

The effect of economic scarcity on women's direct aggression  
toward ovulating women

by

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### **Abstract**

When people feel like their relationship may be threatened by a rival, they engage in competition with the rival. Previous work has found that women are more jealous of and guard their partners more from women who are in the fertile phase of their ovulatory cycle than from women who are not in the fertile phase of their ovulatory cycle. If a woman's male partner had sex with a rival woman when the rival was in the fertile phase of her ovulatory cycle, the rival could become pregnant. Even if the primary relationship remained intact after the affair, the rival woman would likely receive resources from the male partner to help support their child. If resources play a role in this ovulatory effect, resource scarcity should increase the likelihood that participants will engage in direct aggression toward an ovulating rival. Research on women's intrasexual competition has found that women are more likely to engage in subtle and indirect forms of aggression (e.g., socially excluding the rival woman) than direct aggression (e.g., yelling at, or punching the rival). However, field and experimental research has found that women are more likely to engage in direct intrasexual aggression when resources are scarce than when resources are not scarce. In the current study, women in heterosexual relationships were primed to think about scarce resources or they were assigned to a control condition. Next, participants imagined that a female rival flirted with their romantic partner. The rival was pictured when she was ovulating or when she was not ovulating. Finally, participants reported their likelihood of engaging in a variety of aggressive behaviors. I predicted that the scarcity prime would moderate the effect of ovulation on aggression. Specifically, I hypothesized that participants' direct aggression would be highest when participants were primed with economic scarcity and they imagined their partner with an ovulating rival.

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## **Chapter 1**

### **The Effect of Economic Scarcity on Women's Direct Aggression**

#### **Toward Ovulating Women**

Gina Carano is an athlete known as the original queen of mixed martial arts (MMA; Macdonald, 2014). Her success took the world by storm, not only because she was a fierce fighter, but also because she was a fierce fighting woman. MMA requires direct, physical aggression, and historically, women have been perceived as relatively non-aggressive. Gina shattered that perception, demonstrating that sometimes, women can be quite aggressive. Until recently, behavioral scientists also believed that women were mostly non-aggressive (Konner, 1982; Maccoby & Jacklin, 1974). However, recent research findings tell a different story. Per statistics from the United States, young women account for 33% of arrests for simple assaults and 24% of arrests for aggravated assaults (U.S. Department of Justice, 2008). Statistics suggest that three out of four victims of violent female offenders are women (U.S. Department of Justice, 2000). Mirroring research on male-male competition, cross-cultural research suggests that most cases of female-female aggression occur over competition for mates (Burbank, 1987).

Human existence depends on people's ability to find and retain romantic partnerships. Not only must people find partners with whom to reproduce, but their children must live long enough to have children of their own. Paternal investment has been found to improve survival rates of children. Among Ache, a forest-dwelling preindustrial society, the mortality rate for children younger than 15 is 45% among father-absent children, compared to 20% for father-present children (Hill & Hurtado, 1996). Among a United States sample, infants were four times more likely to die within

the first 28 days of life when their fathers were absent than when their fathers were present (Alio, Mbah, Kornosky, Wathington, Marty, & Salihu, 2011). These findings suggest that there are fitness advantages (i.e., increased rates of one's genes surviving in future generations) for people who find and retain romantic partners.

Usually, women employ indirect strategies to compete against rivals for mates (Österman et al., 1998). Indirect strategies include spreading rumors or socially distancing oneself from a rival woman, whereas direct strategies involve face-to-face confrontations. There are multiple factors that may contribute to women being likely to aggress against a rival woman. Previous research has found that economically scarce environments increase the likelihood that women will directly aggress against other women (Burbank, 1987; Campbell, Muncer, & Bibel, 1998; Griskevicius et al., 2009). An ovulating rival may be perceived as a greater threat to a woman's resources because an ovulating rival could become pregnant if she had sex with a woman's romantic partner. The extra-pair pregnancy could lead the partner to divert his resources to the rival woman and the new child. I propose that a rival woman's ovulatory status will interact with economically scarce environments to increase women's direct aggression toward rival women. Specifically, I predict that women primed with economic scarcity will directly aggress more against ovulating rivals than non-ovulating rivals.

### **Factors that Increase Competition**

Romantic relationships provide people with a variety of benefits, including emotional, cognitive, physical, and monetary (e.g., Hazan & Shaver, 1987; Rusbult, 1963; Safilios-Rothschild, 1976; Sprecher, 1985). Given those benefits in addition to the evolutionary importance of human mate selection and reproduction, it is not surprising

that mate acquisition and retention appear to be fundamental human needs (Kenrick, Griskevicius, Neuberg, & Schaller, 2010). People desire close relationships (Baumeister & Leary 1995), and they compete with others to secure and retain those relationships. People use a variety of tactics to protect their partners from rivals. People can either enhance their desirability to their partners (intersexual selection) or they can compete against rivals (intrasexual competition; Buss, 1998b; Buss & Shackelford, 1997). The current proposal will focus on mate retention tactics that employ intrasexual aggression as a form of competition.

Competition can be costly in terms of one's time, energy, social image, health, and relationship. Indeed, jealousy, which is hypothesized to trigger competitive guarding of a romantic partner, has been associated with poor relationship quality (Buunk, 1991; Shackelford & Buss, 2000). Women in particular risk being socially ostracized for acting aggressively (Anderson, 1993; Campbell, 1993). For that reason, people should reserve competitive behaviors for extreme circumstances. Previous findings support this idea. Men's mate guarding increases when they perceive their partners to be highly attractive (Buss & Shackelford, 1997). Men's mate guarding also increases when their partners are near the fertile phase of their ovulatory cycle (i.e., partners are likely to become pregnant from sex with a rival man; Gangestad, Thornhill, & Garver, 2002; Haselton & Gangestad, 2006). Women also engage in more competition when the rival is highly threatening (Dijkstra & Buunk, 2001; Fink et al., 2014; Hurst, Alquist, & Puts, 2017; Krems, Neel, Neuberg, Puts, & Kenrick, 2016; Leenaars, Dane, & Marini, 2008; Puts, Barndt, Welling, Dawood, & Burriss, 2011; Vaillancourt & Sharma, 2011), and when the consequences of

a sexual affair are highly threatening (Hurst et al., 2017; Krems et al., 2016; Maner & McNulty, 2013; Woodward, Thompson, & Gangestad, 2015).

### **The rival is highly threatening**

Some rival women are more threatening to a relationship than others. Rivals may be threatening for a variety of reasons, such as being highly physically desirable to men, being perceived as sexually available, or being perceived as untrustworthy.

Because men are particularly interested in women who are physically beautiful (Buss & Schmitt, 1993), many women focus on physical beauty when they compete. Past work has found that women are more jealous of, feel more threatened by, and engage in more mate guarding toward rival women whom they perceive to be highly physically attractive (Dijkstra & Buunk, 1998; Fink et al., 2014; Hurst et al., 2017; Krems, et al., 2016; Puts, et al., 2011). Pictures of physically attractive rivals evoke more jealousy among women than pictures of physically unattractive rivals (Dijkstra & Buunk, 1998). Further, the higher women rate a rival's facial femininity, facial attractiveness, and breast size, the higher women rate the rival on perceived competition (Fink et al., 2014). The higher rivals are rated on facial attractiveness, the greater women's intentions to guard their romantic partners from the rivals (Hurst et al., 2017; Krems et al., 2016).

Studies suggest that women are more threatened by rivals who appear to be sexually available than rivals who do not appear to be sexually available. Among high school girls, as the number of recent sexual partners increased, reports of other girls derogating them increased (Leenaars et al., 2008). Women also report less interest in befriending a rival as the rival is described as more promiscuous (Bleske & Shackelford, 2001). Finally, women are less likely to befriend a rival and let their romantic partner

spend time alone with the rival when the rival is dressed in sexy clothing relative to conservative clothing (Vaillancourt & Sharma, 2011). This effect presumably occurs because women in sexy clothing are perceived to be more sexually available than women in conservative clothing.

In addition to being perceived as physically attractive and sexually available, a rival may also threaten a relationship if she is perceived as untrustworthy. A rival may be desirable to men and she may be willing to have sex with men, but if she is perceived as trustworthy, a woman may not feel as threatened by her as she would by an untrustworthy rival. If a rival is perceived as untrustworthy, one may assume that vigilance toward her is warranted. Previous work has found that women are more likely to guard their partners from rivals as their perceptions of the rival's trustworthiness decrease (Hurst et al., 2017; Krems et al., 2016). This effect was most pronounced when the women perceived their partners as highly desirable (i.e., the partner was worth guarding). Two separate research teams found that women with desirable partners perceived ovulating rivals as untrustworthy, and this was associated with less desire to befriend the rivals (Krems et al., 2016) and more desire to guard their partner from the rivals (Hurst et al., 2017). As women perceive a rival to be more threatening, women engage in more competitive behavior.

### **The consequences of an affair are highly threatening**

Relative to women who have abundant resources, women who have scarce resources (e.g., lack of job, money, food, shelter, etc.) incur more costs if their partner deserts them and diverts his resources to rival women. Scarce resources limit reproduction. Not only must women be nutritionally sustained in order to ovulate and

maintain a pregnancy, but they must also have emotional support and resources to care for their offspring. Because natural selection favors behaviors that increase reproduction, individuals should compete more when resources are scarce than when resources are not scarce (Sterck, Watts, & van Schaik, 1997; van Schaik, 1989). The comparative literature provides evidence that female primates compete when resources are scarce. For example, female brown capuchins behave more aggressively when food patches are of intermediate size relative to the group than when food patches are large relative to the group (Janson, 1985). Subordinate female long-tailed macaques have been found to feed away from dominant females –increasing their risk of predation – in order to avoid aggression inflicted by dominant females during feeding (van Schaik & van Noordwijk, 1988). Field data and experimental data provide evidence that women are also more likely to aggress against rival women when they are exposed to resource scarcity compared to women who are not exposed to resource scarcity (Burbank, 1987; Campbell et al., 1998; Griskevicius et al., 2009). Archival data indicate that gender structure can affect a woman’s ability to obtain resources, and that in turn can lead to enhanced aggression among women. For example, when Zambian women lost their right to own land and had to rely on men for resources, rates of female-female aggression increased (Burbank, 1987). Even in the United States where men and women have equal rights, as women’s enrollment in public assistance programs increase, rates of female-female aggression increase (Campbell et al., 1998). Similarly, women who imagined that they were competing with a rival for a job were more likely to confront another woman to her face (direct aggression) than women who did not imagine that they were competing for a job (Griskevicius et al., 2009).

The effect of the scarcity prime on women's direct aggression did not occur among women who were primed to think about having a family. Griskevicius and colleagues (2009) posited that direct aggression is riskier for women with children than women without children, because injuries caused by retaliation may hinder a woman's ability to care for her children. These findings highlight a boundary condition of the effect of resource scarcity on women's direct aggression: having or not having children. Although Griskevicius and colleagues (2009) found evidence that women who thought about having children were less likely to directly aggress than women who did not think about having children, one could also make the argument that women with children have more to fight for than women without children. It may be the case that women with children are highly selective about their decision to employ direct aggression. If one is actually at risk of dying due to scarce resources and actually has children, it may be better to risk *potential* death than to allow *certain* death from lack of resource. In truly scarce environments, one may predict that mothers would be more likely to directly aggress than non-mothers, simply because they have more to lose by failing to act (i.e., they and their children could die). Griskevicius and colleagues (2009) did not report if their participants had children. Rather, their participants either imagined that they had children or did not imagine that they had children. It is possible that actually having children while living in a resource-scarce environment produces different behavioral patterns than imagining that one has children and that one may lose her resources.

