Original Article

Current Fertility Status Does Not Predict Sociosexual Attitudes and Desires in Normally Ovulating Women

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Abstract

Previous research has found that women at peak fertility show greater interest in extra-pair sex. However, recent replications have failed to detect this effect. In this study, we add to this ongoing debate by testing whether sociosexuality (the willingness to have sex in the absence of commitment) is higher in women who are at peak fertility. A sample of normally ovulating women ($N = 773$) completed a measure of sociosexuality and had their current fertility status estimated using the backward counting method. Contrary to our hypothesis, current fertility was unrelated to sociosexual attitudes and desires, even when relationship status was included as a moderator. These findings raise further doubts about the association between fertility and desire for extra-pair sex.

An ongoing debate within evolutionary psychology centers on whether the mating preferences of women change across their menstrual cycle to reflect peaks in fertility around the time of ovulation. According to the ovulatory-shift hypothesis, women have evolved to shift their mating preferences and behavior during peak fertility in order to maximize reproductive success (e.g., Gangestad et al., 2005; Pillsworth et al., 2004; Thornhill & Gangestad, 2003). The related dual-mating strategy hypothesis posits that women may cheat on their partner with highly attractive men in order to secure good genes for their offspring while maintaining a committed relationship with a partner who will share the burden of child rearing with them (Pillsworth & Haselton, 2006). As infidelity may result in abandonment or abuse, this extra-pair desire for genetically superior mates is thought to be restricted to the brief fertile window, thus minimizing risk (Pillsworth et al., 2004). If this is the case, then we should expect to find natural variation in willingness to have uncommitted sex across the cycle that tracks the probability of conception. In this study, we examine whether the sociosexual attitudes and desires of fertile women vary as a function of their current fertility status.

A number of studies have indicated that women's mating preferences change around ovulation. These include an increased preference for masculinity (Penton-Voak et al., 1999; Penton-Voak & Perrett, 2000), symmetry (Gangestad & Thornhill, 1998), the expression of dominant and competitive behavior (Gangestad et al., 2004, 2007; Havlicek et al., 2005), and lower frequency voices (Puts, 2005). Additionally, women have been found to adjust their behavior in a way that is indicative of mate seeking, such as showing greater interest in attending social events where men are likely to be present (Haselton & Gangestad, 2006), choosing more revealing clothing, and spending more time grooming (Durante et al., 2008; Haselton et al., 2007). Some of this research points to relationship status as a potential moderator of ovulatory shift effects, finding that only partnered women experience increased sexual

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desire when fertile (Pillsworth et al., 2004) and that extra-pair desire increases only among fertile women with less attractive mates (Haselton & Gangestad, 2006; Pillsworth & Haselton, 2006). Thus, it may be the case that ovulatory shift effects emerge only in specific contexts, such as when a woman is pair-bonded.

While the evidence supporting the ovulatory shift hypothesis may appear persuasive, a number of recent studies have failed to replicate these effects (e.g., Jones, Hahn, Fisher, Wang, Kandrik, Han et al., 2018; Marcinkowska et al., 2016; Marcinkowska et al., 2018a; Marcinkowska et al., 2018b). Of particular note are cyclical changes in preferences for masculine faces, bodies and voices (Dixson et al., 2018; Harris, 2011; Jünger et al., 2018) even when excluding women over the age of 30 (Harris, 2012).

