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Sexual Fantasies and Viewing Times Across the Menstrual Cycle: A Diary Study

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Abstract Recent research has revealed that many aspects of female sexuality change across the menstrual cycle. In this study, we examined changes in sexual fantasies and visual sexual interests across the menstrual cycle. A total of 27 single, heterosexual women (M age = 21.5 years) not using hormonal contraceptives answered questions on a web-based diary every day for 30 days about their sexual fantasies and behaviors. Twenty-two of them also completed a viewing time task during three different menstrual cycle phases (follicular, ovulation, and luteal) to assess changes in visual sexual interest. Ovulation status was determined by a self-administered urine test. Results showed that the frequency and arousability of sexual fantasies increased significantly at ovulation. The number of males in the fantasies increased during the most fertile period, with no such change for the number of females. Fantasy content became more female-like during ovulation, focusing more on emotions rather than explicit sexual content. Women displayed a category non-specific pattern of viewing time with regard to target age and gender, regardless of fertility status. Results were discussed in the context of the ovulatory shift hypothesis of female sexuality.

Keywords Daily diary · Sexuality · Ovulation · Menstrual cycle · Sexual fantasies · Viewing time

Introduction

There are several well-replicated sex differences in sexual fantasy (Leitenberg & Henning, 1995), sexual arousal (Chivers, Rieger, Latty, & Bailey, 2004; Suschinsky, Lalumière, & Chivers, 2009), and visual sexual interest (Israel & Strassberg, 2009). There are also well-documented within-sex differences in these domains (Bullivant et al., 2004; Chivers, Seto, & Blanchard, 2007; Landolt, Lalumière, & Quinsey, 1995). For a long time, researchers have explored the role of sex hormones in explaining these differences and, more recently, have focused on the role of the menstrual cycle in modulating sexual desire, arousal, and preferences among women (for an extensive review, see Thornhill & Gangestad, 2008). To date, results from this research suggest that many aspects of female sexuality change at or near ovulation (e.g., Bullivant et al., 2004). In this study, we aim to add to this literature by exploring changes in female sexual fantasies and covertly measured visual sexual interest (using viewing time) across the menstrual cycle.

Sex Differences in Sexual Fantasy

Sexual fantasies involve any kind of mental image that induces an erotic meaning for the individual (Sierra, Ortega, & Zubeidat, 2006). According to Singer (1966), fantasies are almost universally experienced, with the most common involving romance and sex. Sexual fantasies are private, enabling opportunities for unique and unrestricted experiences (Eisenman, 1982). These experiences are probably more indicative of an individual's sexual desires than actual sexual behaviors or measures of sexual arousal, because they are less constrained by partner availability, the range of stimuli presented in a laboratory session, or legal, moral, and social concerns (Ellis & Symons, 1990; Gagnon & Simon, 1973).

There are well-established sex differences in the frequency and content of sexual fantasies. In a questionnaire study of 182

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women and 125 men (Ellis & Symons, 1990), men reported experiencing a sexual fantasy at least once per day while women reported experiencing a sexual fantasy once per week. Wilson and Lang (1981), again using a questionnaire, found that men reported a higher frequency of sexual fantasies for all four types of fantasies they studied: exploratory, intimate, impersonal, and sadomasochistic. Overall, men reported experiencing twice the number of different fantasies than women. Iwawaki and Wilson (1983) found an even larger sex difference in a Japanese college sample: Men reported six times the number of fantasies that women did. A similar sex difference has been observed among American adolescents: 45% of male teens but only 6% of female teens reported having sexual fantasies “many times a day” (Knoth, Boyd, & Singer, 1988). In fact, the sex difference has been observed for all age groups studied so far (Cameron & Biber, 1973; Giambra, 1974; Jones & Barlow, 1990; Purifoy, Grodsky, & Giambra, 1992).

With regard to the content of sexual fantasies, Person, Terestman, Myers, Goldberg, and Salvadori (1989) questioned students about whether they had experienced 55 different sexual fantasies in the previous 3 months: Men’s reported frequency of fantasies (overall) was double that of women’s and men reported a greater variety of fantasies across the 55 options. In addition to diversity, men and women focus on different aspects of sexual activity during their fantasies. Ellis and Symons (1990) found that men’s fantasies tended to focus on sexually explicit visual images, such as the physical attractiveness of the partner or images of their partner’s genitalia. Women’s fantasies, in contrast, tended to focus on emotional and personal characteristics of their partner and the romantic relationship. They contained more subtle sexual content, such as feelings, mood, and context, whereas men’s fantasies contained more obvious and explicit sexual content, such as details of the sex act. Barclay (1973) also found that men’s fantasies were more visually and sexually explicit whereas women’s fantasies contained more emotional and personal content.

Men and women also differ in the roles taken in a particular fantasy. In Wilson and Lang’s (1981) study, women were more likely to fantasize about being in the receptive or passive role during a sexual act whereas men were more likely to fantasize about being in the proceptive or active role. An extreme form of accepting the passive role is evident in fantasies of submission, force, or rape. Hariton and Singer (1974) first approached this question in their study of 141 married women. Using a checklist, the theme of being overpowered was the second most frequently reported fantasy. Bivona and Critelli (2009) more recently explored the nature of women’s rape fantasies in a group of 355 female undergraduates. They found that 62% of the women had experienced a rape fantasy in their lifetime and 14% of the women reported experiencing this fantasy on a regular basis.