One may predict that a rival's ovulatory status could increase the likelihood that she could be a threat to a woman's resources. If a woman loses her partner to a rival, the woman loses that partner's resources. This would be particularly impactful among

women who have limited opportunities to obtain resources for themselves (e.g., women who do not have the right to own land, earn an education, work outside the home, etc.). But even within egalitarian societies, romantic partners provide each other with resources. Notably, a man does not have to leave a relationship entirely for a rival to threaten one's resources. If the man gives a rival woman any resources, one can assume that the rival may be perceived as threatening. One situation in which this is likely to happen is when a child is conceived from a sexual affair. If conception results from a sexual affair, a man will have a long-term commitment to provide resources to the child. Even a short-term sexual affair could lead to a long-term diversion of resources away from the primary partner to the rival and the new child. For that reason, a rival woman who is in the fertile phase of her ovulatory cycle is more threatening to a relationship than a rival woman who is not in the fertile phase of her ovulatory cycle.

Females of other mammalian species are more likely to be victims of intra-female aggression when they are near peak fertility than when they are not near peak fertility. For example, there is evidence that African elephants and yellow baboons aggress more against low ranking females when the low ranking females are in the fertile phase of their ovulatory cycle than when they are not in the fertile phase of their cycle (Dublin, 1983; Wasser, 1983; Wasser & Starling, 1988).

Recent extensions of that literature have found that women are also vigilant of ovulating rivals. Specifically, women are more jealous of, mate guard more toward, and report more distrust of rival women who are near the fertile phase of their ovulatory cycle than rival women who are not near the fertile phase of their cycle (Hurst et al., 2017; Krems et al., 2016). Previous studies have also found that women's testosterone, a

hormone associated with aggression, is higher after exposure to an ovulating rival than a non-ovulating rival (Bateup, Booth, Shirtcliff, & Granger, 2002; Maner & McNulty, 2013; Woodward et al., 2015). This suggests that women's hormonal response to ovulating rivals may prepare them for competition and aggression. Overall, the evidence suggests that women can detect ovulation in rivals and women's behavior and physiology respond to the ovulatory status of rivals.

Women are more likely to compete when a rival is highly threatening and when the consequence of an affair are highly threatening (Dijkstra & Buunk, 2001; Fink et al., 2014; Hurst, Alquist, & Puts, 2017; Krems, Neel, Neuberg, Puts, & Kenrick, 2016; Leenaars, Dane, & Marini, 2008; Maner & McNulty, 2013; Puts, Barndt, Welling, Dawood, & Burriss, 2011; Vaillancourt & Sharma, 2011; Woodward, Thompson, & Gangestad, 2015). There is also evidence that the tactics women use to compete are dictated by the severity of the situation.

### **How Women Compete with Rivals**

Women are more likely to indirectly aggress against rivals than directly aggress against rivals (Österman et al., 1998). Although learned gender norms likely contribute to gender differences in aggression (Eagly & Wood, 1999; Wood & Eagly, 2002), evolutionary theorists additionally posit that women's tendency to use indirect aggression is a byproduct of the fitness advantages afforded to ancestral women who opted for safer, indirect strategies (Campbell et al., 1998). Direct aggression can prompt retaliation, which may result in a physical injury. Because both men and women should aim to avoid physical injury, both sexes should reserve direct aggression for exceptionally threatening circumstances. However, direct aggression may have a worse cost-to-benefit ratio for

women than men. Historically, women have been the primary caregivers of children. Research on infants from developed and non-developed countries indicates that a child's probability of surviving to adulthood decreases as maternal care decreases, and the loss of a mother is reportedly more detrimental than the loss of a father (Andersson, Högberg, & Akerman, 1996; Beekink, Van Poppel, Liefbroer, 1999; Högberg & Broström, 1985; Pavard, Gagnon, Desjardins, & Heyer, 2005; Sear, Steele, McGregor, & Mace, 2002; Weitoft, Hjern, Haglund, & Rosén, 2003). An injury or death incurred from direct aggression could cost a woman her child's life. For that reason, women should be particularly selective about the types of situations in which they choose to directly aggress.

Although women are less likely to directly aggress than indirectly aggress, direct aggression does happen in specific situations. The evidence suggests that rates of direct intra-female aggression increase when women are in resource-scarce environments. When women find themselves in situations in which they must fight for resources or face certain death, they fight. The experimental data from the study that used a resource-scarcity manipulation (Griskevicius et al., 2009), the archival data from women in Zambia (Burbank, 1987), and the data on public assistance and crime rates from women in the United States all suggest that direct aggression increases when resources decrease.

One cue that a rival could threaten a woman's resources is the rival's ovulatory status. Ovulating rivals can become pregnant from a sexual affair, so ovulating rivals are more likely to obtain a man's resources (for child care) than non-ovulating rivals. Consequently, one may predict that women will exhibit more direct aggression toward ovulating rivals than non-ovulating rivals. Evolutionary theory provides the rationale to

predict that women will behave more aggressively toward ovulating rivals than non-ovulating rivals. By enhancing vigilance toward ovulating rivals specifically, women decrease the probability of their partner impregnating a rival. That decreases the probability of their partner diverting resources away from them and their children, which consequently enhances women's and their children's probability of survival. If ancestral women reaped fitness rewards (i.e., successful mate retention leading to greater numbers of offspring surviving and reproducing) by aggressing more against ovulating rivals than non-ovulating rivals, this behavioral tendency should be present among modern women. The literature suggests that women do aggress more against ovulating rivals than non-ovulating rivals (Hurst et al., 2017; Krems et al., 2016). However, the literature does not indicate if direct aggression in particular increases toward ovulating rivals. If ovulating rivals are perceived as threats to one's resources, and women's direct aggression increases when resources are threatened, it is plausible that women's direct aggression will be greater toward ovulating rivals than non-ovulating rivals.

Hurst and colleagues (2017; Study 2) found that women reported more direct aggression toward ovulating rivals than non-ovulating rivals, but other researchers did not find support for this effect (Woodward et al., 2015). There are a few potential reasons why these research teams found different results. The studies used different ovulation cues (pictures versus scent of t-shirt), different samples (online mTurk workers versus in-person college students), and slightly different measures of aggression (a composite score versus a single response score). Further, direct aggression seems to be closely tied to a fear of losing resources, so thoughts about scarce resources may be a critical component of this process. The study that found evidence of higher aggression toward ovulating than

non-ovulating rivals was performed on an mTurk sample (Hurst et al., 2017). Because women were participating in exchange for money, it is likely that the participants were thinking about resources when they participated in the study. The study that did not find support for this hypothesis was performed on college students who were participating for course credit, so resource scarcity may not have been highly salient when they participated in the study (Woodward et al. 2015).

### **The Current Study**

The evidence suggests that women are more likely to engage in intrasexual competition when the rival woman is highly threatening and when the consequences of an affair are highly threatening. Further, women are more likely to engage in direct aggression when resources are scarce than when resources are not scarce. Not only are women more likely to engage in direct aggression when resources are scarce, but they are also highly sensitive to threats that their partner may divert his resources to rival women (Buss, 1988a; Buss & Shackelford, 1997). One way that a rival may secure a man's resources is by having a child with the man. For that reason, rival women who are in the fertile phase of their ovulatory cycle may be particularly threatening to partnered women. An extra pair pregnancy could prompt a woman's male partner to divert his resources away from her to the rival and the new child. In an environment in which resources are already scarce, the threat of an ovulating rival conceiving a child with one's romantic partner may motivate direct aggression to guard one's partner from the ovulating rival. I predicted that thoughts of scarce resources would lead to women engaging in more direct aggression toward ovulating rivals than non-ovulating rivals. Further, I also predicted that this effect would be moderated by the presence or absence of children. One hypothesis

(based on Griskevicius et al., 2009) was that the interaction between ovulatory status and resource scarcity would only be present for non-mothers (because mothers should aim to avoid injury). An alternative hypothesis was that the interaction between ovulatory status and resource scarcity would only be present for mothers (because mothers have children that require resources to survive).

## **Method**

### **Participants**

Previous research suggests that ovulatory effects are small (Gildersleeve et al., 2014). Using G\*Power 3 software (Faul et al., 2007), I determined that I needed a sample size of at least 430 participants to detect a small-sized effect ( $f = .16$ ,  $\alpha = .05$ ,  $1 - \beta = .80$ , Numerator  $df = 3$ , Number of groups = 4, Number of covariates = 1). I collected data from participants on Amazon's Mechanical Turk. Eligibility requirements indicated that all participants must be women who were in serious, committed relationships. Several participants did not meet those requirements and were excluded from analyses. The final sample included 393 participants.

### **Procedure**

The experiment was a 2 (Prime: scarcity vs. control) X 2 (Rival Fertility: high vs. low) between-subjects design. After providing consent, participants answered a few demographic questions and the scarcity manipulation was listed at the end of that questionnaire (Nelson & Morrison, 2005; Appendix C). Next, participants read a vignette about a rival woman flirting with their romantic partner at a party (Huelsenitz et al., 2015; Appendix D). The rival woman was pictured on the screen while the participants read the vignette (rival pictures were used in Hurst et al., 2017; Puts et al., 2013). The set of

pictures included 22 different women pictured once at high fertility and once at low fertility. Participants were randomly presented with one of the women pictured at either high or low fertility.

Finally, participants reported their likelihood of engaging in a variety of direct and indirect mate guarding behaviors in response to the rival woman's behavior (Appendix E). After dependent measures were collected, participants completed a questionnaire to assess their trait jealousy (Pfeiffer & Wong, 1989; Appendix F). Participants also reported their physical attractiveness, their partner's physical attractiveness, the rival woman's physical attractiveness, and their perceptions of the rival woman's personality. Finally, participants reported other demographic information including information about their household income, their children, and their menstrual cycle (Appendix G).

## **Materials**

*Scarcity prime.* To prime participants with scarce resources, I used a manipulation developed by Nelson and Morrison (2005). All participants reported the combined amount of money in their checking and savings accounts. In the scarcity condition, the 11-point response scale ranged from 1 (\$0 - \$500) to 11 (over \$400,000). In the non-scarcity condition, the 11-point response scale ranged from 1 (\$0 - \$50) to 11 (over \$500). Except for extreme cases, participants in the scarce condition should have selected an option toward the bottom of the scale and participants in the non-scarce condition should have selected an option toward the top of the scale. Selecting an option at the bottom of the scale should have created the perception that the participant had scarce

resources, while selecting an option at the top of the scale should have created the perception that the participant did not have scarce resources.

*Rival fertility manipulation.* All participants viewed a headshot of a rival woman. The rival stimulus set included 22 different women, and each rival woman was pictured once when she was in the fertile phase of her ovulatory cycle and once when she was in the non-fertile phase of her ovulatory cycle. These photographs were created and used by Puts and colleagues (2013) and have been used in other research testing women's behavior toward ovulating rival women (Hurst et al., 2017). The fertility status of the pictured women was assessed through hormonal analyses. Details about the selection of these pictures is described in Hurst and colleagues (2017). In the current study, participants were randomly presented with one of the 22 different women pictured at either high or low fertility.

*Aggression manipulation and measure.* Participants imagined that a rival woman was flirting with their partner (Appendix D). Then participants reported their likelihood of engaging in a variety of behaviors that were classified as indirect aggression and direct aggression (Appendix E). Most of the behaviors have been used in previous measures of women's intrasexual aggression (Björkqvist et al., 1992; Griskevicius et al. 2009; Hurst et al., 2017; Krems et al., 2016; Shackelford, Goetz, & Buss, 2005;), though some were unique to the current study (1 item in Direct scale and 3 items in Indirect scale). A pilot test ( $N = 25$ ) of both measures indicated good reliability and variability across response options (Direct Aggression: Cronbach's  $\alpha = .95$ ; Indirect Aggression: Cronbach's  $\alpha = .78$ ). Alphas from the current sample are reported in results.