These contradictory findings may be due in part to methodological limitations. There has been a large degree of heterogeneity in the methods used while researching this topic, particularly among those used to identify a woman's position within her menstrual cycle and subsequent fertility status. Some studies have used peaks of different hormones such as luteinizing hormone, estradiol, and progesterone, which fluctuate across the cycle and can offer a relatively precise method of detecting fertility (Dixson et al., 2018; Marcinkowska et al., 2016). Others have gathered self-report information about cycle length and the onset of menses to estimate current location within the menstrual cycle (Penton-Voak et al., 1999; Puts, 2005). Although measuring ovulation using hormonal methods is the more accurate method for determining fertility, practical limitations set by the costly and time-consuming nature of hormonal testing means sample sizes are often limited. Although less reliable, self-report measures are more conducive to recruiting larger samples and have been used in the vast majority of previous studies (Gildersleeve et al., 2014). However, there is variation within self-report methods. Some studies have employed forwards counting (i.e., counting days since onset of the last menstrual bleed) to determine day of cycle, whereas others have used backward counting (i.e., using predicted onset of the next menstrual bleed). Gangestad et al. (2016) note that despite the general limitations of self-report measures, the backward counting method is superior due to the greater variability in the follicular phase than the luteal phase of the cycle. Furthermore, some of these studies differentiate high or low fertility participants using discrete windows of fertility. Not only are the lengths of these windows highly variable between studies, but those that use larger windows typically detect larger effects (Wood et al., 2014). Gangestad et al. (2016) are explicit in their condemnation of this method, and refer to the use of windows of fertility in any form as a "mistake" (p. 91). The preferred method is to use verified actuarial fertility scores, which capture a woman's probability of conceiving on a given day of their cycle (Wilcox et al., 2001).

Additionally, the statistical power in ovulatory-shift research is often low. Although within-subjects designs are the gold standard in ovulatory-shift research, they are relatively rare, likely due to the practical limitations of requiring participants to complete tests on multiple occasions. Despite this, Jones et al. (2019) note that the benefits of this design are so great that to obtain a medium effect size with 80% power only 55–71 participants are needed compared to 900–1,000 for a between-subjects design. Nonetheless, the mean sample size in facial masculinity preference research, at that time, was just 40 participants. Gangestad et al. (2016) advises between-subjects designs use a sample size of no less than 700. To our knowledge, there are only two sufficiently large sample between-subjects studies published in this area to date, both of which found no effect of fertility shifts in masculinity preferences (Dixson et al., 2018; Marcinkowsa et al., 2018b).

It could also be argued that shifts in attractiveness ratings are a relatively indirect measure of motivation to mate with high genetic quality men (see van Stein et al., 2019). One study which measured in-pair and extra-pair sexual desire across the cycle found that, unlike in-pair desire, women's extra-pair desire increases before ovulation (Shimoda et al., 2017; although see Shirazi, Jones, et al., 2019). However, in this study a single question was used to measure extra-pair desire, which directly asked "How strong is your desire to engage in sexual activity with a person you find attractive (not your partner)?" As infidelity is generally seen as immoral, asking so explicitly about this desire may have reduced the participant's likelihood to endorse this question, as it may contradict their moral beliefs. Measures of sociosexuality, such as the Sociosexual Orientation Inventory—Revised (SOI-R; Penke & Asendorpf, 2008) may provide a subtler and more nuanced measure of increased sexual desire. The SOI-R measures three separate facets of an individual's inclination to engage in casual sexual relations outside a committed relationship: actual behavior, attitudes toward casual sex, and desire for casual sex. The attitude and desire subscales of the SOI-R are particularly relevant to the ovulatory-shift hypothesis. If women are more likely to engage in uncommitted extra-pair sex around the time of peak fertility in order to secure high quality genes, then they should express greater willingness to have uncommitted sex. Thus, we should be able to detect these differences using measurements of sociosexual attitudes and desire. While often used as a trait measurement, the SOI-R (and its predecessor, the SOI; Simpson & Gangestad, 1991) also captures state changes in sociosexuality both in hormonal (Jones et al., 2018; Marcinkowska et al., 2020; Oinonen et al., 2008; Shirazi, Self, et al., 2019; van Stein et al., 2019) and experimental work (Arnocky et al., 2016; Moss, & Maner, 2016).

