



A longitudinal analysis of women's salivary testosterone and intrasexual competitiveness



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ABSTRACT

Research on within-subject changes in women's intrasexual competitiveness has generally focused on possible relationships between women's intrasexual competitiveness and estimates of their fertility. While this approach is useful for testing hypotheses about the adaptive function of changes in women's intrasexual competitiveness, it offers little insight into the proximate mechanisms through which such changes might occur. To investigate this issue, we carried out a longitudinal study of the hormonal correlates of changes in intrasexual competitiveness in a large sample of heterosexual women ($N = 136$). Each woman provided saliva samples and completed an intrasexual competitiveness questionnaire in five weekly test sessions. Multilevel modeling of these data revealed a significant, positive within-subject effect of testosterone on intrasexual competitiveness, indicating that women reported greater intrasexual competitiveness when testosterone was high. By contrast, there were no significant effects of estradiol, progesterone, estradiol-to-progesterone ratio, or cortisol and no significant effects of any hormones on reported relationship jealousy. This is the first study to demonstrate correlated changes in measured testosterone levels and women's reported intrasexual competitiveness, implicating testosterone in the regulation of women's intrasexual competitiveness.

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1. Introduction

Intrasexual competition refers to competition between individuals of the same sex for access to mating opportunities (Andersson, 1994). Most work on intrasexual competition in humans has focused on direct (i.e., physically aggressive) competition among men (Stockley and Campbell, 2013). Although direct competition among women clearly does occur (Stockley and Campbell, 2013), intrasexual competition among women more commonly takes other forms, such as self-promotion and the derogation of competitors (Vaillancourt, 2013).

Studies investigating the physiological factors that may be implicated in changes in women's intrasexual competitiveness have generally focused on a possible relationship between estimates of women's fertility and measures of their intrasexual competitiveness. For example, during the high-fertility phase of their menstrual cycle, women are more motivated to dress sexily

(Durante et al., 2008; Haselton et al., 2007), more likely to purchase desirable consumer goods (Durante et al., 2011), and more likely to withhold resources from attractive women (Lucas and Koff, 2013). While these results link women's fertility to the extent to which they engage in self-promotion, other work has examined the relationship between fertility and the extent to which women derogate other women's attractiveness. For example, young women are more likely to derogate other women's attractiveness during the high-fertility phase of their menstrual cycle than during other phases (Fisher, 2004). Similarly, pre-menopausal women are more likely to derogate other women's attractiveness than are post-menopausal women (Vukovic et al., 2009). Increases in intrasexual competitiveness around ovulation, such as those described above, are suggested to occur because successful competition for mating opportunities with high-quality mates is more likely to translate into fitness benefits at this time (Durante et al., 2008, 2011; Fisher, 2004; Haselton et al., 2007; Lucas and Koff, 2013; Vukovic et al., 2009).

The approach adopted by the studies described in the previous paragraph (i.e., linking changes in competitiveness to fertility) is useful for testing hypotheses about the adaptive function of

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changes in women's intrasexual competitiveness. However, it offers little insight into the proximate mechanisms through which such changes might occur. In an effort to address this issue, recent work has compared women's intrasexual competitiveness during the late-follicular and mid-luteal cycle phases and following hormonal contraceptive use in an effort to infer the hormonal correlates of changes in women's intrasexual competitiveness (Cobey et al., 2013). Cobey et al. (2013) found that partnered women's reported intrasexual competitiveness was lower following hormonal contraceptive use than it was during either the late-follicular or mid-luteal phases of the cycle when these women were not using hormonal contraceptives. Moreover, intrasexual competitiveness did not differ between these late-follicular or mid-luteal phases. Since hormonal contraceptive use lowers testosterone levels in women (Zimmerman et al., 2014) and evidence that testosterone levels change between the late-follicular and mid-luteal phases is mixed (Dabbs, 1990; Dabbs and de La Rue, 1991; see also Caruso et al., 2014), Cobey et al. (2013) speculated that the observed changes in women's intrasexual competitiveness may be a consequence of changes in their testosterone levels. Indeed, this explanation would be consistent with findings showing that women's testosterone levels increased after they imagined their partner flirting with an attractive woman (Ritchie and van Anders, 2014) or were exposed to olfactory cues associated with ovulation in other women (Maner and McNulty, 2013). This explanation would also be consistent with findings from research with some non-human animals (e.g., birds and rats), which suggests that testosterone administration increases intrasexual competitiveness (Albert et al., 1990; Zysling et al., 2006).