## Results

### Manipulation check

Participants in the resource scarce condition ( $M = 4.48$ ,  $SD = 2.30$ ) tended to report lower financial satisfaction than participants in the non-scarce condition ( $M = 4.90$ ,  $SD = .235$ ) but the effect was not significant,  $F(1, 370) = 3.050$ ,  $p = .082$ ,  $d = .181$ , 95%  $CI = [-.055, .417]$ . This suggests that the manipulation may not have successfully elicited feelings of scarcity from participants. Further, financial satisfaction did not significantly predict direct aggression,  $B = -.021$ ,  $t(368) = -.457$ ,  $p = .648$ ,  $R^2 = .010$ , 95%  $CI = [-.110, .068]$ , or indirect aggression,  $B = .007$ ,  $t(365) = .202$ ,  $p = .840$ ,  $R^2 = .001$ , 95%  $CI = [-.061, .075]$ .

### Reliability of direct and indirect aggression scales

Both scales had good reliability. The direct aggression scale had a Cronbach's  $\alpha = .901$  ( $N = 9$ ,  $M = 3.45$ ,  $SD = 1.99$ ), and the indirect aggression scale had a Cronbach's  $\alpha = .798$  ( $N = 10$ ,  $M = 3.71$ ,  $SD = 1.51$ ). In all analyses, I adjusted for participants' self-rated attractiveness, because previous research suggests that self-perceived attractiveness influences jealousy (Bush, Bush, & Jennings, 1988; Dijkstra & Buunk, 1998), and jealousy has been linked to aggression (Edalati & Reduan, 2010).

### Direct aggression: Test of primary hypothesis

*Scarcity manipulation and rival ovulatory status.* I predicted a significant scarcity prime X rival ovulatory status interaction on direct aggression. Specifically, I hypothesized that the effect of ovulation on direct aggression would be stronger among women primed with scarcity than women not primed with scarcity. As depicted in Figure

1, there was no significant manipulated scarcity X rival ovulatory status interaction,  $F(1, 366) = .031, p = .861, d = .0007, 95\% CI = [-.204, .203]$ .

I also predicted a main effect of the scarcity prime on direct aggression, replicating previous research (Griskevicius et al., 2009). I expected for women in the scarcity condition ( $M = 3.43, SD = 1.93$ ) to report greater direct aggression than women in the non-scarcity condition ( $M = 3.44, SD = 2.04$ ). There was no main effect of manipulated scarcity on direct aggression,  $F(1, 366) = .099, p = .753, d = .001, 95\% CI = [-.203, .201]$ .

I predicted that women would report being more willing to directly aggress against ovulating rivals ( $M = 3.31, SD = 1.88$ ) than non-ovulating rivals ( $M = 3.56, SD = 2.09$ ). There was also no main effect of rival ovulatory status on direct aggression,  $F(1, 368) = 1.536, p = .216, d = .128, 95\% CI = [-.073, .330]$ .

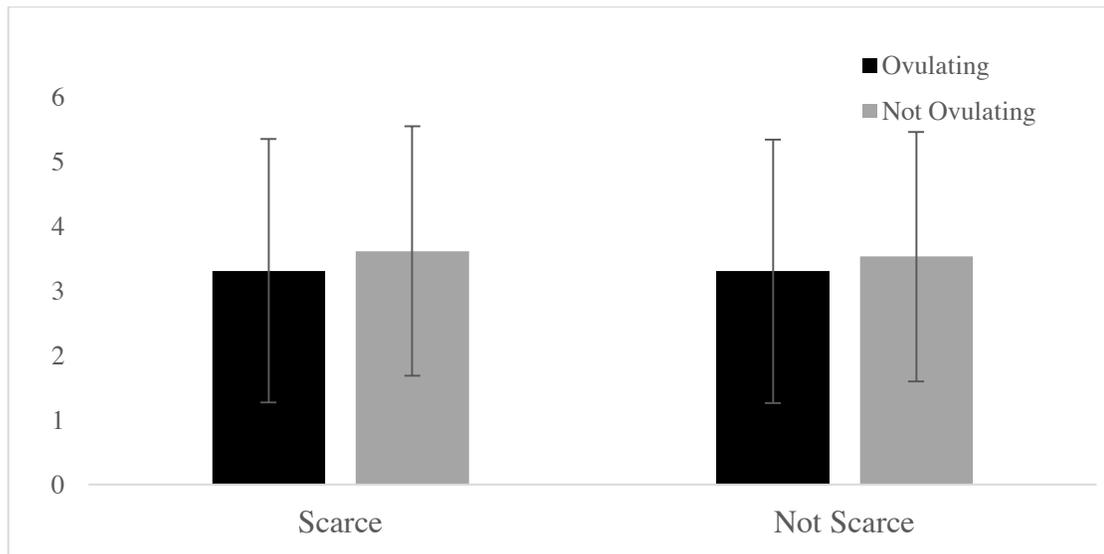
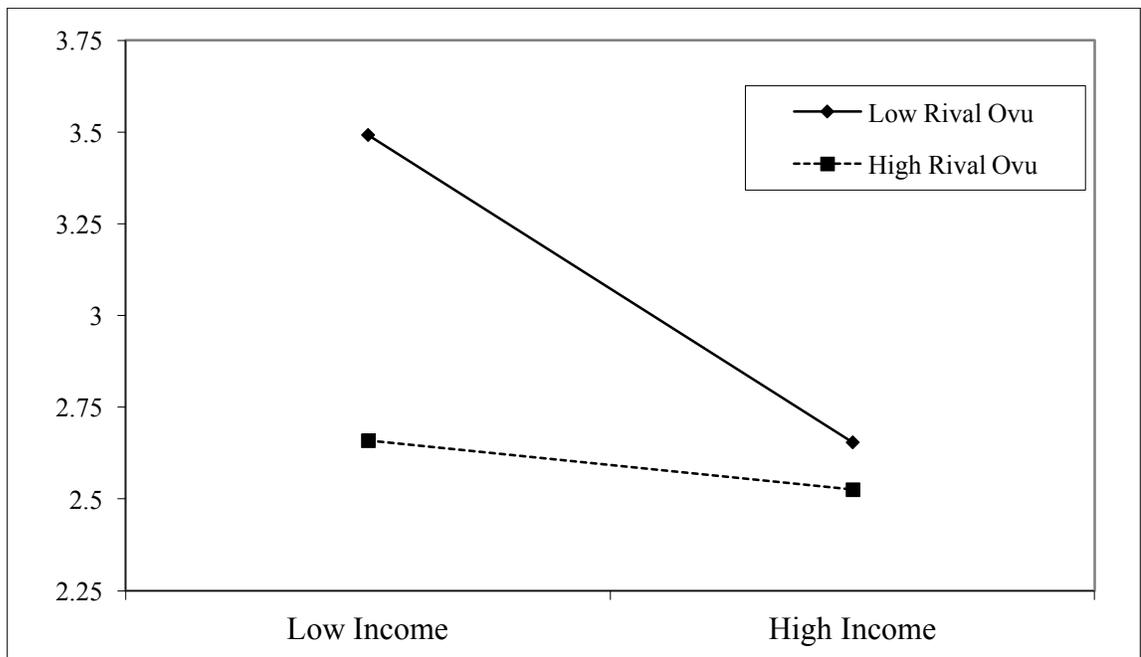


Figure 1. Scarcie manipulation by rival ovulatory status interaction on direct aggression.

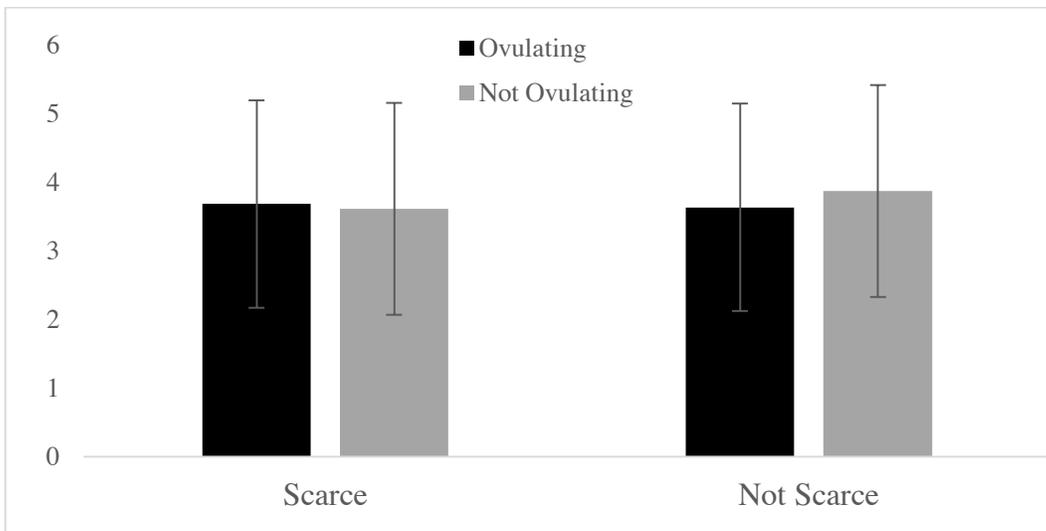
*Household income and rival ovulatory status.* The following analyses focused on participants' total household income (not their personal contribution to household income). There was a significant main effect of household income on direct aggression,  $B = -.163$ ,  $t(366) = -.151$ ,  $p = .016$ ,  $R^2 = .027$ , 95%  $CI = [-.273, -.028]$ . Consistent with predictions, as participants' income decreased, direct aggression increased (see Figure 2). There was not an income X rival ovulatory status interaction,  $B = .176$ ,  $t(365) = 1.408$ ,  $p = .160$ ,  $R^2 = .032$ , 95%  $CI = [-.070, .421]$ . These findings replicate previous research suggesting that direct aggression is higher when resources are scarce (Burbank, 1987; Campbell et al., 1998; Griskevicius et al., 2009).



*Figure 2.* Household income by rival ovulatory status interaction on direct aggression.

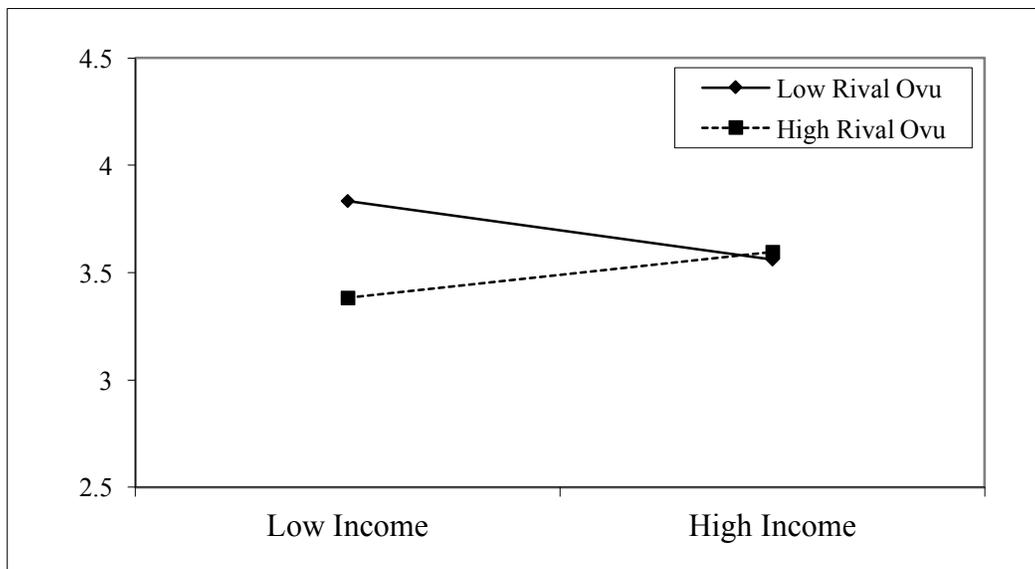
### Indirect aggression

*Scarcity manipulation and rival ovulatory status.* I predicted that ovulatory status would significantly predict indirect aggression (Hurst et al., 2017; Krems et al., 2016), but scarcity would not moderate the effect for indirect aggression. As depicted in Figure 3, there was no main effect of manipulated scarcity (Scarce:  $M = 3.54$ ,  $SD = 1.59$ ; Non-Scarce:  $M = 3.76$ ,  $SD = 1.47$ ) on indirect aggression,  $F(1, 364) = .374$ ,  $p = .541$ ,  $d = .076$ ,  $95\% CI = [-.079, .231]$ . Further, there was no main effect of rival ovulatory status (Ovulating:  $M = 3.66$ ,  $SD = 1.51$ ; Non-Ovulating:  $M = 3.77$ ,  $SD = 1.54$ ) on indirect aggression,  $F(1, 364) = .278$ ,  $p = .598$ ,  $d = .072$ ,  $95\% CI = [-.083, .228]$ . Further, there was no Scarcity X Rival Ovulatory Status interaction,  $F(1, 364) = .924$ ,  $p = .337$ ,  $d = .076$ ,  $95\% CI = [-.280, .129]$ .