It should be noted that it is unlikely that women’s rape fantasies indicate a desire to experience rape or necessarily reflect past experiences of unwanted sexual activity. In Bivona and Critelli’s (2009)

study, the women were asked to rate the content of their rape fantasies as aversive, erotic–aversive, or erotic. Only 9% of the fantasies were rated as aversive, involving complete non-consent. Erotic–aversive fantasies (46%) and purely erotic fantasies (45%) were reported much more frequently. In the latter two categories, the consent shifted from unwillingness to willingness during the fantasy. Thus, it seems that women want to view themselves as sexually desirable, not as sexually vulnerable in these fantasies; they fantasize that they are so sexually appealing that they are irresistible to men and force is required to persuade them into submission (Bivona & Critelli, 2009; Bond & Mosher, 1986). With regard to fantasies of dominance, men more often than women report fantasies in which they force a partner into sexual activity (Miller & Simon, 1980; Sue, 1979).

Ellis and Symons (1990) suggested that the sex differences in frequency and content of sexual fantasies are a result of sex-specific selection pressures on sexual psychologies. Men, having a lower necessary parental investment cost, have received fitness benefits from a strategy that involves copulating with as many fertile women as possible. Thus, selection favored men who had low thresholds for arousal and who were proceptive in their sexual pursuits. Comparatively, women would not have received as much fitness benefits as men from maximizing number of copulations. The minimal parental investment cost for women is much higher than that of men’s. Thus, selection favored women who were discriminating in their mate choice based on signals of high genetic quality, willingness to provide resources, and timing of copulation (Symons, 1979).

There is additional support for Ellis and Symons’ (1990) suggestion. For instance, men, more than women, fantasize about many different partners during the course of one fantasy and the fantasy is typically limited to sexual activity (Ellis & Symons, 1990; Hunt, 1974). Similarly, men are more likely than women to report experiencing group sex fantasies (Leitenberg & Henning, 1995; Wilson & Lang, 1981). In contrast, women report fewer fantasies containing multiple partners and more fantasies about relationships, commitment, and monogamy (Leitenberg & Henning, 1995). Men’s fantasies also include significantly more strangers and anonymous partners as participants whereas women’s fantasies tend to include current or past acquaintances (Barclay, 1973).

Sex Differences in Sexual Arousal and Visual Interest

Studies using more objective measures of sexual interest, such as studies of genital sexual arousal and visual sexual interest measured by viewing time, have also found sex differences. Specifically, the *category-specificity* of these responses differs significantly between men and women. Men are category-specific, in that they show the greatest genital or viewing time response to particular sexual stimulus categories (usually those depicting their preferred sexual targets or activities). Women, however, are much less category-specific, in that they show relatively similar

responses to many sexual stimulus categories, including non-preferred sexual targets and activities (Chivers et al., 2004; Ebsworth & Lalumière, 2012; Imhoff et al., 2010; Israel & Strassberg, 2009; Suschinsky & Lalumière, 2011; Suschinsky et al., 2009).

It is unclear at this time whether sex differences in category-specificity—as measured by genital arousal and viewing time—are associated with sex differences in sexual fantasies. The only study relevant to this question suggested that women's romantic attractions and fantasies were less category-specific than men's (Rullo, Kinnish, & Strassberg, 2006). Specifically, 25% of the fantasies reported by heterosexual women included bisexual or homosexual relations, compared to 10% for heterosexual men.

Intra-Sex Differences and the Menstrual Cycle

Many aspects of women's sexuality are related to the menstrual cycle. Stanislaw and Rice (1988) conducted a 2-year longitudinal study of 1,066 women to investigate the timing of sexual desire during the menstrual cycle. They suggested that selection should have synchronized periods of peak desire, behavior, and fertility. They investigated the correspondence of the reports of sexual desire and intercourse and the basal body temperature (BBT) shift—the BBT rises by at least four tenths of a degree after ovulation has occurred (Royston & Abrams, 1980): A strong positive correlation was found between the BBT shift and the onset of sexual desire. Similarly, Bullivant et al. (2004) found that sexual activity, sexual desire, and the frequency and intensity of sexual fantasies all peaked during the pre-ovulatory surge of the luteinizing hormone in their study of 46 heterosexual women across one menstrual cycle. Women who report sexual orientations other than heterosexual also exhibit heightened sexual motivation at ovulation (Diamond & Wallen, 2011).

Pair-bonded women tend to prefer partner features indicative of dominance, symmetry, and masculinity during the fertile period of their menstrual cycle (Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004; Gangestad & Thornhill, 1998; Gangestad, Thornhill, & Garver-Apgar, 2010a; Penton-Voak & Perrett, 2000). They also place greater emphasis on the physical attractiveness of their current sexual partner, report greater arousal to male body features, and show greater interest in sexual encounters with masculine men during their follicular (i.e., pre-ovulatory) phase, relative to their luteal (i.e., post-ovulatory) phase (Gangestad, Thornhill, & Garver-Apgar, 2010b).

Overall, these studies show that female preferences and evaluation of male mate quality change over the menstrual cycle in accordance with the *ovulatory shift hypothesis* (Gangestad, Garver-Apgar, Simpson, & Cousins, 2007). The ovulatory shift hypothesis states that women's preferences change across the menstrual cycle to serve specific functions. During the fertile phase, women adopt a more short-term mating strategy and seek

partners with good genes (e.g., they report sexual attraction to men who are more dominant or masculine than their primary partners) (Gangestad et al., 2007). During non-fertile phases, women adopt a more long-term mating strategy and seek commitment (e.g., they prefer men who are less masculine but who offer high investment potential) (Gangestad & Thornhill, 1998; Gangestad, Thornhill, & Garver-Apgar, 2005; Gangestad et al., 2010b; Thornhill & Gangestad, 2008).

