



Risk of sperm competition moderates the relationship between men's satisfaction with their partner and men's interest in their partner's copulatory orgasm

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ARTICLE INFO

Article history:

Received 18 May 2010
Received in revised form 29 July 2010
Accepted 5 August 2010
Available online 9 September 2010

Keywords:

Mating
Sperm
Sperm competition
Orgasm

ABSTRACT

Sperm competition occurs when the sperm of multiple males concurrently occupy a female's reproductive tract and compete for fertilization. Sperm competition may have been a recurrent adaptive problem over human evolutionary history (Shackelford & Pound, 2006). Women's orgasm may facilitate selective uptake and retention of a particular man's sperm (Thornhill & Gangestad, 2008). Men who are more satisfied with and invested in their relationship may experience greater costs in the event of sperm competition and potential cuckoldry. Therefore, these men may be especially interested in ensuring their partner's copulatory orgasm. We hypothesized that men's relationship satisfaction and investment would predict interest in their partner's copulatory orgasm, and that sperm competition risk would moderate the association between relationship satisfaction and interest in partner's copulatory orgasm. Using structural equation modeling on self-report data secured from 229 men in a committed heterosexual relationship, we tested and found support for these hypotheses.

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1. Introduction

Sperm competition is the competition that occurs between the sperm of multiple males within a female's reproductive tract for the fertilization of the ova (Parker, 1970). Sperm competition can occur in any sexually reproducing species in which females mate with or receive sperm from multiple males (Parker, 1970). Sperm competition has likely been a recurrent adaptive problem for human males over evolutionary history (Smith, 1984; see also Shackelford & Pound, 2006, for a review).

Sperm competition can result in loss of fertilizations to other males. Additionally, males who invest more than just an ejaculate, such as providing parental care and resources, are at risk of cuckoldry—unwittingly investing in another male's offspring (Shackelford, Pound, Goetz, & LaMunyon, 2005a). Because human males invest in putative offspring, they may have evolved adaptations to reduce the costs of sperm competition and cuckoldry (Shackelford, Pound, & Goetz, 2005b).

1.1. Adaptation to sperm competition in humans

Previous work provides evidence of adaptations to sperm competition in men. For example, men's testes size relative to body weight is larger than for the monandrous gorilla, which experiences very low sperm competition risk. However, men's relative testes size is smaller than that of chimpanzees, whose polygynandrous mating system generates substantial sperm competition (Smith, 1984). Men's moderate testes size provides evidence of physiological adaptation to species-typical moderate levels of sperm competition (Goetz, Shackelford, Platek, Starratt, & McKibbin, 2007; Smith, 1984).

Several studies provide evidence that men unconsciously increase sperm number in an ejaculate when they are at greater sperm competition risk. Specifically, men who spent a greater proportion of time apart from their partners since the couple's last copulation (time during which a man cannot account for his partner's sexual behavior) produce more sperm in their next in-pair copulatory ejaculate (Baker & Bellis, 1989, 1993, 1995). These results are consistent with a physiological adaptation sensitive to shifts in an individual man's sperm competition risk.

Men also may have evolved psychological adaptations to sperm competition. Shackelford et al. (2002) demonstrated that men who spent a greater proportion of time apart from their partners since

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the couple's last copulation (representing a greater risk of sperm competition) reported that they found their partner more attractive, were more interested in copulating with their partner, and indicated that their partner was more interested in copulating with them. Such psychological adaptations might motivate men to have sex with their partner sooner, thus affording greater opportunity to out-compete potential rival sperm in their partner's reproductive tract.