*Figure 3.* Scarcity manipulation by rival ovulatory status interaction on indirect aggression.

*Household income and rival ovulatory status.* The following analyses focused on participants' total household income (not their personal contribution to household income). As depicted in Figure 4, there was no effect of income on indirect aggression,  $B = .047$ ,  $t(365) = .975$ ,  $p = .330$ ,  $R^2 = .005$ , 95% CI=[-.048, .144]. There was not an Income X Rival Ovulatory Status interaction,  $B = .121$ ,  $t(363) = 1.246$ ,  $p = .214$ ,  $R^2 = .009$ , 95% CI=[-.070, .313].



*Figure 4.* Household income by rival ovulatory status interaction on indirect aggression.

### **Effect of children**

Although my primary hypothesis was not supported, I collected measures on participants' children to test if being a mother moderated the effects of ovulation and resource scarcity on direct aggression. The proceeding analysis used participants' total household income as the resource scarcity variable because the scarcity manipulation was not successful. I predicted a significant scarcity prime X rival ovulatory status X presence

of children interaction on direct aggression. I had competing hypotheses. If mothers are more concerned about injury than non-mothers, then non-mothers with scarce resources should directly aggress more against ovulating rivals than non-ovulating rivals. If mothers are more concerned about obtaining resources than non-mothers, then mothers with scarce resources should directly aggress more against ovulating rivals than non-ovulating rivals.

Having children (yes/no) did not predict direct aggression,  $B = .209$ ,  $t(358) = .999$ ,  $p = .318$ ,  $R^2 = .026$ , 95%  $CI = [-.203, .622]$  or indirect aggression,  $B = -.026$ ,  $t(355) = -.160$ ,  $p = .873$ ,  $R^2 = .006$ , 95%  $CI = [-.341, .290]$ . However, the Children X Income interaction on Direct Aggression was significant,  $B = -.287$ ,  $t(358) = -2.275$ ,  $p = .023$ ,  $R^2 = .040$ , 95%  $CI = [-.535, -.039]$ . As depicted in Figure 5, among women with children, as income decreased, direct aggression increased,  $B = -.297$ ,  $t(358) = -3.295$ ,  $p = .001$ , 95%  $CI = [-.475, -.120]$ . This effect was not present for women without children,  $B = -.010$ ,  $t(358) = -.116$ ,  $p = .908$ , 95%  $CI = [-.184, .163]$ . The Children X Income X Rival Ovulatory Status interaction on Direct Aggression was not significant,  $B = -.141$ ,  $t(353) = -.597$ ,  $R^2 = .042$ ,  $p = .551$ , 95%  $CI = [-.649, .346]$ . None of the variables had significant effects on indirect aggression. Women's willingness to engage in direct aggression is context sensitive. Specifically, women will risk the dangers of direct aggression when resources are scarce and they have children to provide for.

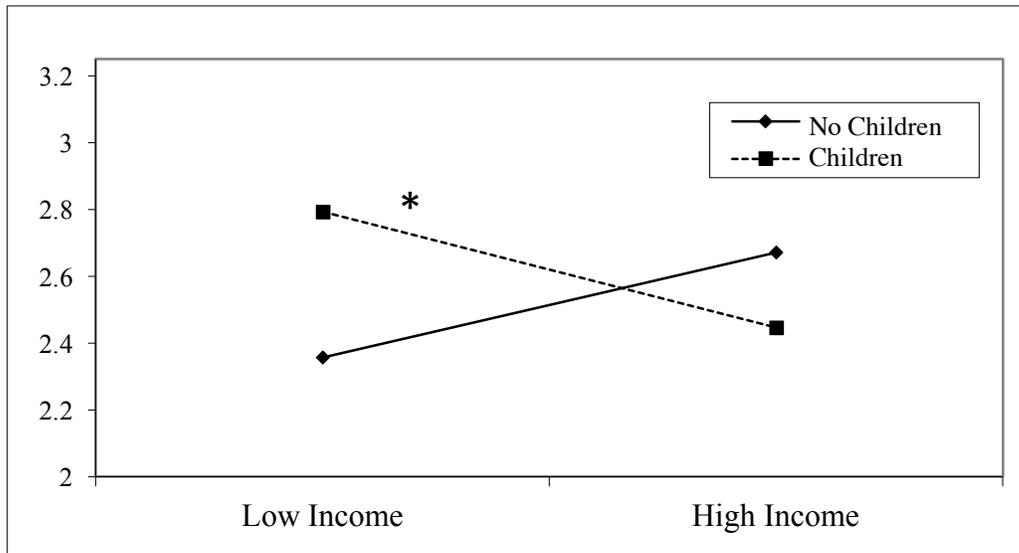


Figure 5. Having children by income interaction on direct aggression.

These results also replicated when I replaced the dichotomous “presence/absence of children” variable with the continuous “time spent caring for children” variable (Time Spent X Income interaction on Direct Aggression,  $B = -.052$ ,  $t(365) = -3.043$ ,  $p = .003$ ,  $R^2 = .063$ ,  $95\% CI = [-.086, -.018]$ ). As depicted in Figure 6, among women who spent a large amount of time with their children, as income decreased, direct aggression increased,  $B = -.129$ ,  $t(365) = -2.024$ ,  $p = .044$ ,  $95\% CI = [-.255, -.004]$ . The effect was not present among women who spent a small amount of time with their children,  $B = .250$ ,  $t(365) = 1.638$ ,  $p = .102$ ,  $95\% CI = [-.050, .551]$ . None of the variables had significant effects on direct aggression. Results further support the idea that women tend to only engage in dangerous forms of aggression (i.e., direct) when they have limited resources and children to care for.

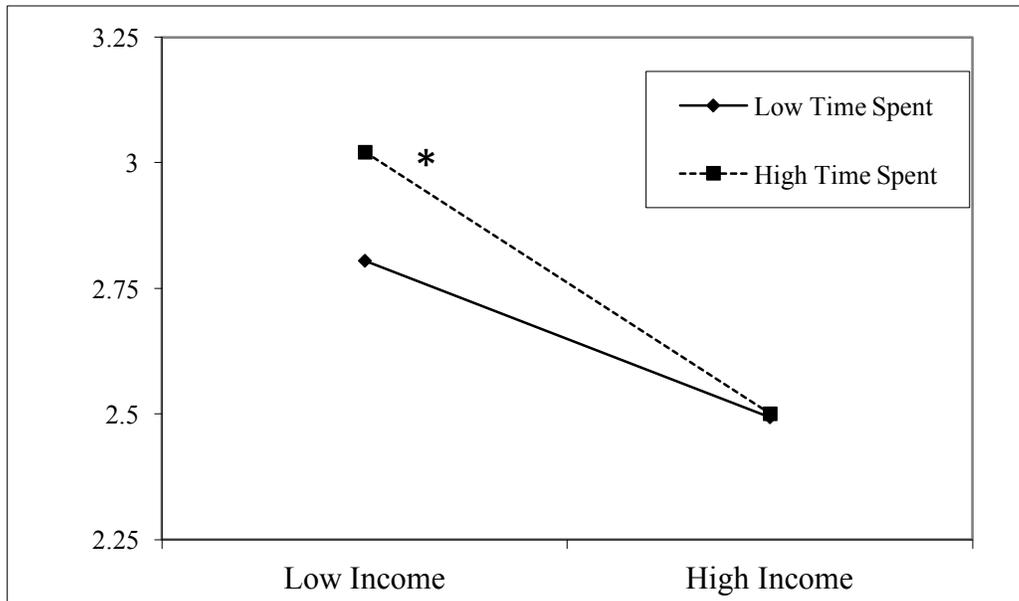


Figure 6. Time spent with children by income interaction on direct aggression.

When I limited the analyses to participants who were mothers, there was also a significant Time Spent X Income interaction,  $B = -.14$ ,  $t(196) = -3.14$ ,  $p = .002$ .

Surprisingly, among women who spent a small amount of time with their children, as income increased, direct aggression significantly increased,  $B = 1.33$ ,  $t(196) = 2.54$ ,  $p = .012$ . The effect was not significant among women who spent a large amount of time with their children,  $B = .302$ ,  $t(196) = 1.46$ ,  $p = .146$ .

### Discussion

I predicted that women primed with economic scarcity would engage in more direct aggression toward an ovulating rival than a non-ovulating rival. This hypothesis was not supported. The economic scarcity manipulation did not produce differences in women's direct aggression toward ovulating versus non-ovulating rivals. A manipulation check on the economic scarcity prime suggested that the scarcity prime did not have a

significant effect on participants' satisfaction with their finances. Thus, one potential reason why the economic scarcity prime did not affect direct aggression is because the manipulation did not elicit feelings of scarce or abundant resources.

Another method used to assess participants' economic scarcity was a self-report measure of participants' actual household income. Household income significantly predicted direct aggression. As women's household income decreased, they reported greater levels of direct aggression toward a rival. Although this finding is only correlational, it replicates previous experimental research that found that direct aggression was higher among women who were primed to think about scarce resources than women who were not primed to think about scarce resources (Griskevicius, 2009). Contrary to my prediction, women with low household income did not engage in more direct aggression toward an ovulating rival than a non-ovulating rival. One potential reason why the prediction was not supported is because the rival's ovulatory status produced no main effect on women's aggression (neither direct nor indirect). Previous research has consistently found that women's aggression is higher toward ovulating rivals than non-ovulating rivals, so the null effect of ovulatory status is surprising (Hurst et al., 2017; Krems et al., 2016). It may be that the effect of a rival's ovulatory status on aggression is more nuanced than the literature suggests. Supplemental analyses that are reported at the end of the document suggest that ovulatory effects on aggression may depend on context. In the present study, women's aggression increased when the rival's attractiveness increased, but only when the rival was ovulating. Further, women's aggression decreased when the rival's trustworthiness and likeability increased, but only

if the rival was not ovulating. Overall, these findings support the idea that women's vigilance toward rivals is calibrated to the level of threat that rivals present.

