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Original Article

Other women's fertility moderates female resource distribution across the menstrual cycle

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ABSTRACT

Status competition among female mammals tends to intensify near ovulation. Females compete selectively, targeting females who most threaten their own likelihood of conception. The present study explored the extent to which regularly cycling women differentially compete with other women in a behavioral economic game as a function of both women's fertility. We find evidence for an interaction between participant and target fertility, such that women withhold more resources from another woman, thereby keeping more for themselves, when both women are in the fertile (late follicular) phase of their menstrual cycle. Results expand research on women's perceptions of fertility cues in other women by demonstrating a possible role for such cues in modulating female social behavior.

There are only approximately six days in the average premenopausal woman's regular ovulatory cycle during which intercourse may result in conception (Wilcox, Dunson, Weinberg, Trussell, & Baird, 2001). During the late follicular (i.e., "fertile") phase of a woman's cycle, she is more likely to demonstrate mating-related psychology and behavior such as interest and engagement in, and potentially even initiation of, sexual behavior (Bullivant et al., 2014; Roney & Simmons, 2013). Near ovulation, women also tend to behave in ways that can increase their attractiveness to males, wearing revealing clothing (Durante, Li, & Haselton, 2008) and dancing and perhaps walking suggestively (Fink, Hugill, & Lange, 2012; but see Provost, Quinsey, & Troje, 2008). In addition to attracting potential mates directly, these behaviors may also divert male attention from other women. That is, these behaviors may be one way in which women compete with each other.

Indeed, fertile women's self-promoting behavior is elicited more by the presence of other women than of potential mates. For example, during their fertile phase, women preferred to purchase sexier clothing items when primed with images of attractive women, but not when primed with images of unattractive women or of attractive or unattractive men (Durante, Griskevicius, Hill, Perilloux, & Li, 2011). Other behaviors associated with aspects of competition have also been observed in women near ovulation (although see Cobey, Klipping, & Buunk, 2013), such as dehumanizing other women (Piccoli, Foroni, & Carnaghi, 2013) and giving other women fewer resources (Durante, Griskevicius, Cantú, & Simpson, 2014).[1]

Furthermore, fluctuations in competitive behavior throughout the estrous cycle can be observed across species, with competition tending to be highest among female mammals near estrous (Stockley & Bro-Jørgensen, 2011). In yellow baboons (*Papio cynocephalus*), for example, ovulating and pre-ovulating estrous females are more likely to form attack coalitions against other females (Wasser, 1983). Moreover, pre-ovulating (but not ovulating) estrous females are more likely to be the targets of such attacks (Rowell, 1972; Wasser, 1983), the effect of which is an increase in the number of cycles before conception (Wasser & Starling, 1988). A negative association between adult sex ratio (females/males) and birth rate in this species suggests that some attacks may reflect female competition for mating opportunities (Dunbar & Sharman, 1983). Yellow baboons live in multi-male, multi-female societies in which females mate promiscuously with multiple males. By contrast, humans tend to exhibit mildly polygynous mating with a high degree of social monogamy. Within socially monogamous relationships, women may exhibit mixed mating strategies, seeking out extra-pair copulations with mates of higher genetic quality than their long-term partner during peak fertility (Gangestad & Haselton, 2015). To the extent that mating opportunities with males of high genetic quality are limited, women may therefore confront increased mating competition when they are near peak fertility.

Successful intrasexual competition can increase opportunities to conceive and chances of offspring survival (Clutton-Brock & Huchard, 2013; Stockley & Bro-Jørgensen, 2011). However, intrasexual

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[1] Because research in this area is often underpowered, extant findings should be taken as suggestive of a relationship between fertility and competition, but not as definitive.

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Table 1
Descriptive statistics and breakdown by cell.

Variable	Fertile		Non-Fertile		*p*
	n	*M* (SD)	*n*	*M* (SD)	
Cycle Day	30	12.37 (1.85)	97	16.77 (10.47)	1.35E-4 *
Average Cycle Length	30	28.43 (2.32)	97	29.07 (3.51)	0.352
Demographic					
Age	30	21.82 (4.25)	97	21.81 (4.32)	0.990
Years of Education	30	13.90 (1.49)	97	14.16 (1.75)	0.456
Marital					0.378
Married	0		2		
Cohabitating	0		4		
Separated	0		0		
Divorced	0		0		
Widowed	0		0		
Never Married	30		91		
Ethnicity					0.439
African American	3		23		
Asian/Pacific Islander	10		32		
Caucasian	10		28		
Hispanic	3		8		
Native American	0		1		
Other	4		5		
Sexual Orientation					0.789
Heterosexual	25		70		
Bisexual	2		12		
Homosexual	0		1		
Decline to label my sexuality	2		9		
Choose not to respond	1		5		
Romantic Relationship					0.562
Romantically Uninvolved	20		70		
Romantically Involved	10		27		
Partner's Sexual Attractiveness	10	18.70 (3.53)	26	19.38 (3.98)	0.637
Fertile Opponent	15		52		
Non-Fertile Opponent	15		45		