Researchers have also theorized that the morphology of the human penis suggests an evolved function as a semen displacement device (Baker & Bellis, 1995; Gallup & Burch, 2004, 2006; Gallup et al., 2003). Furthermore, Gallup et al. (2003) demonstrated that men might unconsciously perform more vigorous copulatory behaviors to displace a rival's sperm that may be present. Both sexes reported that men thrust more deeply and more quickly at the couple's next copulation when they experienced contexts in which sperm competition is more likely to occur. Further supporting the semen displacement hypothesis, Goetz et al. (2005) found that with a greater proportion of time spent apart, men performed more behaviors such as mate retention, to reduce the risk of female infidelity and sperm competition. Goetz and colleagues also found that as sperm competition risk increased, men performed more copulatory behaviors that might act to displace the sperm of a potential rival that may be present (such as more thrusts and deeper thrusts during copulation). Goetz and Shackelford (2006) provided evidence that men may use forced in-pair copulation as a sperm competition tactic (see also McKibbin, Shackelford, Goetz, & Starratt, 2008, for a review). Such behaviors, which are typically performed subconsciously, might function to reduce the sperm competition risk.

1.2. Women's orgasm

Symons (1979) argued that women's orgasm and associated physiological structures such as the clitoris are byproducts of selection on male genitalia and orgasm. Recently, Lloyd (2005) extended the "orgasm as byproduct" argument in a book-length treatment (For a critique of Lloyd's arguments, see Puts & Dawood, 2006). There is cumulating evidence, however, that women's orgasm may be adaptive and under selection.

Researchers have argued that orgasm functions as a means of cryptic female choice (Baker & Bellis, 1995; Thornhill & Gangestad, 1996, 2008; Thornhill, Gangestad, & Comer, 1995). Cryptic female choice refers to adaptations that function during or after copulation to facilitate retention and/or use of a particular male's sperm (Thornhill & Gangestad, 2008). Research indicates that women's experience of orgasm varies systematically. For example, multiple studies have found that women are more likely to experience copulatory orgasm with more physically attractive men (e.g., Shackelford et al., 2000; Thornhill et al., 1995). Research also indicates that orgasm increases the retention of sperm (Baker & Bellis, 1993, 1995). This might particularly occur in the context of multiple mating and sperm competition (Baker & Bellis, 1995). Because women's orgasm may have been related ancestrally to the likelihood of success in sperm competition, men who have invested in a long-term, committed relationship may be especially interested in and attentive to their partner's orgasm, particularly when experiencing greater sperm competition risk.

1.3. Relationship satisfaction and investment

Men who are dissatisfied with their relationship may bestow fewer benefits on their partner (e.g., sexual gratification) or inflict additional costs on their partner (Shackelford & Buss, 2000). Men who are more satisfied with their relationship are likely to be more invested in and committed to the relationship, and thus risk

greater costs associated with cuckoldry. Therefore, men's relationship satisfaction and investment also may predict men's interest in their partner's orgasm. As relationship satisfaction and investment increases, men may be more interested in the occurrence of their partner's copulatory orgasm, both to provide benefits to their partner, and to mitigate the costs of cuckoldry—the latter of which loom larger (in terms of time, resources, and lost mating opportunities) for men who are more invested in and committed to a relationship.

1.4. Hypotheses

In summary, women's orgasm may represent adaptation to bias retention of a particular man's sperm. If so, men may have evolved counter-adaptations in response. For example, ancestral men who were particularly interested in the occurrence of their partner's copulatory orgasm may have been more successful in the context of sperm competition. This may be especially so in the context of long-term committed relationships in which men invest substantially.

Men who are more satisfied with and invested in a relationship may be more attentive to and interested in their partner's copulatory orgasm, regardless of the current sperm competition risk. In addition, men in committed, long-term relationships may be particularly attentive to and interested in their partner's copulatory orgasm when sperm competition risk is greater. We tested in the current research the following hypotheses:

Hypothesis 1. Men who report higher relationship satisfaction will report greater interest in and attentiveness to their partner's copulatory orgasm, relative to men who report lower relationship satisfaction.

Hypothesis 2. The hypothesized positive relationship between men's relationship satisfaction and men's interest in their partner's copulatory orgasm will be moderated by sperm competition risk, such that the relationship between interest in partner's orgasm and relationship satisfaction will be stronger for men who report greater sperm competition risk, relative to men at lesser sperm competition risk.