One factor that may influence a rival's level of threat is one's affiliation with the rival. The rival in the current study was described as an acquaintance. In previous research on women's vigilance toward ovulating rivals, the rival was described as a stranger. Vigilance toward acquaintances may be different than vigilance toward strangers. One reason why aggression may be different toward acquaintances and strangers is because one may feel less threatened by an acquaintance than by a stranger. Thus, overall aggression may be lower toward an acquaintance than a stranger. Even if vigilance toward an acquainted rival is warranted, aggression toward an acquaintance may be less direct than aggression toward a stranger. People who are motivated to affiliate receive several benefits, such as attention, positive stimulation, emotional support, and social comparison (Hill, 1987). Directly aggressing against an acquaintance could negatively impact one's friendships (with both the acquaintance and the friends of the acquaintance). One may predict that direct aggression, which rarely occurs among women, would be even rarer in response to an acquainted rival due to affiliation motives. Previous research has found that men's competitive behavior is modulated by their affiliation to a potential mating rival (Flinn, Ponzi, & Muehlenbein, 2012). It is possible that women's competitive behavior is also modulated by their affiliation to a mating rival. Future research should test how affiliation with a rival influences women's competitive behavior.

I predicted that women would perceive ovulating rivals as threats to resources, which would elicit direct aggression toward ovulating rivals. Results revealed no

difference in direct aggression toward ovulating and non-ovulating rivals. Perhaps women do not perceive ovulating rivals as threats to resources. Or, perhaps women's direct aggression depends on many factors, including some that were not directly tested in the present study. For example, women may only directly aggress for a romantic partner if the partner contributes a substantial amount of resources. The current study asked about partner physical attractiveness, but it did not ask what other resources the partner contributed (e.g., emotional support, financial support, etc.). It is also possible that participants' direct aggression to protect a partner from an ovulating rival would only be heightened if alternative, potential partners were scarce. If other potential partners are in high supply, direct aggression may not be worth the risk. Several other contextual factors, including the participants' ovulatory status, the current economic climate (e.g., ability to obtain one's own resources if a partner left), the likelihood that one would get hurt or "win" against the rival, and many others may affect direct aggression. Future research should both consider and test the effect of these contextual factors on direct aggression using an adequate sample size.

In addition to my primary hypotheses, I also tested for a 3-way interaction involving participants' children (presence or absence of children), resource scarcity (household income), and rival ovulatory status on direct aggression. Previous research suggests that women who do not have children are more likely to engage in direct aggression for scarce resources than women who have children (Griskevicius et al., 2009). This effect is thought to occur because direct aggression may result in an injury and an injury may impair a woman's ability to care for her children. I expected to replicate and extend that finding by showing the effect to be strongest among women

who viewed an ovulating rival. Although the 3-way interaction involving rival ovulatory status was not significant, the presence of children X income interaction was significant. Surprisingly, instead of finding that non-mothers' direct aggression increased as income decreased (as predicted based on Griskevicius et al., 2009), the current data found that *mothers'* direct aggression (and not non-mothers') increased as income decreased. This significant pattern appeared when the predictor was having or not having a child and when the predictor was the amount of time spent caring for one's child. These findings support the notion that among women who are living in scarce conditions (compared to simply imagining scarce conditions), the *risk* of injury or death to obtain resources may be perceived as a better option than *certain* death due to lack of resources.

There are a few potential reasons why the current study's pattern of results differed from previous research. In the previous study (Griskevicius et al., 2009), participants were primed to imagine that they already had a job and they were competing with other women to potentially keep or lose their job. In the current design, the significant scarcity variable was actual household income. An *actual* lack of resources likely affects people differently than an *imagined potential* to lose resources. If one is not actually experiencing the effects of scarcity, staying safe and avoiding danger may seem like the best option. If one is currently experiencing the pains of hunger, unstable living conditions, etcetera, taking a risky action may seem like the best option. A second potential reason why the current study and the previous study produced different results is that the current study measured actual children and the previous studied primed the concept of children. It is possible that actually having children elicits greater risk-taking behavior among parents than non-parents. Because the current study's significant

findings were from measured variables (income and children), one may argue that those variables felt more real for the current participants and that greater reality may have produced the differences between the current findings and the findings by Griskevicius and colleagues (2009). However, because measured variables are not controlled, it is possible that our study includes confounds that produced the different findings between the two research teams. For that reason, the present findings should be interpreted with caution.

Results of the current study did not support the hypothesis that women with scarce resources directly aggress more against ovulating rivals than non-ovulating rivals. Although lower household income was related to higher indirect aggression, the rival's ovulatory status had no effect on women's direct aggression. The current study did find that women with children (but not women without children) engage in more direct aggression as household income declines. There are many factors that may play a role in whether a woman directly aggresses against a potential rival

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## **Appendix A**

### **Expanded Literature Review**

Gina Carano is an athlete known as the original queen of mixed martial arts (MMA; Macdonald, 2014). Her success took the world by storm, not only because she was a fierce fighter, but also because she was a fierce fighting woman. MMA requires direct, physical aggression, and historically, women have been perceived as relatively non-aggressive. Gina shattered that perception, demonstrating that sometimes, women can be quite aggressive. Until recently, behavioral scientists also believed that women were mostly non-aggressive (Konner, 1982; Maccoby & Jacklin, 1974). However, recent research findings tell a different story. Per statistics from the United States, young women account for 33% of arrests for simple assaults and 24% of arrests for aggravated assaults (U.S. Department of Justice, 2008). Statistics suggest that three out of four victims of violent female offenders are women (U.S. Department of Justice, 2000). Mirroring research on male-male competition, cross-cultural research suggests that most cases of female-female aggression occur over competition for mates (Burbank, 1987). As the number of eligible men decreases, female-female aggression increases.

Human existence depends on people's ability to find and retain romantic partnerships. Not only must people find partners with whom to reproduce, but their children must live long enough to have children of their own. Paternal investment has been found to improve survival rates of children. Among Ache, a forest-dwelling preindustrial society, the mortality rate for children younger than 15 is 45% among father-absent children, compared to 20% for father-present children (Hill & Hurtado, 1996). Infants in a United States sample were four times more likely to die within the

first 28 days of life when their fathers were present than when their fathers were absent (Alio, Mbah, Kornosky, Wathington, Marty, & Salihu, 2011). These findings provide rationale for people to be motivated to both find and retain romantic partners. Usually, women employ indirect strategies to compete with other women for mates (Österman et al., 1998). Indirect strategies include spreading rumors or derogating the appearance of another woman, and direct strategies include verbally or physically assaulting a rival. Previous research has found that economically scarce environments increase the likelihood that women will use direct strategies to compete with other women (Burbank, 1987; Campbell, Muncer, & Bibel, 1998; Griskevicius et al., 2009). One cue that may suggest that a rival woman is a threat to a woman's resources is a rival's ovulatory status. An ovulating rival may be perceived as a threat to a woman's resources because an ovulating rival could become pregnant if she had sex with the woman's romantic partner. The extra-pair pregnancy could lead the partner to divert his resources to the rival woman and the new child. I propose that the rival woman's ovulatory status will interact with economically scarce environments to increase women's direct aggression toward other women. Specifically, I predict that women primed with economic scarcity will directly aggress more against ovulating rivals than women who are not primed with economic scarcity.

### **Factors that Increase Competition**

Romantic relationships provide people with a variety of benefits, including emotional, cognitive, physical, and monetary (e.g., Hazan & Shaver, 1987; Rusbult, 1963; Safilios-Rothschild, 1976; Sprecher, 1985). Given those benefits in addition to the evolutionary importance of human mate selection and reproduction, it is not surprising

that mate acquisition and retention appear to be fundamental human needs (Kenrick, Griskevicius, Neuberg, & Schaller, 2010). People desire close relationships (Baumeister & Leary 1995), and they compete with others to secure and retain those relationships. There are a variety of tactics people can use to protect their partners from rivals. People can either enhance their desirability to their partners or they can compete against rivals (Buss, 1998b; Buss & Shackelford, 1997). The current proposal will focus on mate retention tactics that employ intrasexual aggression as a form of competition.

Until recently, mate competition among females was not well understood. Early work focused primarily on male-male competition. A widely-held belief was that competition and aggression only occurred in females as a byproduct of sharing genes with males (Darwin, 1871; Lande, 1980; Wallace, 1891). The process whereby one sex exhibits behaviors simply because those behaviors are favored by the other sex is called correlational selection. This framework for viewing women's aggression implies that competition is not an adaptive trait for women. This implies that more competitive women do not have a survival advantage over less competitive women. Female-female competition remained understudied until researchers realized the survival value of competitive behaviors in females. Studies on non-human animals found that the more females engaged in competition, the more likely they were to have the best nesting sites (Borg, Forsgren, & Magnhagen, 2002; Rosvall, 2008), the best feeding spots (Eggert, Otte, & Muller, 2008), a greater number of offspring born (Eggert, Otte, & Muller, 2008; Pusey, Williams, & Goodall 1997), and a higher offspring survival rate (Pusey, Williams, & Goodall 1997). Those findings suggest that females do gain a survival advantage by behaving competitively. For that reason, natural selection should favor females who

engage in competition and aggression. This realization provided a strong basis for studying female-female competition.

Competition can be costly in terms of one's time, energy, social image, and health. For that reason, people should reserve competitive behaviors for extreme circumstances. Previous findings support this idea. Men's mate guarding increases when they perceive their partners to be highly attractive (Buss & Shackelford, 1997). Men's mate guarding also increases when their partners are near the fertile phase of their cycle (i.e., partners are likely to become pregnant from sex with a rival man; Gangestad, Thornhill, & Garver, 2002; Haselton & Gangestad, 2006). Women also engage in more competition when the rival is highly threatening (Dijkstra & Buunk, 2001; Fink et al., 2014; Hurst, Alquist, & Puts, 2017; Krems, Neel, Neuberg, Puts, & Kenrick, 2016; Leenaars, Dane, & Marini, 2008; Puts, Barndt, Welling, Dawood, & Burriss, 2011; Vaillancourt & Sharma, 2011), and when the consequences of a sexual affair are highly threatening (Hurst et al., 2017; Krems et al., 2016; Maner & McNulty, 2013; Woodward, Thompson, & Gangestad, 2015).

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### **The Rival is Highly Threatening**

Some rival women are more threatening to a relationship than others. Women may be threatening for a variety of reasons, such as being highly physically desirable to men, being perceived as sexually available, or because they are perceived to be untrustworthy.

Because men are particularly interested in women who are physically beautiful (Buss & Schmitt, 1993), many women focus on physical beauty when they compete. Past work has found that women are more jealous of, feel more threatened by, and engage in more mate guarding toward other women who they perceive to be highly physically attractive (Dijkstra & Buunk, 2001; Fink et al., 2014; Hurst et al., 2017; Krems, et al., 2016; Puts, et al., 2011). For example, rivals with low waist-to-hip-ratios (a trait that men find attractive in women) evoked jealousy among women (Dijkstra & Buunk, 2001). Further, the higher women rated a rival's facial femininity, facial attractiveness, and breast size, the higher women rated the rival on perceived competition (Fink et al., 2014). Finally, the higher rivals were rated on facial attractiveness, the greater women's intentions were to guard their romantic partners from the rivals (Hurst et al., 2017; Krems et al., 2016).

Studies suggest that women are more threatened by women who seem sexually available than women who do not seem sexually available. Women are more likely to aggress against women whom they perceive to be promiscuous than women whom they do not perceive to be promiscuous (Leenaars et al., 2008). Among high school girls, as the number of recent sexual partners increased, reports of other girls derogating against them increased (Leenaars et al., 2008). Women also reported less interest in befriending a rival as the rival was described as more promiscuous (Bleske & Shackelford, 2001). Finally, women are less likely to befriend a rival and let their romantic partner spend time alone with the rival when the rival is dressed in sexy clothing relative to conservative clothing (Vaillancourt & Sharma, 2011) This effect presumably occurs because women in sexy clothing are perceived to be more sexually available than women in conservative clothing. Notably, women were more likely to guard their romantic partner from the sexily dressed rival than the conservatively dressed rival regardless of the rival's body type (i.e., heavysset versus thin).