Note: *p*-values indicate the results of *t*-tests for continuous variables (which also include means and standard deviations) or of Chi-squared tests for categorical variables. The only difference between the fertile and non-fertile groups was cycle day. The numbers of fertile and non-fertile participants who were randomly assigned to view a fertile and non-fertile opponent are included in the bottom two rows.

competition can also be costly, potentially leading women to overlook objectively better outcomes in favor of advancing their position *relative* to other women (Durante et al., 2014). Thus, women often compete selectively, engaging in competition preferentially with women who present proximate threats to reproductive resources, such as attractive women and women who live nearby (Durante et al., 2011, 2014; Lucas & Koff, 2013). Given that women have only a few days each month during which they are likely to conceive, the competitors who also experience increased conception risk and mating motivation during those days (e.g., other fertile women) may especially challenge a woman's ability to attract prospective mates' attention, thereby potentially decreasing her chances of reproduction.

Like men, women are attuned to subtle physical and behavioral cues to other women's fertility, such as facial and vocal attractiveness (Puts et al., 2013). These cues may induce competitive responses in women. For example, across four experiments, Krems, Neel, Neuberg, Puts, and Kenrick (2016) found that, after viewing photographs of other women taken during either their fertile or non-fertile ovulatory-cycle phases, partnered women consistently reported intentions to socially avoid fertile-phase (but not non-fertile-phase) women—but only when their own partners were highly desirable. Viewing fertile-phase women also increased women's sexual desires for their (highly desirable) partners. In another study, women experienced heightened levels of endogenous salivary testosterone (which may facilitate competitive behaviors) when exposed to olfactory cues from other women who were in the late follicular, but not luteal, phase of their cycle (Maner & McNulty, 2013). Preliminary findings also suggested that women with endocrine profiles consistent with the late follicular phase may be the only ones to exhibit this effect (Woodward, Thompson, & Gangestad, 2015), indicating that both a woman's own fertility and that of a potential rival could be important for mounting a testosterone response. In other words, not only does a woman's competitiveness over mates appear to be influenced by her own cycle phase and the cycle phase of other women, but the two may also exert an interactive effect on her competitive behavior.

Despite this intriguing possibility, to our knowledge, no study has used a behavioral indicator of competition to examine whether women's intrasexual competitive behavior differs as a function of both their own fertility and the fertility of their potential competitors. The goal of the present study was to therefore explore this hypothetical interaction. In the present study, we used resource distribution in the dictator game to measure aspects of competitive behavior. During the dictator game, one participant determines how much of a cash reward another participant will receive. Strong fairness norms typically lead most respondents to give their opponents part of the cash reward (Engel, 2011). Consistent with prior research (c.f., Durante et al., 2014), we reasoned that giving a potential opponent less money may provide a woman with greater competitive advantage, and that as the need to compete decreases, women might give more generously. We predicted that fertile women would give less to fertile opponents than to non-fertile opponents, but that there would not be an effect of opponent's fertility on non-fertile women.

1. Methods

1.1. Participants

Women who reported that they experienced menstruation in the past 35 days, were not taking hormonal contraceptives, and had not been diagnosed with a hormonal disorder ($N = 149$, aged 18–40 years, $M = 22.03$, $SD = 4.48$) provided consent and participated in a University of Chicago IRB-approved study. Eligible participants were pre-screened from a larger population. Prescreening surveys included distractor questions to mask criteria relevant to the study.

1.2. Procedure

Participants engaged in a Dictator Game, ostensibly with another participant in a different room. To obscure study purpose, we photographed participants smiling, neutral-faced, and frowning before they began the study to suggest that the study was about emotion. We informed participants that we would share their picture with the other "participant". Participants learned that each participant pair would receive $5 and that participants would be randomly assigned to play the role of the "Proposer," who could allocate any portion of the money to the other participant, or the "Receiver," who would receive the money that the Proposer allocated to them (all participants actually played Proposers and received whatever money they kept from the Receiver as compensation for participating). Participants were randomly assigned to view a photograph of one of four women (the "Receiver") in either her late follicular ("fertile") or luteal ("non-fertile") phase (assessed via hormonal sampling). Stimuli demonstrated maximal deviations in attractiveness and in estrogen-to-progesterone ratio between fertile and non-fertile phases and were obtained from Puts et al., 2013.[2] In a free response box beneath the Receiver's photo, participants indicated how much money they wanted to share with her. After the Dictator Game, participants reported their demographic

[2] Stimulus selection procedure in Supplementary Material, available on the journal's website at www.ehbonline.org. Because our stimulus selection procedure confounded opponent attractiveness and fertility, and because opponent attractiveness influences the size of offers that participants provide in behavioral economics games (Rosenblat, 2008), we include opponent attractiveness as a covariate in analyses.