2. Method

2.1. Participants

Participants were 229 men aged 18 years or older, reported current involvement in a committed heterosexual relationship, and reported having sexual intercourse with their partner at least once in the past week. Participants were drawn from a university population in the Southeastern United States. The mean age of the participants was 22.12 years ($SD = 6.04$), and of the participants' partners was 21.80 years ($SD = 6.24$). The mean length of the participants' relationships was 23.32 months ($SD = 41.55$).

2.2. Materials

We administered a survey to participants using an online survey provider. This method allowed participants to answer questions in a comfortable setting, and helped to ensure participants' anonymity. Responses were stored in a secure database accessible only by the researchers. The survey assessed (1) demographic information including participant's age, partner's age, and relationship length, (2) total amount of time since the participant's last in-pair sexual intercourse, (3) total amount of time that the participants spent together with their partner since the last time they

had sexual intercourse, (4) participant's relationship satisfaction, and (5) participant's interest in their partner's orgasm at the next in-pair sexual intercourse.

2.2.1. Time since last sexual intercourse

We asked participants to indicate, in hours, how long ago they and their partner last had sexual intercourse (last sex) (following Shackelford, Goetz, McKibbin, & Starratt, 2007; Shackelford et al., 2002).

2.2.2. Proportion of time spent apart

We calculated the proportion of time the couple had spent apart since their last sexual intercourse by subtracting the time, in hours, that the couple spent together since their last sexual intercourse from the total time, in hours, since the couple last had sexual intercourse, and then dividing the difference by the time, in hours, that had elapsed since the couple's last sexual intercourse (Shackelford et al., 2002, 2007).

2.2.3. Relationship satisfaction

The relationship satisfaction construct ($\alpha = 0.89$) consisted of four measured variables ($\beta = 0.78\text{--}0.93$) (following Shackelford et al., 2002): (1) "How committed are you to your partner?" (2) "How satisfied are you, overall, with your partner?" (3) "How sexually satisfied are you with your partner?" and (4) "How emotionally satisfied are you with your partner?" Participants responded using a scale from 0 = *Not at all* to 9 = *Extremely*.

2.2.4. Interest in partner's orgasm

The interest in partner's orgasm construct ($\alpha = 0.73$) consisted of four composite variables ($\beta = 0.41\text{--}0.85$): (1) Interest: men's interest in their partner achieving orgasm at the couples' next sexual intercourse ($\alpha = 0.73$), (2) Persistence: men's persistence in helping or encouraging their partner to achieve orgasm at the couples' next sexual intercourse ($\alpha = 0.91$), (3) Distress: men's distress if their partner does not achieve orgasm at the couples' next sexual intercourse ($\alpha = 0.85$), and (4) Relief: men's relief in response to their partner achieving orgasm at the couples' next sexual intercourse ($\alpha = 0.72$).

The Interest composite consisted of responses to two questions: (1) "Thinking about the next time you and your partner have sex, how important is it to you for your partner to have an orgasm?" and (2) "Thinking about the next time you and your partner have sex, how necessary is it to you for your partner to have an orgasm?" The Persistence composite consisted of responses to two questions: (1) "Thinking about the next time you and your partner have sex, how persistent would you be in making sure your partner has an orgasm?" and (2) "Thinking about the next time you and your partner have sex, how determined would you be in making sure your partner has an orgasm?" The Distress composite consisted of responses to three questions: (1) "Thinking about the next time you and your partner have sex, how frustrated would you be if you thought your partner did not orgasm?", (2) "Thinking about the next time you and your partner have sex, how angry would you be if you thought your partner did not orgasm?", (3) "Thinking about the next time you and your partner have sex, how upset would you be if you thought your partner did not orgasm?" The Relief composite consisted of responses to two questions: (1) "Thinking about the next time you and your partner have sex, how excited would you be if you thought your partner had an orgasm?" and (2) "Thinking about the next time you and your partner have sex, how relieved would you be if you thought your partner had an orgasm?" Participants responded to all items on a scale ranging from 0 = *Not at all* to 7 = *Extremely*.