The research investigating cyclical shifts in women's fantasies and interests has explored changes in frequency, intensity, and arousability. Slob, Bax, Hop, Rowland, and van der Werff ten Bosch (1996) tested women during the follicular and luteal phases of their menstrual cycles and found that, in the 24 h following testing, women who were in the follicular phase reported experiencing the most sexual fantasies. Women in the follicular phase also reported heightened levels of sexual arousal to erotic films. Similarly, Wallen and Rupp (2010) reported that women first tested in the follicular phase showed increased visual sexual interest in sexual stimuli in subsequent sessions compared to women first tested in their luteal phase.

Some researchers have failed to find a shift in sexual desire and interest in sexual activity across the menstrual cycle. From a literature review of 64 studies, Meuwissen (1990) concluded that there were inconsistent findings for the timing of peak sexuality in women. Peak sexuality was not limited to the fertile phase and peaks in sexual desire were reported to occur in all menstrual cycle phases. Meuwissen suggested that the diversity of results was likely due to methodological differences among studies, specifically, inconsistencies in the classification and testing of the menstrual cycle phases, use of contraceptives, partner availability, stimuli, and measures of arousal.

Little research has been conducted to explore whether hormones affect sexual fantasies and the category-specificity of visual sexual interests of women across the cycle (Bullivant et al., 2004; Slob et al., 1996; Wallen & Rupp, 2010). Few studies have been conducted to investigate changes in both the frequency and content of women's sexual fantasies continuously across an entire menstrual cycle using an accurate measure of ovulation. Several studies have investigated visual sexual interest across the menstrual cycle, but no study has explicitly investigated changes in the category-specificity of sexual interest across the cycle. In this study, we explored the role of the menstrual cycle in sexual fantasies and category-specificity of sexual interest using a valid hormonal measure to confirm ovulation. Based on the ovulatory shift hypothesis and prior research, we predicted that during ovulation women's sexual fantasies would increase in frequency and arousability and would be more likely to reflect a male-like short-term mating strategy by showing an increased focus on sexual and visual content. We also predicted that the category-specificity of visual sexual interest would become more male-like (more category-specific) at ovulation.

Method

Participants

A total of 34 women were recruited from university and college campuses. To be eligible for the study, women were required to be between 18 and 30 years of age, not using any form of hormonal contraceptives, and not pregnant or trying to conceive a child. Women were also required to be single or at least not in a long-term relationship (i.e., not engaged, living together, or married, or in a relationship longer than 6 months). The last criterion was used because we found that it was very difficult to recruit naturally cycling women (women not using hormonal contraceptives) who were in relationships. Women also had to report experiencing regular menstrual cycles (i.e., cycle length between 25 and 32 days). Women who reported exclusive sexual attractions to women were also ineligible for the study, because they produce a different pattern of viewing time than heterosexual women (Ebsworth & Lalumière, 2012; Rullo, Strassberg, & Israel, 2010).

A total of 27 heterosexual women were included in the final analyses involving the electronic diary and 22 heterosexual women were included in the final analyses involving viewing time. Participants were excluded from the final analysis for the diary component of the study for the following reasons: Self-reported sexual orientation other than heterosexual on questionnaire items ($n = 5$) and voluntary withdrawal from the study ($n = 2$). Five additional participants failed to attend one of the sessions of the viewing-time component of the study and were excluded from those analyses.

The mean age of the 27 heterosexual women used in the final analysis for the electronic diary was 21.5 years ($SD = 3.3$; range, 18–29). The majority of the women were single (82%) at the beginning of the study and the remaining women (18%) were in relationships. At the conclusion of the study, just over half of the women were single (55%), the remainder being in relationships (45%). Sexual orientation was assessed using the Kinsey scale (Kinsey, Pomeroy, Martin, & Gebhard, 1953); women were considered heterosexual and included in the final analyses if they reported predominantly or exclusively male partners in their romantic attractions and previous sexual relations.

Measures

Questionnaire

Participants completed a self-report questionnaire constructed for this study and designed to determine participants' biographic background and sexual history.

Electronic Daily Diary

Participants received a daily email that included the link to the electronic diary entry (SurveyMonkeyTM). An electronic diary

produces better participant compliance than the more traditional paper diary (Green, Rafaeli, Bolger, Shrout, & Reis, 2006). The diary consisted of questions about the sexual fantasies that the participants had experienced since their last diary entry (up to five fantasies per day). The diary was completed during the hours of 17:00 and 01:00, for a consecutive 30-day period. Some questions contained in the electronic diary were modified versions of questions from Ellis and Symons' (1990) Sexual Fantasy Questionnaire.

Ovulation

A 10-day window was determined using the reverse counting method (RCM) during the first session based on cycle information provided by participants (Chen, 2005). A set of 10 ovulation urine midstream tests (saveontests) was issued to measure ovulation during the 10-day window. The midstream test measures the surge in luteinizing hormone that is present in urine preceding ovulation and was used to confirm ovulation during the 10-day window. Ovulation was confirmed for all women used in the final analyses.

Viewing Time Stimuli

The stimulus set consisted of 84 pictures: 80 pictures of computer composite images of individuals from the five Tanner age categories clothed in bathing suits and four neutral landscapes (Pacific Psychological Assessment Corporation, 2004). The pictures were presented once per session in one of 30 random orders. An equal number of male and female stimuli from each age category were present in each randomization. The five Tanner stages represent five stages of sexual development using the presence or absence of secondary sex characteristics (e.g., pubic hair, testicular weight and penis size, and breast size) (Tanner, 1962). These composite images have been used by other researchers and have produced high age and gender category-specificity among heterosexual men (e.g., Ebsworth & Lalumière, 2012; Imhoff et al., 2010).