In addition to being perceived as physically attractive and sexually available, a rival may also threaten a relationship if she is perceived as untrustworthy. A rival may be desirable to men and she may be willing to have sex with men, but if she is perceived as trustworthy, a woman may not feel as threatened by her relative to an untrustworthy rival. If a rival is perceived as untrustworthy, vigilance toward her may be warranted. Previous work has found that women are more likely to guard their partners from rivals as their perceptions of the rival's trustworthiness decrease (Hurst et al., 2017; Krems et al., 2016). Notably, these effects were most pronounced when the women perceived their partners as highly desirable (i.e., the partner was worth guarding). Specifically, two separate research

teams found that women with attractive partners perceived ovulating rivals as untrustworthy, and this was associated with less desire to befriend the rivals (Krems et al., 2016) and more desire to guard their partner from the rivals (Hurst et al., 2017).

### **The Consequences of an Affair are Highly Threatening**

Relative to women who have an abundance of resources, women who are in resource scarce environments suffer more consequences if their partner deserts them and diverts his resources to other women. Scarce resources limit reproduction. Not only must women be nutritionally sustained in order to ovulate and maintain a pregnancy, but they must also have emotional support and resources to care for their offspring. Because natural selection favors behaviors that increase reproduction, individuals should be more likely to compete when resources are scarce than when resources are not scarce (Sterck, Watts, & van Schaik, 1997; van Schaik, 1989). The comparative literature provides evidence that female primates compete when resources are scarce. For example, female brown capuchins demonstrate more aggression when food patches are of intermediate size relative to the group than when food patches are large relative to the group (Janson, 1985). Subordinate female long-tailed macaques have been found to feed away from dominant females –increasing their risk of predation – in order to avoid aggression inflicted by dominant females during feeding (van Schaik & van Noordwijk, 1988). Field data and experimental data provide evidence that women are also more likely to aggress against other women when they are exposed to resource scarcity compared to women who are not exposed to resource scarcity (Burbank, 1987; Campbell et al., 1998; Griskevicius et al., 2009). Archival data found that among both Zambian and United States samples, as environmental pressures lead women to become more reliant on men

for resources, rates of female-female aggression increased (Burbank, 1987; Campbell et al., 1998). Similarly, women who imagined that they were competing with a rival for a job were more likely to confront another woman to her face (direct aggression) than women who did not imagine that they were competing for a job (Griskevicius et al., 2009).

Further, when the sex ratio is unfavorable for women (i.e., there are more women relative to men), women report more sexually open attitudes (presumably to attract men) and they are more likely to aggress against other women (Moss & Maner, 2016; Baumeister & Vohs, 2004). Specifically, women blasted higher levels of noise to a desirable rival when the sex ratio was favorable than when it was unfavorable (Moss & Maner, 2016). Further, high school girls were more likely to derogate other girls' promiscuous behavior when the sex ratio was unfavorable for the girls (Coleman, 1961). The literature suggests a similar process occurs in other animals. Both male and female Japanese medaka engage in more same-sex competitive aggression when the sex ratio is unfavorable than when it is favorable (Grant & Foam, 2002). The more females could suffer by losing a mate or his resources, the more likely females are to compete.

One variable that may affect a woman's resources is a rival's ovulatory status. If a woman loses her partner to a rival, the woman loses that partner's resources. This would be particularly impactful among women who have limited opportunities to obtain resources for themselves (e.g., women who do not have the right to own land, earn an education, work outside the home, etc.). But even within egalitarian societies, romantic partners provide each other with resources. Notably, a man does not have to leave a relationship entirely for a rival to threaten one's resources. If the man gives a rival

woman any resources, the rival may be perceived as threatening. One situation in which this is likely to happen is when a child is conceived from a sexual affair. If conception results from a sexual affair, a man will have a long-term commitment to provide resources to the child. Even a short-term sexual affair could lead to a long-term diversion of resources away from the primary partner to the rival and the new child. For that reason, a rival woman who is in the fertile phase of her ovulatory cycle is more threatening to a relationship than a rival woman who is not in the fertile phase of her ovulatory cycle.

Females of other mammalian species are more likely to be the targets of intra-female aggression when they are near peak fertility than when they are not near peak fertility. For example, there is evidence that African elephants and yellow baboons aggress against low ranking females when the females are in the fertile phase of their ovulatory cycle (Dublin, 1983; Wasser, 1983; Wasser & Starling, 1988).

Recent extensions of that literature have found that women are also vigilant of ovulating rivals. Specifically, women are more jealous of, mate guard more toward, and report more distrust of rival women who are near the fertile phase of their ovulatory cycle than rival women who are not near the fertile phase of their cycle (Hurst et al., 2017; Krems et al., 2016). Previous studies have also found that women's testosterone, a hormone associated with aggression, is higher after exposure to an ovulating woman than a non-ovulating woman (Bateup, Booth, Shirtcliff, & Granger, 2002; Maner & McNulty, 2013; Woodward et al., 2015). This suggests that women's hormonal response to ovulating rivals may prepare them for competition and aggression. Overall, the evidence

suggests that women are sensitive to ovulating rivals and their behavior and physiology respond to ovulating rivals.

### **The Aggressor is Ovulating**

Not only do women compete more with ovulating women than non-ovulating women, but a woman's own ovulatory cycle also influences her competitive behavior. Women can only become pregnant during a limited window of time each month. During that window, it is critical that women have access to desired mates. Indeed, there is evidence that women are more competitive when they are near ovulation. The closer women are to peak fertility, the more likely they are to purchase and wear attractive clothing (Durante et al., 2008; Haselton et al., 2007). This effect is stronger for women who are primed with a potential female rival than women primed with a potential mate (Durante et al., 2011). Women also report that they spend more time applying cosmetics and styling their hair when they are near (versus far) from peak fertility (Röder, Brewer, & Fink, 2009). Fertile-phase women also make economic decisions to increase their social standing relative to other women. In an economics game, when women were ovulating, they gave smaller offers to female game partners but not to male game partners (Durante, Griskevicius, Cantú, Simpson, 2014). Together, these findings suggest that ovulatory effects on competitive behavior are driven by a motivation to outdo other women rather than to simply gain men's attention.

### **The Partner is Desirable**

Individuals obtain fitness benefits through selective mating. People who are healthy or have resources can contribute healthy genes or resources to their children, and both of those contributions increase the probability that children will survive to sexual

maturity. For that reason, people should be particularly motivated to compete for desirable mates. Mates may be considered desirable because they are physically attractive, but they may also be desirable because they provide benefits such as food, protection, parental care, etc. (Rosvall, 2011). There is evidence that non-human females engage in both selective mating and competition for desirable mates. For example, female topi antelopes have been found to risk high male harassment, high predation, and low food supplies to visit territories containing high quality males (Bro-Jørgensen, 2002). Further, there is more intra-female aggression and interference of other females' mating opportunities in these territories than in other territories.

The literature suggests that female competition for desirable mates is higher among species with males who help care for their offspring than species with males who do not help care for their offspring (Wittenberger & Tilson, 1980). Men provide a substantial amount of parental care to their children, so women should compete for quality men. The evidence supports this hypothesis. Women who evaluate their partners high in desirability engage in more mate guarding toward an ovulating rival, especially when the rival is perceived as untrustworthy (Hurst et al., 2017; Krems et al., 2016).

Women are more likely to compete when a rival is highly threatening and when the consequence of an affair are highly threatening (Dijkstra & Buunk, 2001; Fink et al., 2014; Hurst, Alquist, & Puts, 2017; Krems, Neel, Neuberg, Puts, & Kenrick, 2016; Leenaars, Dane, & Marini, 2008; Maner & McNulty, 2013; Puts, Barndt, Welling, Dawood, & Burriss, 2011; Vaillancourt & Sharma, 2011; Woodward, Thompson, & Gangestad, 2015). There is also evidence that the tactics women use to compete are dictated by the severity of the situation.

### **How Women Compete with Other Women**

It has been hypothesized that aggression evolved as a strategy to compete against rivals for access to mating opportunities (Daly & Wilson, 1988). A large body of evidence suggests that there are gender differences in aggression, though the effects are smaller than previous work suggested (Archer, 2004; Hyde, 2014). Specifically, men are more likely to use direct aggression than women (Archer, 2004). Women also appear to be slightly more likely to engage in indirect aggression than men, although meta-analyses indicate that this effect is small.

Direct aggression is a type of aggression that is witnessed by the victim and is intended to hurt (Archer, 2004; Griskevicius et al., 2009; Wyckoff & Kirckpatrick, 2016). Examples of direct aggression are yelling at or hitting another person. Indirect aggression involves behaviors that are circuitous in nature, and usually are not witnessed by the victim (Archer, 2004; Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Wyckoff & Kirkpatrick, 2016). Examples of indirect aggression are social exclusion and rumor spreading (Campbell, 1999). The literature suggests that women are more likely to use indirect aggression than direct aggression in intrasexual competition (Archer, 2004; Österman et al., 1998).

Gender differences in aggression have been explained using different theories. Sociocultural theory, also known as social role theory, suggests that a society's division of labor drives gender differences (Eagly & Wood, 1999; Wood & Eagly, 2002). According to the theory, biological gender differences in size, strength, and capacity to bear and nurse children lead to a division of labor based on gender. Because men are, on average, the bigger, stronger sex, they engaged in war and consequently achieved status

and dominance. Women, the smaller sex, became subordinate and were assigned the role of care taker and nurturer. If one subscribes to these gender roles, men are expected to be the more dominant sex and women are expected to be the more passive sex (Eagly & Wood, 1999; Wood & Eagly, 2002). Men are more likely to use direct aggression than women (Archer, 2004), and direct aggression may be a strategy that showcases dominance. Women are more likely to use indirect aggression than direct aggression (Archer, 2004; Österman et al., 1998). These indirect strategies may help women avoid perceptions that they are dominant, and thus avoid social ostracism for acting “unladylike.”

Evolutionary psychologists explain gender differences in aggression by highlighting the fitness advantages and disadvantages of different behavioral strategies. Campbell’s evolutionary framework (Campbell et al., 1998) suggests that women’s preference for indirect aggression over direct aggression is related to safety concerns. Direct aggression carries high costs for both men and women, so both sexes should reserve direct aggression for circumstances in which the rival is highly threatening. However, direct aggression may have a worse cost-to-benefit ratio for women than men. Historically, women have been the primary caregivers of children. Research on infants from both developed and non-developed countries provides evidence that a child’s chance of surviving to adulthood greatly decreases as maternal care decreases (Andersson, Högberg, & Akerman, 1996; Beekink, Van Poppel, Liefbroer, 1999; Högberg & Broström, 1985; Pavard, Gagnon, Desjardins, & Heyer, 2005; Sear, Steele, McGregor, & Mace, 2002; Weitoft, Hjern, Haglund, & Rosén, 2003). An injury or death incurred from direct aggression could cost a woman her child’s life. For that reason,

women should be particularly selective about the types of situations in which they choose to directly aggress.

Although sociocultural theories and evolutionary theories have been pitted against each other, and there is evidence both for and against the two theories (Archer, 2009), they are not necessarily incompatible explanations of human aggression. It is likely the case that evolution shaped humans to respond in ways that were adaptive across their ancestral history, while also shaping humans to respond in ways that are adaptive for proximal social-environmental pressures. Both forces may act on women's motivation to directly aggress. Whether women are avoiding life threatening injuries (evolutionary argument) or social ostracism (sociocultural argument), there is good reason for women to limit their direct aggression to highly threatening situations.

Although women are less likely to directly aggress than indirectly aggression, direct aggression does happen in specific situations. The evidence suggests that rates of direct intra-female aggression increase when women are in resource-scarce environments. When women find themselves in situations in which they must fight for resources or face certain death, they fight. Archival data on Zambian women suggest that, when the area became colonized and women lost their rights to own land and other resources, cases of female-female aggression increased (Burbank, 1987). Presumably, this effect was related to women's increased reliance on men for resources. Although women in more egalitarian cultures may rely less on men for financial support than women in Zambia, evolutionary instincts to compete for mates more in times of economic scarcity may persist in women.

