being a good member of the group, so it is a possibility that women were giving more socially desirable answers. However, a direct observation of behavior would be a better demonstration of competition since they are behaviors, not feelings.

In conclusion, our findings show that women using the combined oral contraceptive pill had higher self-reported intrasexual competition than women using the implant or shot. However, our findings did not show an interaction between type of contraceptive and relationship status. Future research should aim to employ a within subject design with a randomized controlled trial to emulate Cobey et al. (2013) to directly test the causal effects of contraceptive type on intrasexual competition. Additionally, future research would benefit from investigating the differences between

each contraceptive type separately instead in two broad categories to see the individual differences on testosterone levels and behavior.

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Appendix

SCALE FOR INTRASEXUAL COMPETITION: English version

Primary reference:

Buunk, A.P., & Fisher, M. (2009). Individual Differences in Intrasexual Competition. *Journal of Evolutionary Psychology*, *7*, 37-48.

Response scale for all items:

1 2 3 4 5 6 7

Not at all applicable Completely applicable

[Version for women]

Please indicate how much the following statements apply to you. Circle the number that corresponds to the answer of your choice.

1. I can't stand it when I meet another woman who is more attractive than I am.

2. When I go out, I can't stand it when men pay more attention to a friend of mine than to me.

3. I tend to look for negative characteristics in attractive women.

4. When I'm at a party, I enjoy it when men pay more attention to me than to other women.

5. I wouldn't hire a very attractive woman as a colleague.

6. I just don’t like very ambitious women.

7. I tend to look for negative characteristics in women who are very successful.

8. I wouldn't hire a highly competent woman as a colleague.

9. I like to be funnier and more quick-witted than other women.

10. I want to be just a little better than other women.

11. I always want to beat other women.

12. I don’t like seeing other women with a nicer house or a nicer car than mine.