Subjective Ratings

Participants were asked to rate how sexually appealing they found the picture to be, using a 5-point scale that ranged from 1 (*very sexually appealing*) to 5 (*very sexually unappealing*) using the keyboard. The computer program (Limestone Technologies Inc.'s PrefAssessTM) measured the time spent between each keyboard press.

Procedure

Screening

Prospective participants indicated their interest in the study by email and a phone interview was arranged. During the phone interview, women who met the eligibility criteria and who remained interested in participating were then asked to tell the

experimenter an approximate date for the commencement of the next menses. This date was used to schedule the first viewing time session.

Session 1

Participants were tested individually and the first session coincided with the first or second day of menses. Participants were given instructions on how to use the computer program and were given eight practice pictures. They were instructed to enter their subjective ratings of sexual appeal using the keypad and that this action cued the program to transition to the next picture. Participants were not informed that their viewing time was being measured. Once the eight practice pictures had been rated, the experimenter set up the viewing time task (the one to be recorded) and left the room. Participants were instructed to “*Please take as long as you need to complete the slide-viewing task. Look at each slide carefully and decide how you want to rate it*” and to notify the experimenter when the session was complete. After the completion of the viewing time task, the experimenter returned to the room and issued the questionnaire.

Each participant recorded (on a 4-month calendar included in the questionnaire) the days of her last two menses, the first day of her current menses, and the estimated timing of her next menses. Information regarding the regularity and length of the participants’ cycles was also obtained. The menstrual cycle information was then used by the experimenter to estimate average cycle length and when each participant was most likely going to be ovulating during the study period, using the RCM (Fehring, 2005). The RCM estimates ovulation by counting backwards 14 days from a woman’s next expected menses in order to estimate the next ovulation. Using the menstrual cycle information provided, the researcher identified a window (10 days) when ovulation would most likely occur. For example, if a woman’s cycle was 28 days, with her estimated menses beginning on the 19th of the following month, then ovulation would most likely occur on the 5th of that month (with her ovulation window identified as the first to tenth of that month).

Participants were instructed on how to use the ovulation midstream tests and how to read the response during the first session (participants were told that the tests measured hormone levels and were not told that the tests assessed ovulation). Reminder emails were sent the day before the onset of the 10-day window as well as the day of onset, to remind participants to begin using the tests. Participants were instructed to use the tests between the times of 10:00 h and 20:00 h (and not the first urine sample of the day), when luteinizing hormone is most concentrated. This test detects the surge in luteinizing hormone that precedes ovulation, usually by 36 h (Fehring, 2005). Participants recorded the results of the midstream test in their daily diary as prompted and were instructed to notify the experimenter by email when the results were positive. A positive test triggered an appointment for Session 2 of the study.

The first diary entry took place during the first session. The diary was organized so that participants received a daily email with the electronic diary link an hour before the allotted diary entry period of 17:00 to 01:00 h. The fixed time period was to ensure that approximately one full day had passed between entries. Total participant compliance for the daily electronic diary was 95% for the duration of the 30-day period. Eighteen of the 27 participants used in the final analyses had 100% compliance for all study components (i.e., 30 diary entries and three viewing time sessions).

Session 2

During the 10-day window, participants were instructed to contact the experimenter when the midstream test results were positive, indicated by a darker than control-band color. An appointment was then scheduled by email for the second session within 24–48 h of the surge in luteinizing hormone. Any participant unable to attend the second session within this time frame was not included in the final analyses for viewing time ($n = 5$). The same procedure used in the first session was followed, the only difference being a different random order of pictures. After completing the second viewing time session, the experimenter reminded participants to use all remaining midstream tests in order to have a record of all possible positive results.

Session 3

During the last few days of the 30-day study period, participants were contacted by email for the third and last viewing time session. At the conclusion of the third viewing time session, participants completed an additional questionnaire to determine changes in participants’ circumstances during the 30-day period (e.g., change in relationship status, the use of hormonal contraceptives). Compensation for the study (up to \$60 CDN) was based on participant compliance with the different components of the study: \$1 per completed diary entry, \$5 per viewing time session, and \$15 as a bonus to those who completed all components of the study. The procedure for this experiment was reviewed and approved by the university ethics review board prior to the commencement of the study.

Data Analysis

The menstrual cycle was standardized into a 28-day cycle with ovulation anchored on Day 14. The phases of the menstrual cycle were as follows: follicular (the first few days of menstruation until the day before the positive recorded midstream test result; Days 1–12), ovulation (the day of the recorded positive midstream test result, plus 2 days; Days 13–15), and luteal (the remaining days in the study period; Days 16–28).

The viewing time data were examined for possible outliers. An outlier was defined as any time that was 5 s or longer than the next highest viewing time (typically caused by distraction). The 21 outliers were rounded to the next whole number specific to

that session (menstrual cycle phase) and participant. The scale used for the subjective ratings was counter-intuitive and was based on the default scale provided by the computer program; the ratings were reversed so that a high number would correspond with a high level of sexual appeal.