Women also engage in more direct aggression when men are scarce. Archival data suggest that when the sex ratio is unfavorable for women (i.e., there are more women than men), rates of direct aggression increase (Campbell, 1998; Schuster, 1983). Experimental data has also found that women are more likely to use direct aggression after an unfavorable sex ratio prime than after a favorable sex ratio prime (Moss & Maner, 2016). Given that women often rely on men for resources, the sex ratio findings provide further support that women are more likely to use direct aggression when they fear losing resources than when they do not fear losing resources.

One prediction that is unique to the evolutionary framework on female aggression is that women should be wary of ovulating rivals because ovulatory status provides a subtle cue to a rival's ability to secure a man's resources. The evidence suggests that women are indeed more vigilant of ovulating rivals than non-ovulating rivals (Hurst et al., 2017; Krems et al. 2016), but it is unlikely that women simply learned this behavioral response. Ovulation is relatively concealed in women, and consequently, difficult to consciously detect. Thus, it seems unreasonable to assume that vigilance toward ovulating rivals would become part of women's behavioral repertoire due to learned social roles. More reasonable is the assumption that ancestral women gained a survival advantage by successfully thwarting mate poaching attempts from ovulating rivals. This survival advantage among ancestral women would result in today's women possessing keen ovulation detection abilities that likely operate unconsciously. The literature suggests that women do possess keen ovulation detection abilities (Hurst et al., 2017; Krems et al., 2016; Necka, Puts, Dimitroff, & Norman, 2016; Pipitone & Gallup, 2008; Puts et al., 2013; Woodward, Thompson, & Gangestad, 2015).

Because fertile-phase rivals are more likely to secure a man's resources due to an extra-pair pregnancy, women should also engage in more direct aggression toward fertile-phase women than non-fertile phase women. Although Hurst and colleagues found support for this hypothesis (Hurst et al., 2017, Study 2), other researchers did not find evidence that women use more direct aggression toward fertile-phase rivals than non-fertile-phase rivals (Woodward et al., 2015). There are a few potential reasons why these research teams found different results. The studies used different ovulation cues (pictures versus scent of t-shirt), different samples (online mTurk workers versus in-person college students), and slightly different measures of aggression (a composite score versus a single response score). Further, increased direct aggression seems to be closely tied to decreased resources, so thoughts about scarce resources may be a critical component of this process. The study that found evidence of higher aggression toward fertile than non-fertile women was performed on an mTurk sample (Hurst et al., 2017). Because women were participating in exchange for money, it is likely that the participants were thinking about scarce resources when they participated in the study. The study that did not find support for this hypothesis was performed on college students who were participating for course credit, so resource scarcity may not have been highly salient when they participated in the study (Woodward et al. 2015). I predicted that women will be more likely to use direct aggression toward a fertile-phase woman than a non-fertile-phase woman when resource scarcity is made salient.

## Appendix B

### Supplemental Analyses

The following analyses are supplemental. Although my primary hypothesis was not supported, I measured several theoretically relevant variables in order to fully explore women's intrasexual aggression. The proceeding analyses use participants' household income as the resource scarcity variable because the scarcity manipulation was not successful. The following analyses were included to test various moderators that have been used in previous, related literature.

#### **Rival characteristics.**

*Attractiveness to men as a short-term mate.* As ratings of the rival's short-term attractiveness increased (Range = 1-8;  $M = 4.73$ ;  $SD = 1.95$ ), direct aggression tended to increase, but the effect was not significant,  $B = .100$ ,  $t(360) = 1.864$ ,  $p = .063$ . However, the Short-Term Attractiveness X Rival Ovulatory Status interaction on direct aggression was significant,  $B = .223$ ,  $t(357) = 2.092$ ,  $p = .037$ . Among women who viewed an ovulating rival, as ratings of the rival's short-term attractiveness increased, direct aggression significantly increased,  $B = .222$ ,  $t(357) = 2.941$ ,  $p = .003$ . This effect was not significant among women who viewed a non-ovulating rival,  $B = -.001$ ,  $t(357) = -.009$ ,  $p = .993$ . The same interaction emerged for indirect aggression,  $B = .234$ ,  $t(355) = 2.842$ ,  $p = .008$ . Among women who viewed an ovulating rival, as ratings of the rival's short-term attractiveness increased, indirect aggression significantly increased,  $B = .154$ ,  $t(355) = 2.630$ ,  $p = .009$ . There was no effect of rival attractiveness on indirect aggression when the rival was not ovulating,  $B = -.080$ ,  $t(355) = -1.388$ ,  $p = .166$ . Overall, these results

indicate that women are more sensitive to attractiveness among rivals who are at higher risk of becoming pregnant.

**General attractiveness.** Women's general attractiveness ratings (Range: 1-8;  $M = 3.82$ ;  $SD = 1.86$ ) of the rival did not significantly predict direct aggression,  $B = .070$ ,  $t(369) = 1.235$ ,  $p = .218$ . However, the Attractiveness X Ovulation interaction on direct aggression was significant,  $B = .221$ ,  $t(366) = 1.975$ ,  $p = .049$ . Among women who viewed an ovulating rival, as ratings of the rival's attractiveness increased, direct aggression significantly increased,  $B = .166$ ,  $t(366) = 2.182$ ,  $p = .030$ . This effect disappeared among women who viewed a non-ovulating rival,  $B = -.055$ ,  $t(366) = -.670$ ,  $p = .503$ . The Attractiveness X Ovulation interaction also significantly predicted indirect aggression,  $B = .323$ ,  $t(364) = 3.781$ ,  $p < .001$ . Among women who viewed an ovulating rival, as ratings of the rival's attractiveness increased, indirect aggression significantly increased,  $B = .182$ ,  $t(364) = 3.117$ ,  $p = .002$ . Unexpectedly, when women viewed a non-ovulating rival, as ratings of the rival's attractiveness increased, indirect aggression significantly decreased,  $B = -.141$ ,  $t(364) = -2.259$ ,  $p = .024$ . Overall, these results provide more evidence that women's aggression increases when rivals are both attractive and ovulating.

**Difference Score.** The difference between participants' self-rated attractiveness and ratings of the rival's attractiveness (participant minus rival) did not predict direct or indirect aggression ( $p$ 's  $> .800$ ).

**Trustworthiness.** As participants' ratings of the rival's trustworthiness increased, direct aggression significantly decreased,  $B = -.126$ ,  $t(361) = -2.250$ ,  $p = .025$ . There was also a significant Rival Trustworthiness X Ovulation interaction on direct aggression,  $B =$

.339,  $t(358) = 3.053$ ,  $p = .002$ . Among women who viewed a non-ovulating rival, as perceptions of the rival's trustworthiness increased, direct aggression significantly decreased,  $B = -.269$ ,  $t(358) = -3.579$ ,  $p < .001$ . Trustworthiness was not associated with decreased direct aggression toward an ovulating rival,  $B = .070$ ,  $t(358) = .853$ ,  $p = .394$ . A similar pattern emerged for indirect aggression. The Rival Trustworthiness X Ovulation interaction significantly predicted indirect aggression,  $B = .256$ ,  $t(356) = 2.975$ ,  $p = .003$ . Among women who viewed a non-ovulating rival, as perceptions of the rival's trustworthiness increased, indirect aggression significantly decreased,  $B = -.180$ ,  $t(356) = -3.102$ ,  $p = .002$ . Trustworthiness was not related to decreased indirect aggression toward an ovulating rival,  $B = .076$ ,  $t(356) = 1.197$ ,  $p = .232$ . A rival's trustworthiness was associated with decreased aggression if the rival was not ovulating. If the rival was ovulating, her trustworthiness was insignificant.

**Likeability.** Women's ratings of the rival's likeability did not significantly predict direct aggression,  $B = -.063$ ,  $t(368) = -1.144$ ,  $p = .253$  or indirect aggression,  $B = -.059$ ,  $t(365) = -1.393$ ,  $p = .165$ ). There were no significant interactions among rival likeability, income, and rival ovulatory status on direct aggression. However, there was a significant Rival Likeability X Rival Ovulatory Status interaction on indirect aggression. When the rival was not ovulating, as ratings of her likeability increased, indirect aggression decreased,  $B = -.174$ ,  $t(363) = -2.960$ ,  $p = .003$ . When the rival was ovulating, likeability was not associated with decreased indirect aggression toward the rival,  $B = .069$ ,  $t(363) = 1.140$ ,  $p = .255$ . Mirroring the trustworthiness finding, these results suggest that likeability of a rival only relates to decreased indirect aggression when a rival is not

ovulating. Women's indirect aggression is unrelated to the likeability of a rival when the rival is ovulating.

***Flirtatiousness.*** As women's ratings of the rival's flirtatiousness increased, women's direct aggression tended to increase, but the effect was not significant,  $B = .083$ ,  $t(369) = 1.832$ ,  $p = .068$ . Flirtatiousness did not significantly predict indirect aggression either,  $B = .058$ ,  $t(366) = 1.651$ ,  $p = .100$ . There were no significant interactions among Rival Flirtatiousness, Income, and Rival Ovulatory Status on direct aggression. However, there was a significant Rival Flirtatiousness X Rival Ovulatory Status interaction on indirect aggression,  $B = .147$ ,  $t(364) = 2.105$ ,  $p = .036$ . When the rival was ovulating, as ratings of her flirtatiousness increased, indirect aggression significantly increased,  $B = .135$ ,  $t(364) = 2.675$ ,  $p = .008$ . Rival flirtatiousness did not significantly predict indirect aggression when the rival was not ovulating,  $B = -.012$ ,  $t(364) = -.243$ ,  $p = .808$ . Flirtatiousness of the rival only predicted women's aggression when the rival was ovulating. These findings support the idea that women's vigilance toward rivals is calibrated to the level of threat that rivals present.

#### **Participant characteristics: Theory-driven analyses**

The following analyses test the relationships among theoretically relevant demographic variables on women's aggression toward mating rivals.

***Partner attractiveness.*** There was not a significant main effect of partner attractiveness on direct aggression,  $B = .111$ ,  $t(367) = 1.324$ ,  $p = .183$ , or indirect aggression,  $B = .036$ ,  $t(364) = .576$ ,  $p = .565$ . There was no significant Partner Attractiveness X Income X Ovulation interaction on either direct or indirect aggression.

***Relationship commitment and length.*** As women's commitment to their relationship increased, both direct aggression ( $B = -.240, t(368) = -2.462, p = .014$ ) and indirect aggression ( $B = -.192, t(365) = -2.579, p = .010$ ) significantly decreased. There were no significant interactions among commitment, income, and rival ovulatory status for either type of aggression. Further, the numbers of years participants had been involved with their partner did not significantly predict direct aggression,  $B = -.010, t(365) = -.502, p = .616$ , or indirect aggression,  $B = -.002, t(362) = -.114, p = .910$ . There were no significant interactions among relationship length, income, and rival ovulatory status on either type of aggression. Results suggest that women's commitment to their partner, not length of relationship, is associated with lower levels of overall aggression toward rivals.

***Participant ovulatory status.*** That participants' ovulatory status did not significantly predict direct aggression ( $B = -2.162, t(208) = -.446, p = .656$ ) or indirect aggression, ( $B = -3.694, t(206) = -.988, p = .324$ ). Further, there was not a significant Participant Ovulatory Status x Rival Ovulatory Status x Income interaction on either type of aggression (Direct:  $B = 2.12, t(202) = .305, p = .760$ ; Indirect:  $B = 6.061, t(200) = 1.126, p = .261$ ). Previous research suggests that women who are near ovulation increase their competitive behavior toward other women (e.g., Durante, Griskevicius, Hill, Perilloux, & Li, 2011, Durante, Li, & Haselton, 2008; Haselton, Mortezaie, Pillsworth, Bleske-Rechek, & Frederick, 2007). Although the current study did not replicate that effect, the current study likely did not have enough participants to adequately power this analysis. Based on a recent article about powering ovulatory studies, the current study would need approximately 700 naturally cycling participants to detect an effect of participant

ovulatory status (Gangestad et al., 2016). The current study barely included 200 naturally cycling participants, so it is unlikely that a true participant ovulatory effect would be detected.