Although Cobey et al. (2013) suggested that women's intrasexual competitiveness may track naturally occurring changes in their testosterone levels, no previous studies have tested for correlated changes in women's intrasexual competitiveness and measured testosterone levels. Thus, we investigated the hormonal correlates of within-subject changes in women's reported intrasexual competitiveness. We did this using a longitudinal design, in which women reported their intrasexual competitiveness and provided saliva samples in five consecutive weekly test sessions. Following Cobey et al. (2013), we assessed intrasexual competitiveness using Buunk and Fisher (2009) intrasexual competitiveness scale. Our analyses considered the possible effects of testosterone, estradiol, progesterone, estradiol-to-progesterone ratio, and cortisol, as well as women's partnership status. This type of design has recently been used to investigate the hormonal correlates of changes in women's responses to facial and vocal cues (Hahn et al., 2015; Pisanski et al., 2014; Wang et al., 2014) and appearance (Jones et al., 2015).

While some research implicates testosterone in the regulation of women's intrasexual competitiveness (Cobey et al., 2013; Maner and McNulty, 2013; Ritchie and van Anders, 2014), other work suggests that relationship jealousy (i.e., the extent to which women would become jealous at the thought or observation of their partner interacting with another woman) varies as a function of women's estradiol. Geary et al. (2001) reported that salivary estradiol and reported jealousy were positively correlated and Cobey et al. (2012) found that women reported greater jealousy during the high-fertility, late-follicular phase of their menstrual cycle and that partnered women reported greater jealousy following hormonal contraceptive use. Reported jealousy (Cobey et al., 2011) is also greater among women using high-estrogen hormonal contraceptives than among women using low-estrogen hormonal contraceptives. In light of these findings, we also investigated the hormonal correlates of changes in women's reported relationship jealousy. We assessed relationship jealousy using Buunk's (1997) jealousy scale, which has previously been used in work investigating differences in jealousy as a function of hormonal contraceptive

use and cycle phase (Cobey et al., 2012) and hormonal contraceptive estrogen dosage (Cobey et al., 2011). That previous research has linked women's reported relationship jealousy and intrasexual competitiveness to estradiol and testosterone respectively, suggests that reported relationship jealousy and intrasexual competitiveness may be related, but dissociable, behaviors.

2. Methods

2.1. Participants

Participants were 141 heterosexual women (mean age = 21.58 years, $SD = 3.12$ years) at the University of Glasgow. Participants were recruited via an advert circulated to all women registered with the School of Psychology (University of Glasgow) participant pool. Participants were recruited only if they were not currently using any hormonal supplements (e.g., oral contraceptives) and had not used any form of hormonal supplements in the 90 days prior to their participation. None of the participants reported being pregnant, having been pregnant recently, or breastfeeding. Forty-seven of the women reported that they were currently in a romantic relationship and 94 of the women reported that they were not. Each participant completed five consecutive weekly test sessions. Data on 45 of these women's voice preferences are reported in Pisanski et al. (2014). Data on the reward value of adult facial attractiveness and infant facial cuteness for 39 and 45 of these women are reported in Wang et al. (2014) and Hahn et al. (2015), respectively. Data on the facial coloration of 64 of these women are reported in Jones et al. (2015). Data on 44 of these women's makeup preferences are reported in Fisher et al. (in press). Note that, other than the hormone values, there was no overlap in the data analyzed across these pieces of work.

2.2. Assessing intrasexual competitiveness and relationship jealousy

In each test session, participants completed Buunk and Fisher's (2009) intrasexual competitiveness scale and Buunk's (1997) jealousy scale, following Cobey et al. (2013) and Cobey et al. (2012), respectively. Buunk and Fisher's (2009) intrasexual competitiveness scale is a 12-item questionnaire on which participants indicate how applicable each item is to them using a one to seven scale, with higher scores indicating greater intrasexual competitiveness. Examples of scale items include, "I want to be just a little better than other women" and "I tend to look for negative characteristics in women who are very successful". Following (Buunk and Fisher, 2009), scores for the 12 items were averaged; the mean score for the sample was 2.76 ($SD = 1.09$). Consistency across items was high (Cronbach's $\alpha = .90$). Previous research has demonstrated that responses on this scale are sensitive to contextual factors (Buunk and Massar, 2012; see also Cobey et al., 2013), suggesting it is appropriate for detecting changes in reported intrasexual competitiveness.

Buunk's (1997) jealousy scale is a 15-item questionnaire on which answers are reported on a one to five scale, with higher scores indicating higher levels of jealousy. Examples of scale items include "I am concerned that my partner finds someone else more attractive than me", "It is unacceptable to me that my partner has friends of the opposite sex", and "How would you feel if your partner would dance intimately with someone of the opposite sex?". Following Cobey et al. (2011, 2012), partnered women were instructed to consider these questions in the context of their current romantic partner and unpartnered women were instructed to consider these items in the context of their last romantic partner. Following (Cobey et al., 2012), scores for the 15 items were

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