For each viewing time session, the viewing times and subjective ratings were standardized within-subjects (i.e., transformed into *z*-scores), excluding neutrals. Two contrast scores were calculated for each measure. The Gender Viewing Time Contrast score and the Gender Subjective Contrast score were calculated by subtracting the summed standardized viewing times/subjective ratings of the mature female slides (Tanner stages 4 and 5) from the summed standardized viewing times/subjective ratings of the mature male slides. Positive scores indicated greater interest in mature male stimuli. The Age Viewing Time Contrast score and the Age Subjective Contrast score were calculated by subtracting the summed standardized viewing times/subjective ratings of the sexually immature male slides (Tanner stages 1 and 2) from the summed standardized viewing times/subjective ratings of the sexually mature male slides (Tanner stages 4 and 5). Positive scores indicate greater interest in adult stimuli. Male stimuli were chosen for the Age Contrast scores because all participants were heterosexual.

Results

Sexual Fantasies

Five aspects of sexual fantasies were examined: frequency, degree of arousal generated, gender category-specificity, content, and focus of the fantasy. Figure 1a shows the frequency of fantasies across the menstrual cycle. Fantasy frequency was highest during the pre-ovulatory surge in the luteinizing hormone (Day 13) and decreased following ovulation. Daily fantasies were, on average, more frequent during the follicular ($M = 0.84$, $SD = 0.69$) and ovulatory ($M = 0.90$, $SD = 0.77$) phases of the menstrual cycle, compared to the luteal phase ($M = 0.61$, $SD = 0.45$). A within-subjects repeated-measures ANOVA showed that there was a significant difference between menstrual cycle phases, $F(2, 52) = 4.49$, $p = .02$. Follow-up pairwise comparisons found significant differences between the follicular and luteal phases ($p = .006$) and between the ovulatory and luteal phases ($p = .01$).

Arousal generated from the fantasy was assessed using a 9-point scale (1 = *not arousing at all*, 9 = *very arousing*). It was calculated by taking the mean arousal ratings of all fantasies experienced during a particular day (up to five). As seen in Fig. 1b, fantasies were more arousing on average during the ovulatory phase ($M = 7.0$, $SD = 1.4$) compared to the follicular ($M = 6.3$, $SD = 1.2$) and luteal ($M = 6.5$, $SD = 1.3$) phases. The ANOVA indicated a significant effect of phase of cycle on level of fantasy arousal, $F(2, 42) = 4.36$, $p = .02$, with a significant difference in the arousal ratings of fantasies experienced

between the follicular and ovulatory phases ($p = .01$). For this and subsequent analyses of fantasies, five participants were excluded because they did not report any fantasies during a given menstrual phase.

Gender category-specificity was assessed by examining the sex of the individuals in the fantasies. It was calculated as a percentage of all reported fantasies that involved males; a value of 100% means a completely category-specific pattern with no female fantasy participants whereas a value of 50% means an equal number of males and females in the fantasies. Figure 1c shows that category-specificity of fantasies remained high and fairly constant across the cycle (follicular: $M = 95.1\%$, $SD = 11.6$, ovulatory: $M = 96.7\%$, $SD = 8.3$, and luteal: $M = 95.9\%$, $SD = 8.4$), $F(2, 42) = 0.28$, *ns*.

The category-specificity of fantasies was also examined using the absolute number of males and females reported in the fantasies (Fig. 1d). The mean number of female fantasy participants remained very low and fairly constant across the cycle (follicular: $M = .04$, $SD = .07$, ovulatory: $M = .05$, $SD = .12$, and luteal: $M = .03$, $SD = .06$), $F(1.63, 42.49) = 0.62$, *ns*. The mean number of males differed across the cycle, with an increase during ovulation ($M = .94$, $SD = .89$) relative to the follicular ($M = .84$, $SD = .73$) and luteal phases ($M = .60$, $SD = .46$), $F(1.57, 40.73) = 4.50$, $p = .02$. Pairwise comparisons revealed significant differences between the follicular and luteal phases ($p = .006$) and the ovulatory and luteal phases ($p = .01$). The Greenhouse–Geisser correction was used because the assumption of sphericity was violated.

Participants reported whether each of the fantasies experienced involved a focus on visual images or a focus on feelings experienced during the fantasies. This question involved a forced choice response where only one selection could be made from two possible options. We calculated the percentage of all reported fantasies that focused on visual images; a value of 100% means that all fantasies included only visual image content and a value of 0% means that all fantasies involved a focus on feelings experienced. Figure 1e shows that fantasies were slightly more often visually focused during the follicular phase ($M = 51.0\%$, $SD = 29.0$), and less often visually focused and more feelings focused during the ovulatory ($M = 34.0\%$, $SD = 36.1$) and luteal ($M = 44.0\%$, $SD = 26.8$) phases, $F(2, 42) = 3.14$, $p = .05$. Pairwise comparisons revealed a significant difference between the follicular and ovulatory phases ($p = .01$).

Participants reported whether the focus of the fantasies experienced involved sexual characteristics (i.e., the sexual act or the physical characteristics of the fantasized partner), or emotional characteristics (i.e., the emotions of the fantasized partner(s) or of the participant themselves). This question involved a forced choice response where only one selection could be made from four possible options. We calculated the percentage of all reported fantasies that focused on sexual characteristics; a value of 100% means that all fantasies focused on only sexual characteristics and a value of 0% means that all fantasies involved a focus on