2.3. Procedure

We recruited participants through in-class invitations and through an undergraduate research subject pool. Participants were offered research credits for their participation. We provided participants with the web address necessary for participation either during in-class presentations or on a subject pool flyer. Upon loading the online survey, participants were instructed to read the consent form and indicate their approval for participation. If participants did not indicate consent, had already participated, were not at least 18 years old, or were not currently in a committed, heterosexual sexual relationship they were exited from the study.

2.4. Statistical analyses

We used multiple-group structural equation modeling to test the hypothesis that sperm competition risk, as measured by the proportion of time men had spent apart from their partner since the couple's last sexual intercourse, moderates the relationship between men's relationship satisfaction and men's interest in their partners' orgasm, while controlling for the total time since the couples' last sexual intercourse. Structural equation modeling provides significant advantages over basic regression or path analysis approaches. These advantages include reducing error and bias in the coefficient estimates by utilizing latent variables instead of mean composites, as well as providing an assessment of the model using model fit indices (Coffman & MacCallum, 2005; Kline, 2005). To facilitate analysis, we divided participants into two groups: (1) men who had spent a greater proportion of time apart from their partners since the couple's last sexual intercourse, and (2) men who had spent a lesser proportion of time apart from their partners since the couple's last sexual intercourse. The greater proportion of time group included 154 participants who reported spending at least 50% of the time since last sexual intercourse apart from their partners, and the lower proportion of time group included 75 participants who reported spending less than 50% of the time since last sexual intercourse apart from their partners. Within the greater proportion of time apart group, 19 participants spent exactly 50% of their time apart from their partner since last sexual intercourse. We ran analyses excluding data from these 19 participants, and the pattern of results remained the same (analyses available upon request). The remaining results include data from these 19 participants.

All variables were tested for univariate outliers, multivariate outliers, and skew. The total time since last intercourse variable was skewed. We used square root transformation on this variable to ensure unbiased estimates (Singer & Willett, 2003).

3. Results

We first correlated men's self-report of relationship satisfaction with their interest in partner's orgasm. We found a significant correlation between these variables, $r(229) = .27$, $p < .001$. This relationship also holds after controlling for age and relationship length.

We next tested our measurement model. Before a structural model can be evaluated, it must first be shown that the just-identified measurement model, with all possible paths included, demonstrates goodness of fit. We identified a good overall fit for the measurement model, $\chi^2(50) = 57.58$, $p = 0.215$; CFI = 0.99; RMSEA = .03. A model provides a good fit to the data when the CFI is greater than .95 and the RMSEA is .06 or lower (Hu & Bentler, 1999). Tables 1a and 1b show correlations among the measured variables.

After running the initial model, and as suggested by the modification indices, we respecified the model to include a correlation

Table 1a
Correlations between measured variables for greater proportion of time spent apart ($n = 154$).

	1	2	3	4	5	6	7	8	9
1. Time since last sex									
2. Relief	.123								
3. Distress	.083	.325***							
4. Persistence	.224*	.417***	.281**						
5. Interest	.221**	.411***	.277***	.751***					
6. Comm. to partner	.062	.140*	.094	.255***	.252**				
7. Emotional satisfaction	.065	.149**	.100	.271***	.268***	.616***			
8. Sexual satisfaction	.055	.124*	.084	.227**	.223**	.514***	.547***		
9. Overall satisfaction	.076	.172*	.115	.313***	.309**	.711***	.756***	.631***	

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 1b
Correlations between measured variables for lower proportion of time spent apart ($n = 75$).