In the present research, we add to the current debate surrounding the ovulatory shift hypothesis by testing whether women's preference for uncommitted sex changes in accordance with fluctuations in their fertility throughout the menstrual cycle. We used a well-powered between-subjects design, establishing fertility using the backward counting method. Our hypothesis was that fertility status will positively predict sociosexual attitudes and desires. Because some research suggests that ovulatory shift effects may occur only among pair-bonded women (e.g., Pillsworth et al., 2004), we also performed

Table 1. Correlation Matrix for Actuarial Fertility Scores, Subscales of the SOI-R, and Age.

	1	2	3	4	5
1. Actuarial fertility scores					
2. SOI-R Total	−.01 (.80)				
3. SOI-R Behavior	−.01 (.84)	.71 (<.001)			
4. SOI-R Attitude	.01 (.80)	.80 (<.001)	.36 (<.001)		
5. SOI-R Desire	−.05 (.21)	.68 (<.001)	.29 (<.001)	.27 (<.001)	
6. Age	.02 (.65)	.07 (.08)	.13 (.001)	.05 (.17)	−.07 (.07)

Note: p-values are contained in parentheses.

exploratory analysis to see if fertility effects were moderated by relationship status.

Methods

Participants

Menstrual cycle data were collected from 1,951 female participants across 13 studies conducted between 2011 and 2015. Of these participants, 1,649 completed the full SOI-R and 292 completed just the desire component. Participants were excluded from the analysis if they (a) were currently taking contraceptives which interrupted their menstrual cycle; (b) were currently pregnant; (c) had an irregular cycle; (d) had a cycle which varied by ≥10 days; (e) had a particularly short (< 21 days) or long (> 43 days) cycle; or (f) did not include sufficient information to estimate their fertility score.

The final sample included 773 participants. The mean age of the sample was 23.06 years ($SD = 5.78$). Ninety-one percent of the sample were White, 5% were Asian, 2% were Black, and the remainder were a mixture of other racial groups. The majority of the sample who chose to disclose their sexual orientation identified as heterosexual (92%), with the remaining identifying as homosexual (4%) or bisexual (4%). A single participant identified as asexual. Over half (54%) of participants were in a committed relationship, 38% were single, and 8% were in an uncommitted relationship.

Materials and Procedure

In addition to basic demographic information such as age and sex, participants were asked whether they were pregnant or on contraceptive medication that stopped their menstrual cycle. If none of these conditions were applicable, participants were asked the average length of their menstrual cycle, how much their cycle varied, and when they were due to commence their next menstrual bleed. Sociosexuality was measured using the SOI-R.

Most participants completed the questionnaires as part of an online study (74%; e.g. Stewart-Williams et al., 2017), though some completed a paper copy as part of laboratory work (e.g., Thomas et al., 2018). In all cases, the demographic questionnaire, menstrual cycle data, and SOI-R were measured before exposure to any intervention or measure of interest (e.g.,

attachment style, self-perceived mate value, relationship preference tasks, and primes). All studies were approved by the Ethics Committee of Swansea University's psychology department and all participants gave informed consent for their data to be used to investigate individual differences in mate preferences.

Results

Prior to the analysis, we recoded participants' relationship status and converted menstrual cycle data into actuarial fertility scores. Relationship status was coded as 1 for a committed relationship, and −1 for an uncommitted relationship or single.

The location of each participant within her menstrual cycle was calculated using a backward counting method. For participants who did not have a standard 29-day cycle and who were more than 14 days from the end of their cycle, location was calculated using the method outlined by Puts (2006) which involves standardizing the follicular phase to make it comparable to a typical 29-day cycle. Cycle day was used to calculate actuarial fertility using the conception risk figures from Wilcox et al. (2001).

The average actuarial fertility score for the sample was 0.03 ($SD = 0.03$) for a single incident of unprotected intercourse. For the SOI-R total score, the mean was 32.18 ($SD = 11.95$). For the behavior subscale, the mean was 7.86 ($SD = 4.65$), for attitude, 14.96 ($SD = 6.48$) and for desire, 9.31 ($SD = 5.18$). These averages are comparable to those seen in the previous work, both for total SOI-R and for its subscales (Penke & Asendorpf, 2008). Pearson's correlations between actuarial fertility scores, SOI-R subscales and age are shown in Table 1.