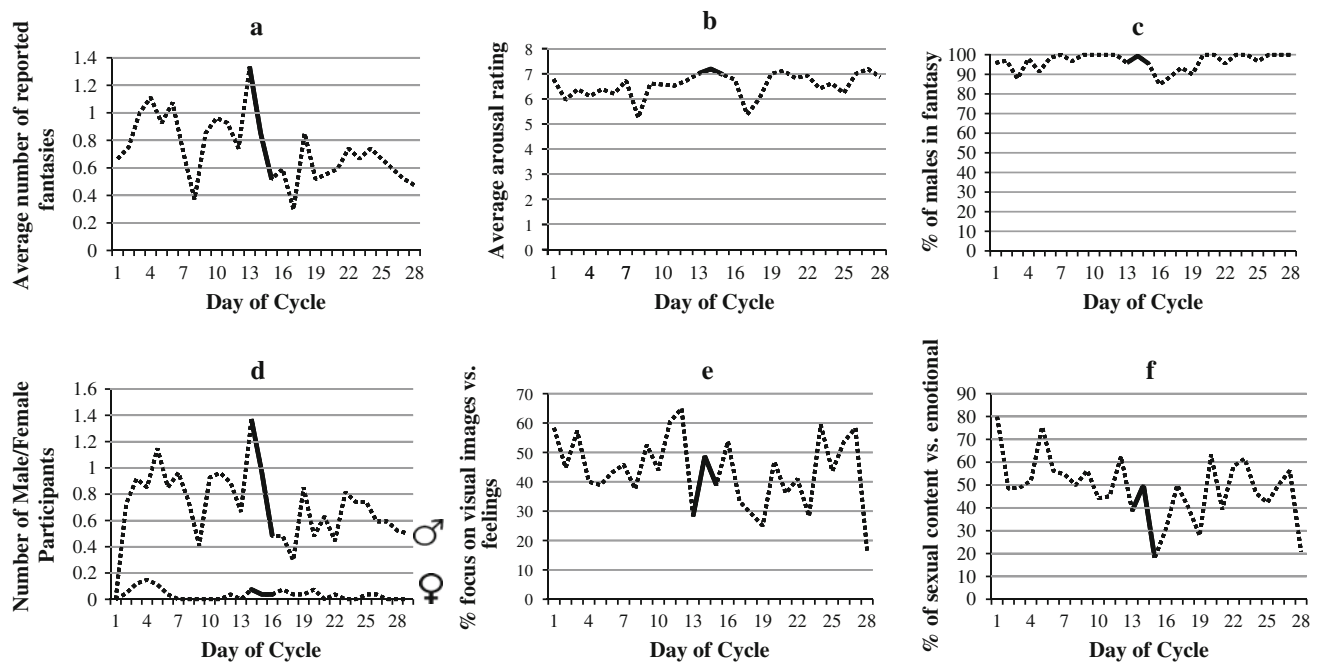


Fig. 1 Sexual fantasy variables across a standardized menstrual cycle. **a** Fantasy frequency, **b** fantasy arousal, **c** category-specificity of fantasy, **d** fantasy participants by gender, **e** fantasy content, and **f** fantasy focus. Non-fertile phases (*dotted line*); fertile phase (*thick line*)

emotional characteristics only. Figure 1f suggests that sexual content was lowest (and emotional content was highest) during the most fertile period of the menstrual cycle ($M = 38.7\%$, $SD = 38.4$). Sexual content was higher during the follicular ($M = 58.3\%$, $SD = 29.4$) and luteal ($M = 47.1\%$, $SD = 35.9$), a difference that approached significance, $F(2, 42) = 2.81$, $p = .07$. Pairwise comparisons showed a significant difference between the follicular and ovulatory phases ($p = .05$).

We also examined whether the fantasy was internally-generated or externally-triggered, changes in fantasy activities (e.g., fantasies focusing on penetrative vs. non-penetrative activities), details about the fantasized individuals (e.g. strangers vs. past partners, how well they knew them, their age), whether the fantasy was recurring, and if there were any changes in participants' actual sexual behavior across the cycle. Repeated-measures ANOVAs revealed no significant effects of cycle phase on any of these variables. The vast majority of the fantasies experienced during the 30-day period had the woman as a participant in the fantasy (97%), usually with only one other participant in the fantasy (91%). Slightly over half the fantasies were recurring fantasies (55%), with the remaining fantasies new to the participant (45%). Fantasies, if they were triggered, were usually triggered by a person (59%) and most of the time the fantasy did not affect the behavior of the individual (76%; i.e., did not lead the participant to engage in sexual activity either alone or with another person). If the fantasy did affect the behavior of the individual, usually it would lead to solitary masturbation because of the lack of an available partner (63%) and re-enacting the fantasy when engaged in this activity (72%).

Viewing Time

Figure 2a shows the average gender contrast scores for viewing times and subjective ratings across the menstrual cycle. During the follicular and ovulatory phases (Sessions 1 and 2), women showed no preference for mature male stimuli. In fact, they looked slightly longer at their non-preferred sexual partners (follicular $M = -0.26$, $SD = 0.83$; ovulatory $M = -0.36$, $SD = 0.92$). During the luteal phase (Session 3) the women looked slightly longer at the mature male stimuli than the female mature stimuli (i.e., they looked longer at images that they rated as more appealing; $M = 0.12$, $SD = 1.04$). A within-subjects repeated-measures ANOVA found no significant effect of menstrual cycle phase on the gender category-specificity of viewing time, $F(2, 42) = 2.26$.

Subjective appraisal for gender-specificity followed a different pattern. That is, the women became subjectively more category-specific (toward males) with successive sessions: follicular ($M = 0.32$, $SD = 1.71$), ovulation ($M = 0.72$, $SD = 1.81$), and luteal phase ($M = 1.11$, $SD = 1.94$), $F(2, 42) = 3.25$, $p = .05$. Pairwise comparisons indicated that the follicular and luteal phases were significantly different from each other ($p = .02$).