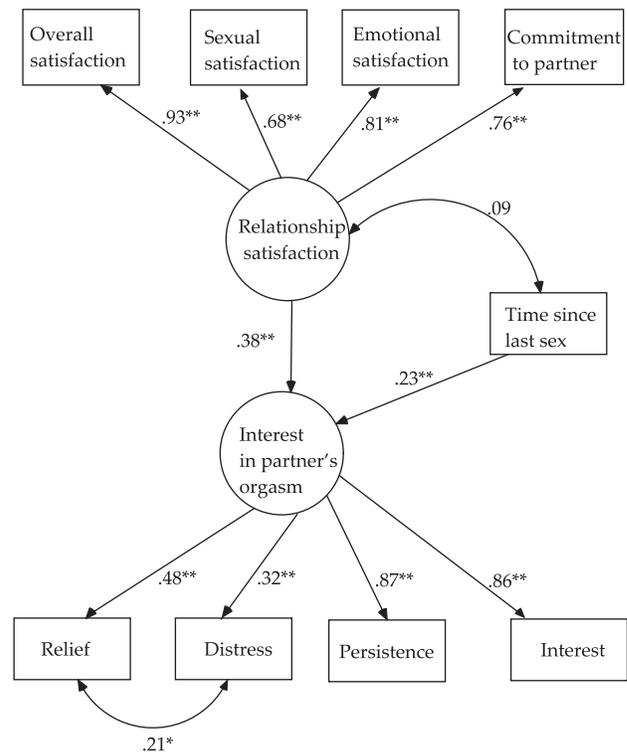
	1	2	3	4	5	6	7	8	9
1. Time since last sex									
2. Relief	.102								
3. Distress	.069	.403***							
4. Persistence	.144	.505***	.345**						
5. Interest	.141	.495***	.338**	.703***					
6. Comm. to partner	-.006	.066**	.045	.094	.092				
7. Emotional satisfaction	-.007	.077	.053	.109	.107	.709***			
8. Sexual satisfaction	-.006	.070*	.047	.099	.097	.641***	.747***		
9. Overall satisfaction	-.007	.079	.054	.113	.110	.730***	.850***	.768***	

* $p < .05$.
** $p < .01$.
*** $p < .001$.

between Distress and Relief. These measures assess emotional components of men's responses to either their partner not achieving orgasm or achieving orgasm. We then tested the theoretical structural model to assess the relationships between the constructs, moderated by the proportion of time men spent apart. The model demonstrated good fit, $\chi^2(48) = 48.15$, $p = 0.467$; CFI = 1.00; RMSEA = 0.004. Men's relationship satisfaction significantly predicted interest in their partner's orgasm when men had spent at least 50% of their time apart from their partner since the couple's last sexual intercourse, while controlling for total time since last intercourse (see Fig. 1). There were no significant relationships between these variables when men had spent less than 50% of their time apart from their partner since the couple last had sexual intercourse (see Fig. 2).

We used men's total time since last intercourse to construct the percentage of time apart grouping variable. We subsequently used total time since last intercourse in our structural model to control for any effects of this variable, following previous research (e.g. Shackelford et al., 2002). To address concerns that using time since last sex in both the creation of the groups and as a predictor in the model might affect the results, we reran the models with this variable removed, and still found the predicted pattern of results for both groups (analyses available upon request).

A reviewer suggested an alternative explanation for our findings: men with a low proportion of time apart may have significantly different relationship satisfaction scores to begin with, resulting in a restriction of range in this group. However, mean relationship satisfaction did not differ between the groups. The mean relationship satisfaction for the higher proportion of time spent apart group ($M = 7.59$; $SD = 1.43$) and the low proportion of time spent apart group ($M = 7.80$; $SD = 1.33$) were not significantly different, $t(227) = .66$, $p = .51$. It was also suggested that relationship length might be an important predictor. Including this variable in the analyses did not change the pattern of results, and



Note. * $p < .05$. ** $p < .01$. $n = 154$.

Fig. 1. Structural model predicting interest in partner's copulatory orgasm from relationship satisfaction for men with a high proportion of time spent apart from their partner; Note. * $p < .05$. ** $p < .01$. $n = 154$.

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