A series of hierarchical regression models were used to determine if total SOI-R or its facets could be predicted by actuarial fertility. As the behavioral component of the SOI-R asks questions about past sexual behavior, it seems unlikely that it would covary with fertility status. However, we included this in the analysis for completeness. In addition, a significant effect here may have suggested that our sample was abnormal in some way or that the participants' view of their own sexual history (e.g., whether they had "an interest in a long-term committed relationship with" their past partners) changes with fertility status.

Step 1 included current fertility, age, and their interaction. Age was included because of its strong correlation with SOI-R behavior. In Step 2, we conducted exploratory analysis by

Table 2. The Results of a Hierarchical Multiple Regression Examining the Effect of Age, Fertility, and Relationship Status on the SOI-R and its Facets.

	SOI-R Facet															
	Total				Behavior				Attitude				Desire			
Predictor	β	p	ΔR^2	p	β	p	ΔR^2	p	β	p	ΔR^2	p	β	p	ΔR^2	p
Step 1			.01	.15			.02	< .01			.00	.53			.01	.12
Age	.07	.07			.14	< .01			.05	.19			−.06	.07		
Fertility	−.01	.90			.00	.99			.00	.91			−.04	.21		
Age × Fertility	.06	.14			.08	.04			−.02	.56			.04	.31		
Step 2			.05	< .001			.00	.66			.00	.28			.14	< .001
Age	.08	.03			.14	< .001			.05	.17			−.02	.58		
Fertility	.00	1.00			.00	.97			.01	.86			−.03	.34		
Age × Fertility	.06	.10			.08	.04			−.02	.58			.04	.20		
Relat.	−.21	< .001			−.04	.37			−.06	.15			−.38	< .001		
Relat. × Fertility	−.01	.82			.00	.99			−.03	.47			−.01	.75		

Note: Relat. = Relationship Status.

adding relationship status, and its interaction with fertility, as additional predictors. The results of these analyses are included in Table 2.

At Step 1, only the SOI-R behavior model was statistically significant. Examination of the individual predictors revealed that sociosexual unrestricted behavior increased with age, but that there was no significant effect of fertility status. The interaction between age and fertility suggested that the effect of age on behavior might be moderated by current within-cycle fertility. Follow-up tests showed that while SOI-R behavior scores increased with age among those who with high fertility (+1 SD; $t(632) = 3.722$, $p < .001$), this relationship was non-significant for those with low fertility (−1 SD; $t(632) = 0.991$, $p = .32$).

The addition of relationship status at Step 2 significantly improved the SOI-R desire and total models, accounting for an additional 5% and 14% of the variance respectively. In the former model, the only significant predictor was relationship status. Women who were in a committed relationship had reduced sociosexual desire relative to their single peers. No other predictor was significant. In the total model, age was a positive predictor and relationship status a negative one. In summary, with the single exception of a small interaction with age in the behavior model, fertility scores did not significantly predict any SOI-R facet, neither in isolation, nor as part of an interaction with age or relationship status.[1]

Discussion

The purpose of this study was to test the idea, derived from the ovulatory shift and dual-mating hypotheses (Gangestad & Thornhill, 1998; Penton-Voak et al., 1999), that women's mating strategies change in accordance with fluctuations in fertility across the menstrual cycle. To do so we used a between-subjects sample of normally ovulating women to examine whether current fertility status could predict sociosexual desires and attitudes. Our hypothesis was not supported. No

relationship was found between fertility status and attitude or desire subscales of the SOI-R. In fact, the β observed in the regression predicting sociosexual desire was in the opposite direction to that predicted (β = −.04). Exploratory analyses showed that the null effect of fertility persisted when relationship status was added to the models as a moderator. We did find that older women reported higher numbers of past partners and acts of uncommitted sex, but only if they were currently high in fertility. We did not predict this weak association and see no theoretical reason for it. Given that this effect also disappeared when covariates were added to the model (see Footnote 1) we are inclined to believe this to be a Type I error.