Figure 2b shows the average age contrast scores over the three sessions for viewing times and subjective ratings. The pattern for age-specificity was similar to the pattern for gender-specificity. During both the follicular and ovulatory phases the women viewed the sexually mature and sexually immature stimuli fairly equally ($M = -0.004$, $SD = 0.81$ and $M = -0.10$, $SD = 0.83$). During the luteal phase (Session 3) viewing times were significantly longer for sexually mature male stimuli ($M = 0.73$,

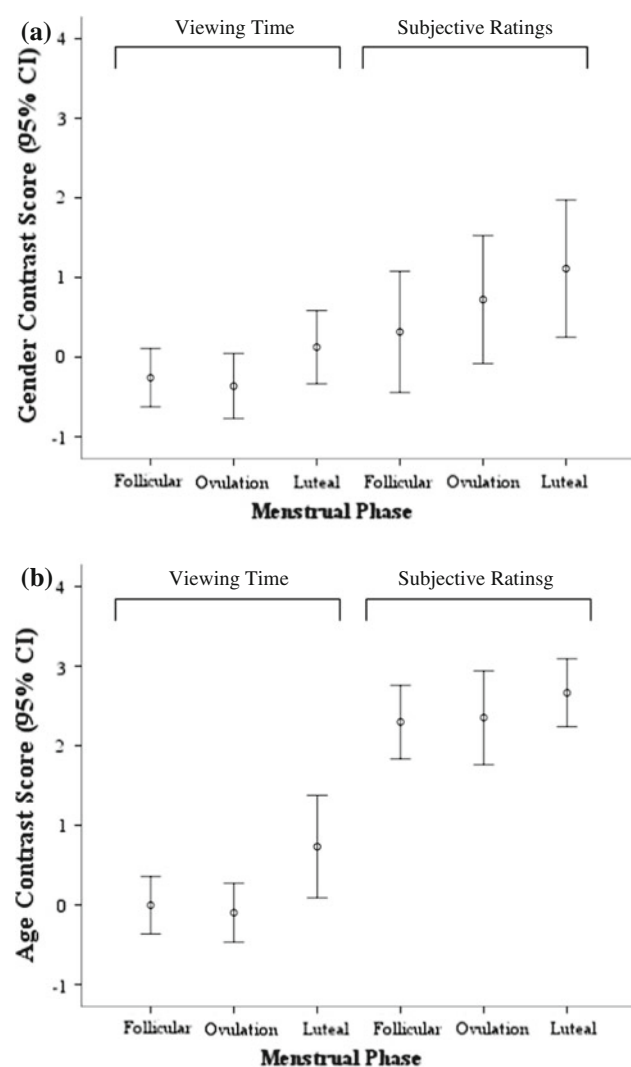


Fig. 2 Average gender (a) and age (b) category-specificity of viewing times and subjective ratings

$SD = 1.45$), $F(2, 42) = 4.69$, $p = .02$. Pairwise comparisons indicated that the follicular and luteal phases were significantly different ($p = .03$), as well as the ovulatory and luteal phases ($p = .01$). This pattern was not true for subjective appraisal; there was no significant effects of phase for the age subjective ratings, $F(2, 42) = 1.35$. Sexually mature images were consistently rated as more sexually appealing than the images of sexually immature males.

Discussion

The goal of the current study was to examine whether aspects of female sexuality, namely sexual fantasy and category-specificity of visual sexual interest, changed as a function of the menstrual cycle. Previous research has suggested that hormones influence sexual interests and sexual motivation; we expected that

changes in women's hormonal condition would alter their fantasies and visual sexual interests. Specifically, we predicted that, during ovulation, sexual fantasies and interests would be different from non-fertile phases of the menstrual cycle in line with the ovulatory shift hypothesis. We expected that fantasy content would reflect a more short-term rather than long-term mating strategy during ovulation and that viewing times would become more category-specific during the most fertile phase of the menstrual cycle. The findings of the current study suggest that not all aspects of female fantasy and sexual interests were contingent on hormonal status. Frequency and arousability of fantasies showed the expected shifts in line with previous research. Fantasy content did not follow the expected pattern; in fact, fantasies became more female-like during the fertile phase. The category-specificity of visual sexual interest did not increase during ovulation as was predicted, but rather increased across sessions.

Women's Sexuality as a Function of the Menstrual Cycle

Previous research has shown that men fantasize at greater frequency than women do (Ellis & Symons, 1990; Wilson & Lang, 1981). Specifically, women have been reported to fantasize only once per week compared to men who fantasize at least once per day (Ellis & Symons, 1990). Contrary to this research, the women in this study reported on average 0.77 sexual fantasies per day. The difference between the frequency of fantasy reported in the current study compared to previous studies could be the result of the use of a daily measure. This measure relied less on long-term recollection of fantasy, compared to those employed in retrospective questionnaire studies; the daily measure might be more accurate or reflective of the actual frequency of women's fantasies than measures assessing fantasies at one point in time (Ellis & Symons, 1990; Wilson & Lang, 1981). Also, the use of a daily diary may have triggered women to pay more attention to their fantasies and perhaps even triggered more fantasies. At the conclusion of the study, the majority of the women (74%) reported becoming "more aware" of their sexual fantasies.

As predicted, sexual fantasies were significantly more frequent during ovulation than during non-fertile phases. Likewise, the level of arousal generated from the fantasies also significantly increased during ovulation, such that fantasies experienced during ovulation were rated as significantly more arousing than fantasies experienced during non-fertile phases. These results support other research that has suggested that peak fertility coincides with increased sexual desire, arousability, and sexual motivation in women (Bullivant et al., 2004; Diamond & Wallen, 2011; Gangestad et al., 2010b; Slob et al., 1996; Stanislaw & Rice, 1988).