**Trait jealousy.** As participants' composite scores on the Multidimensional Jealousy Scale increased, direct aggression,  $B = .769$ ,  $t(366) = 6.90$ ,  $p < .001$  and indirect aggression,  $B = .614$ ,  $t(363) = 7.096$ ,  $p < .001$  significantly increased. There were no significant interactions among trait jealousy, income, and rival ovulatory status for either type of aggression.

### **Participant characteristics: Exploratory analyses**

The following analyses were not based on existing theory. They were purely exploratory, so results should be interpreted with caution.

**Age.** As age ( $M = 30.24$ ;  $SD = 5.67$ ) increased, women engaged in significantly less direct aggression,  $B = -.048$ ,  $t(369) = -2.698$ ,  $p = .007$ . However, there was a significant Age X Income X Rival Ovulatory Status interaction on direct aggression,  $B = -.044$ ,  $t(361) = -2.054$ ,  $p = .041$ . First, I broke down this interaction by looking at the effect of rival ovulatory status on women who were 1 SD above and below the mean age who reported low income (1 SD below the mean), and participants who were 1 SD above and below the mean age who reported high income (1 SD above the mean). Low-aged women with low income engaged in significantly more direct aggression toward non-ovulating rivals than ovulating rivals,  $B = -.751$ ,  $t(361) = -2.156$ ,  $p = .032$ . The rival's ovulatory status did not predict direct aggression among high-aged women with low income,  $B = -.114$ ,  $t(361) = -.242$ ,  $p = .967$ . There were no significant effects of ovulatory status on direct aggression for either low- or high-aged women with high income. The

finding that low-aged women with low-income directly aggressed more against non-ovulating rivals than ovulating rivals is not consistent with my hypothesis. In fact, the pattern is opposite of what I predicted.

To further explore the 3-way interaction, I looked at women who were 1 SD above and below the mean age who viewed an ovulating rival, and then I looked at women who were 1 SD above and below the mean age who viewed a non-ovulating rival. Among high-aged participants who saw an ovulating rival, as income decreased, direct aggression significantly increased,  $B = -.274$ ,  $t(361) = -2.314$ ,  $p = .021$ . Among high-aged participants who saw a non-ovulating rival, income did not predict direct aggression,  $B = -.217$ ,  $t(361) = -1.499$ ,  $p = .135$ . This pattern did not replicate among low-aged participants. There was no significant effect of income on direct aggression for low-aged women who saw an ovulating rival ( $B = .230$ ,  $t(361) = 1.863$ ,  $p = .063$ ) or a non-ovulating rival ( $B = -.210$ ,  $t(361) = -1.883$ ,  $p = .060$ ). The finding that high-aged participants directly aggressed more against ovulating rivals than non-ovulating rivals is consistent with my prediction. Although this is not a direct test of my primary hypothesis, it suggests that resource scarcity is related to aggression toward ovulating rivals, specifically among high-aged participants.

## Appendix C

### Demographics & Scarcity Manipulation

Thank you for agreeing to participate in this study. Before you begin, please answer the following demographic questions.

How old are you?

\_\_\_\_\_

What is your sexual orientation?

Heterosexual

Lesbian

Bisexual

Other (please specify below)

\_\_\_\_\_

I would describe my ethnicity as:

Hispanic or Latino

Not Hispanic or Latino

I would describe by race as:

Native American

Asian

Native Hawaiian or Other Pacific Islander

Black or African American

White

More than one race

Unknown or not reported

Are you in a serious, committed relationship?

Yes

No

Other (please specify below)

\_\_\_\_\_

If you are in a relationship, how long have you been with your partner?

\_\_\_\_\_

If you are in a relationship, how committed are you to your current relationship partner?

Note at all committed

1

2

3

4

5

6

7

8

9

Very much committed

**Manipulation**

<b>Scarcity condition</b>										
Please indicate the combined amount of money in your checking and savings account.										
\$0-500	501-1000	1501-3000	3001-6000	6001-12K	12001-24K	24001-48K	48001-96K	96001-192K	192001-400K	
over \$400K										
1	2	3	4	5	6	7	8	9	10	11

<b>Non-Scarcity condition</b>										
Please indicate the combined amount of money in your checking and savings account.										
\$0-50	51-100	101-150	151-200	201-250	251-300	301-350	351-400	401-450	451-500	over \$500
1	2	3	4	5	6	7	8	9	10	11

## **Appendix D**

### **Vignette About Rival Woman**

**(Huelsnitz, Farrell, Simpson, & Griskevicius, 2015)**

**Instructions:** Please carefully read the following story. As you read, try to imagine yourself in the scenario and try to feel the emotions and feelings that the person is experiencing.

You and your partner are at a friend's party. You are thirsty so you leave your partner to get in line to get a drink. While in line, you see Sara, the woman pictured above, walk up to your partner and talk to him. You don't know Sara very well, but she is friends with your friend who is hosting the party. Your partner continues to talk to Sara. They both seem to be enjoying the conversation and laughing. Soon, you discover that Sara is clearly flirting with your partner. She puts her hand on your partner's shoulder and leans forward. He does not push her away or look uncomfortable. As your partner and Sara continue to talk, she continues to stand closer and closer to your partner, gazing deeply into his eyes and occasionally stroking his side and face.

## Appendix E

### Aggressive Mate Guarding Measure

**Instructions:** While you answer the following questions, please think about the scenario that you just read.

Not at all  
1      2      3      4      5      6      7      8      9  
Very much

Please use the above scale to indicate how likely you would be to engage in the following behaviors:

#### Direct Aggression Behaviors:

- Confront Sara about making a pass at my partner (verbal; Mate Retention Inventory)
- Insult Sara to her face (verbal; Griskevicius et al., 2009 in JPSP)
- Threaten to hurt Sara to her face (verbal; Direct and Indirect Aggression Scale)
- Yell at Sara (verbal; Direct and Indirect Aggression Scale)
- Pour your drink on Sara (physical; made up to be physical but not hand-to-hand contact)
- Hit Sara (physical; Griskevicius et al., 2009 in JPSP)
- Push Sara (physical; Griskevicius et al., 2009 in JPSP)
- Get in Sara's face (physical; Griskevicius et al., 2009 in JPSP)
- Stare coldly at Sara (physical?; Mate Retention Inventory)

#### Indirect Aggression Behaviors:

- Talk behind Sara's back (verbal; Griskevicius et al., 2009 in JPSP)
- Tell someone at the party an embarrassing secret you heard about Sara (verbal; Griskevicius et al., 2009 in JPSP)
- Tell someone at the party a false story about Sara (verbal; Griskevicius et al., 2009 in JPSP)
- Point out to my partner the flaws of Sara (verbal; Mate Retention Inventory)
- Try to exclude Sara from your social group (physical; Griskevicius et al., 2009 in JPSP)
- Ignore Sara (physical; Direct and Indirect Aggression Scale)
- Become friends with Sara (*reverse score*) (verbal; Krems et al., 2016 in JPSP)
- Hide Sara's car keys when she's not looking (physical; made up to include indirect physical)
- Put a piece of gum on Sara's seat when she temporarily leaves her chair (physical; made up to include indirect physical)
- Key Sara's car while she's in the bathroom (physical: made up to include indirect physical)

## Appendix F

### Multidimensional Jealousy Scale (Pfeiffer & Wong, 1989)

Please think of a person with whom you are having or have had a strong romantic/love relationship. This person is referred to as X in this questionnaire. Please rate your response to the following questions by selecting the appropriate item.

How often do you have the following thoughts?

**All the time 1 2 3 4 5 6 7 Never**

- I suspect that X is secretly seeing someone of the opposite sex
- I am worried that some members of the opposite sex may be chasing after X
- I suspect that X may be attracted to someone else
- I suspect that X may be physically intimate with another member of the opposite sex behind my back.
- I think that some members of the opposite sex may be romantically interested in X.
- I am worried that someone of the opposite sex is trying to seduce X.
- I think that X is secretly developing an intimate relationship with someone of the opposite sex.
- I suspect that X is crazy about members of the opposite sex.

How would you emotionally react to the following situations?

**Very pleased 1 2 3 4 5 6 7 Very Upset**

- X comments to you on how great looking a particular member of the opposite sex is.
- X shows a great deal of interest or excitement in talking to someone of the opposite sex
- X smiles in a very friendly manner to someone of the opposite sex.
- A member of the opposite sex is trying to get close to X all the time
- X is flirting with someone of the opposite sex
- Someone of the opposite sex is dating X.
- X hugs and kisses someone of the opposite sex.
- X works very closely with a member of the opposite sex (in school or office)

How often do you engage in the following behaviors?

**Never 1 2 3 4 5 6 7 All the time**

- I look through X's drawers, bag, or pockets.
- I call X unexpectedly, just to see if he is there.
- I question X about previous romantic relationships
- I say something nasty about someone of the opposite sex if X shows an interest in that person.

- I question X about his telephone calls
- I question X about his whereabouts
- I join in whenever I see X talking to a member of the opposite sex.
- I pay X a surprise visit just to see who is with him.

**Appendix G**

**Participant, Partner, & Rival Attractiveness**

How attractive are you?  
 Not at all attractive  
 0 1 2 3 4 5 6 7 Very attractive

How attractive is your partner?  
 Not at all attractive  
 attractive 0 1 2 3 4 5 6 7 Very

Do you have children?  
 \_\_\_\_\_ Yes \_\_\_\_\_ No

How often are you responsible for your children's physical care? That is, are you always the primary caretaker, or are there times when other people take care of your children?  
 Never the caretaker  
 caretaker 0 1 2 3 4 5 6 7 Always the

How attractive do you find Sara, the woman from the picture?  
 Not at all attractive  
 0 1 2 3 4 5 6 7 Very attractive

How attractive do you think men find Sara as a short-term mate? Short-term mates are women who are very attractive for a short-term sexual relationship (for example, a one night stand).  
 Not at all attractive  
 0 1 2 3 4 5 6 7 Very attractive

How trustworthy is Sara, the woman from the picture?  
 Not at all trustworthy  
 trustworthy 0 1 2 3 4 5 6 7 Very

How likable is Sara, the woman from the picture?  
 Not at all likable  
 0 1 2 3 4 5 6 7 Very likable

How flirtatious is Sara, the woman from the picture?  
 Not at all flirtatious  
 flirtatious 0 1 2 3 4 5 6 7 Very

How satisfied are you with your personal finances?

Not at all satisfied										Very satisfied
1	2	3	4	5	6	7	8	9		

What was your total household income before taxes during the past 12 months?

- Less than \$25,000
- \$25,000 to \$34,999
- \$35,000 to \$49,999
- \$50,000 to \$74,999
- \$75,000 to \$99,999
- \$100,000 to \$149,999
- \$150,000 or more

Approximately, how much do you contribute to your annual household income?

\_\_\_\_\_

When was the first day of your last period? (format like mm/dd/yyyy; e.g. 12/13/2017)

\_\_\_\_\_

When do you think your next period will begin? (format like mm/dd/yyyy; e.g. , 12/13/2017)

\_\_\_\_\_

Approximately how many days are there between your periods? Note, we are not asking how long one period lasts. We are asking how many days there are from the start of one period to the start of your next period.

\_\_\_\_\_