It is possible that the null results obtained in this study are due to the methodological issues outlined previously. The 'gold standard' in menstrual cycle research is to use within-subjects designs and to establish fertility status using hormonal measurements (Gangestad et al., 2016). Our study, in contrast, used a between-subjects design with self-reported cycle data and non-verified bleed-dates. Nonetheless, there are several reasons to be confident that our results are not due to a Type II error.

First, the sample size is large and surpasses the minimum requirement set out by both Gangestad et al. (2016) and Jones et al. (2019) for a sufficiently-powered between-subjects study. Second, as recommended by Gangestad et al. (2016), fertility status was not determined using high and low fertility windows, but instead measured along a continuous scale of conception risk (Wilcox et al., 2001). Finally, we employed a backwards-counting method to determine day of cycle. Due to the large degree of variability in the follicular phase compared to the comparatively consistent length of the luteal phase (Fehring et al., 2006), the backwards-counting method is the most reliable way to obtain self-report menstrual cycle data.

The results of this study converge with other recent well-powered between-subject investigations into the ovulatory-shift hypothesis (Dixson et al., 2018; Marcinkowska et al., 2018b) and within-subjects studies using hormonal measures

(Jünger et al., 2018; Marcinkowska et al., 2018a). However, it should be noted that some studies suggest that fertility-related shifts in mating psychology depend on relationship status and on factors within a relationship, such as the attractiveness of one's current partner (Haselton & Gangestad, 2006; Pillsworth & Haselton, 2006). We did not have data about perceived partner attractiveness for partnered women in our dataset, but we were able to include their relationship status in our models. Doing so did not qualitatively alter the role of fertility status. It is worth noting, however, that this exploratory analysis was underpowered. A full understanding of this moderation effect would have required us to examine sub-groups of single and pair-bonded women, effectively halving the sample. The two studies that report an effect of partner attractiveness were also both underpowered (see the calculations of Gangestad et al., 2016; Jones et al. (2019). Therefore, future research should investigate the role of relationship moderators on fertility effects in sufficiently large samples to test these hypotheses adequately.

Further consideration should be given to the role of sociosexuality in acquiring extra-pair partners. There is an established relationship between sociosexuality and infidelity (Barta & Kiene, 2005). Thus, it is reasonable to expect that waxing interest in casual sex would facilitate acts of extra-pair infidelity and that this may form part of an ovulatory shift mechanism that functions to shift mating effort away from a primary partner and toward another. However extra-pair liaisons are not exclusively casual and may involve feelings of love and commitment, such as in cases of mate-switching (Buss et al., 2017). To the extent that uncommitted sex is not a strict prerequisite for extra-pair relationships, we cannot rule out the possibility of dual-mating mechanisms in humans based solely on an absence of relationship between within-cycle fertility and SO. Potential future research could consider forgoing sociosexuality for more implicit indicators of relationship commitment, including motivated biases favoring one's partner (e.g., positive partner illusions) or derogating alternatives (Finkel et al., 2017).

In sum, these null results raise further doubts about the hypothesized association between fertility and desire for extra-pair sex, and more specifically the role of sociosexuality as a potential moderator of this process. Should extra-pair desire change across the menstrual cycle, then this may be context specific and/or facultative. Such changes may be difficult to detect at a general group level, emphasizing the importance of well-powered within-subject designs that both use hormonal verification to reduce measurement error and take relationship context and motivation into account.

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Note

1. At the request of one of the reviewers, we re-ran our models while controlling for sexual orientation. The age by fertility interaction for SOI-R behavior was no longer significant. The role of fertility remained otherwise unchanged. As not all participants disclosed their sexuality, this supplementary analysis was underpowered.

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