Contrary to prediction, gender category-specificity of sexual fantasies did not increase at ovulation. In support of other research (Rullo et al., 2006), however, women's fantasies did not depict an entirely gender category-specific pattern overall. Forty-eight percent of the women studied were completely category-specific

across all menstrual cycle phases, reporting fantasies with only males as partners. The remaining 52% of women reported fantasies that included both their preferred (male) and non-preferred (female) sexual partners. There were no significant cyclical differences with regard to the sex of fantasized individuals when measured as a proportion. There was, however, a difference when the numbers of male and female individuals were analyzed separately. There were no cyclical differences for the number of females in fantasies, but the number of males in fantasies increased significantly during ovulation. We can thus conclude that during ovulation women engaged in more fantasies that include their preferred sexual partners.

From the ovulatory shift hypothesis, it was predicted that the content of women's fantasies would also shift, reflecting a short-term, and more male-like mating strategy. Specifically, we predicted that women's fantasies would become more visual, focusing on sexual characteristics and physical attractiveness, rather than emotional content, during ovulation. In fact, fantasies were most visually-focused during the follicular phase and became feelings-focused from ovulation onwards. It is possible that a mitigating factor contributed to this unexpected finding. In the current sample of women, approximately one third of the women acquired a partner during the course of the study and thus were no longer single. It is possible that the change in relationship status may have been responsible for the shift in fantasy content, rather than hormones. Additional analyses were conducted to examine the effect of acquiring a partner on the content of sexual fantasies. There was no significant interaction between the acquisition of a partner and menstrual cycle phase, suggesting that partner acquisition did not affect sexual fantasy content. However, given the low statistical power, these results should be interpreted with caution.

Nevertheless, our results differ from the pattern reported by Gangestad et al. (2010b) who found that, relative to the luteal phase, women in the fertile phase of their cycle placed greater emphasis on the physical attractiveness of a partner and male body features. Gangestad et al. relied on retrospective self-report questionnaires during three time periods (introductory session, fertile, and non-fertile phases) to assess women's sexual interests over the previous 2 days. Retrospective rather than continual reporting might be less accurate in assessing subtle changes and the results of this study may reflect this difference in methodologies. Another possibility is that our sample contained mostly single women, whereas the majority of research conducted that has observed an ovulatory shift has done so using pair-bonded women (Gangestad et al., 2005, 2007, 2010a, b).

Our study also investigated cyclical shifts in the category-specificity of sexual interest as measured by viewing time. Viewing time research is based on the premise that people look longer at stimuli that they find more attractive or appealing. Contrary to expectations, women did not become more category-specific at ovulation. For both the follicular and ovulatory phases, the heterosexual women looked slightly longer at their non-preferred stimuli. During the luteal phase, however, viewing times better

reflected subjective ratings. This was true for both gender and age of individuals depicted. Ovulation may have had limited effects on the category-specificity of viewing times and perhaps sexual interest was modulated by repeated exposure to the stimuli.

Our viewing time results should be considered carefully, especially those obtained in the first two sessions. Our participants did not produce the usual age category-specificity obtained in most viewing time studies, including studies from our own laboratory (see Ebsworth & Lalumière, 2012). Indeed, women typically produce longer viewing times for mature male stimuli than for immature male stimuli. The lack of ovulation effect on viewing time could, therefore, be due to something unique about this sample or the procedure used in this study.

Limitations

The daily electronic diary, which was designed for this study, required participants to record details regarding their sexual fantasies for a consecutive 30-day period. An electronic diary was utilized because research shows that this method increase participant compliance because the experimenter receives information regarding the time of completion (Green et al., 2006). Compliance for the electronic diary component was high (97%) and missed diary entries were distributed evenly throughout the follicular and luteal phases of the menstrual cycle (there were no missed diary entries during ovulation). In the current study, all women began the study during menses, in order to capture ovulation during the 30-day period. It would be worthwhile to conduct a study over a longer period in order to capture ovulation regardless of when the participant began the study.

As previously mentioned, the stimuli used in the viewing time component of the study were computer-generated composite images. Many of these images looked unrealistic and manipulated and for these reasons may not have been "sexually appealing" for the participants (based on participant feedback). Composite images were used to protect the privacy of the individuals in the original images. However, if images of real individuals were used, or sexually explicit images that better represent objects of sexual interest, then it may have been easier to detect subtle changes in viewing time as a function of ovulation. Also, it may have been better to use different stimulus images during the three menstrual cycle phases to reduce the effect of repeated exposure.

Within sexuality research there are two common issues regarding the participant sample. The first of these is a selection bias that tends to attract more sexually experienced and liberal individuals (e.g., Strassberg & Lowe, 1995). The second issue is that the participants are drawn from a sub-population (university and college students) who may differ from the rest of the population. The results of this study might, therefore, not be generalizable to the rest of the population. In addition, our sample included only single women whereas most studies of the ovulatory shift hypothesis have included pair-bonded women.

This study replicated previous research suggesting that frequency and arousability of fantasies coincide with peak fertility. Other components of fantasy such as fantasy content did not shift in accordance with the ovulatory shift hypothesis. Similarly, it appears that visual sexual interest (category-specificity) is not mediated by fertility status as was expected. Category-specificity of visual sexual interest does not appear to change as a function of ovulation, but rather as an effect of repeated exposure to stimuli. Additional research is needed to confirm these results. Knowledge of hormonal state at the time of testing, as well as the possible effects of hormonal state on sexual responses should be further investigated and taken into consideration when studying and theorizing on female sexuality and interest.

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