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Subjective assessment of sexual images: Influence of hormones and content

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Subjective assessment of sexual images: Influence of hormones and content

By

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B.A., Knox College, 2011

Advisor: Kim Wallen, Ph.D.

An abstract of

A thesis submitted to the Faculty of the

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Abstract

The present study investigated whether plasma levels of gonadal steroids were related to men's and women's subjective ratings of sexual images that differed in the amount of contextual information provided and in the sexual act depicted. 14 men, 14 naturally cycling (NC) women, and 14 women taking oral contraceptives (OCs) rated the level of attractiveness of sexually explicit images at three different testing sessions. NC women were tested during their menstrual, periovulatory, and luteal phases, and OC women were tested at similar time points across their pill-cycles. Men were tested three times approximately 5 – 10 days apart. Blood spots were collected at each testing session and assayed for levels of testosterone in males and progesterone in females. Plasma levels of gonadal steroids at time of testing were not related to subjective ratings for NC women, OC women, or men. However, OC women's hormonal condition during their first test session predicted their ratings of sexual images on the 2nd and 3rd session, and this effect of initial hormonal condition varied with the specific content of the images. Specifically, women who had been taking OCs for three weeks when they entered the study rated images with little contextual information and images depicting female-to-male oral sex as less arousing at all testing sessions than did other women. These results corroborate previous studies in which women's initial hormonal condition was found to predict subsequent interest in sexual stimuli. OC women in the third week of their pill-packs had been exposed to the highest cumulative amount of progestins at the time of testing, as compared to all other groups of women. These results suggest gonadal steroids are related to subjective ratings of sexual stimuli only in specific conditions, where contextual elements of images cannot be used to assist in inducing arousal.

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Introduction

Previous research has revealed a relationship between plasma levels of gonadal steroids and sexual behavior in men and women. Hypogonadal men, although able to achieve and maintain erections, generally report low levels of sexual interest, which can be increased with injections of testosterone (T). This result indicates that in men, at least a baseline level of T is necessary for sexual desire (e.g. Bagatell et al., 1994; O'Caroll and Bancroft, 1984; Kwan et al., 1983). In naturally cycling (NC) women, levels of sexual desire, rates of masturbation, and frequency of paired sexual interactions fluctuate across the menstrual cycle, decreasing in the luteal phase and peaking in the periovulatory phase (Roney and Simmons, 2013; Adams, Gold, & Burt, 1978; Harvey, 1987; Guegen, 2009; Matteo and Rissman, 1984). Furthermore, one of the reported side effects among women taking oral contraceptives (OCs), who do not ovulate and do not experience the hormonal fluctuations that NC women do, is decreased sexual desire (Battaglia et al., 2012; Sanders et al., 2001). Despite these findings, experimental assessment of the relationship between hormones and sexual interest or arousal, as measured by subjective response to visual sexual stimuli, has yielded mixed results (e.g. Chivers et al., 2010; Rupp and Wallen, 2010). Recent work has suggested study design and the nature of stimuli used are two factors that may contribute to these inconsistent findings.

Visual sexual stimuli are frequently used in laboratory studies of sexual arousal, as visual stimuli are markedly more effective in inducing arousal than are auditory or written erotic stimuli (Rupp and Wallen, 2008). Response to sexual stimuli is commonly experimentally assessed via subjective ratings of arousal, either alone or in conjunction

with a physiological measure. Many consider subjective ratings of sexual arousal to reflect an interaction between one's current cognitive state and one's physiological response to the sexual stimulus (as reviewed in Rupp and Wallen, 2008). Although there are a number of variables that likely affect one's subjective ratings of sexual images, such as the subject's age, previous sexual experience, and current affective state, the subject's sex is perhaps the most commonly cited factor. For example, in a meta-analysis of 46 studies that evaluated men's and women's responses to sexual stimuli, Murnen and Stockton (1997) found that men reported higher levels of arousal than did women. However, the effect size of the sex difference was small to moderate ($d = 0.31$), indicating that a great deal of the variability in subjective ratings cannot be attributed to subject sex alone.

Others have suggested that the sex difference in response to sexual images may more specifically be a sex difference in content preferences of sexual images. Janssen, Carpert, and Graham (2003) found that men and women reported more arousal to sexual films selected by members of their respective sex, suggesting there are specific characteristics of images that affect responses in a sex-dependent manner. Rupp and Wallen (2009) further found that men and women did not differ in their overall subjective ratings of sexual images or in the amount of time they spent looking at the images (an implicit measure of cognitive interest in the stimuli), but did differ in these measures for particular types of image. Specifically, men and women rated images depicting a member of the opposite sex receiving oral sex as less arousing than other images. Furthermore, women taking OCs and men rated images showing close-ups of the genitals with little contextual information as less arousing than they did images with contextual information.

In contrast, NC women rated decontextualized images as equally attractive to images with contextual information. That women taking OCs differed in their ratings from NC women indicates ovarian steroids may modulate subjective preferences for content of sexual images; however, the data in this study was not separated by phases of the NC menstrual cycles and the OC women's pill cycle, making it impossible to identify whether specific hormonal conditions affected preference.

Previous work has reported cyclic changes in sexual desire among NC women, and Roney and Simmons (in press) recently provided evidence that these changes in desire are correlated with levels of progesterone and estradiol. By examining daily reports of sexual desire, the authors found that women reported greatest desire mid-cycle, and the increase in desire was positively predicted by estradiol levels two days prior. They also found a substantial luteal phase decrease in sexual desire, which was mediated by circulating levels of progesterone.

In contrast to what has been reported in naturalistic settings, laboratory assessments of sexual interest or arousal across the menstrual cycle in NC women have not yielded positive results. Rather than cyclic changes in sexual interest or arousal, what has been found in the laboratory is that women's plasma levels of ovarian steroids during their first exposure to the experimental setting predict their responses across all testing sessions. By using a within subjects, counterbalanced design, in which a portion of the women were first tested in their follicular phases or first tested in their luteal phases, Slob and colleagues (1991, 1996) showed that women who entered the study in their follicular phases showed a greater genital response to sexual images across both testing sessions, even though they were in a markedly different hormonal condition (their luteal phase) for

the second testing session. Wallen and Rupp (2010) found similar effects of first test-session ovarian steroids using a cognitive measure of sexual interest—looking time. NC women who entered the study in the periovulatory phase looked longer at the images (i.e. showed more interest) across all three test sessions, compared with women who were first tested in their luteal phase. More surprisingly, OC women starting the study in their pill-free phase continued to show more sexual interest in the images during the second and third visit, even though they were now in the second and third weeks of their pill cycle and under markedly different hormonal conditions than during their initial exposure to the images.

Although both Slob and colleagues (1991, 1996) and Wallen and Rupp (2010) collected subjective ratings of arousal in their studies, neither group found a relationship between initial hormonal state and subjective assessment of the images, as they had for their physiological and cognitive measures. In all of these previous studies, the authors looked at subjective ratings of images, regardless of content. It is possible, as was revealed in research on sex differences and subjective ratings of stimuli, that although there was no relationship found between initial hormonal and overall subjective ratings of stimuli, there may be a relationship between initial hormonal state and subjective ratings of specific types of sexual images. Therefore, investigating whether subjective ratings of sexual stimuli were affected by women's initial hormonal condition and the content of particular images was one of the aims of the present study.

Similar to women, in men, gonadal steroids have not been found to be related to subjective evaluations of sexual stimuli (Rupp and Wallen, 2007). There has, however, been very little empirical work on the relationship between plasma levels of gonadal

steroids and response to sexual stimuli in men. In their eye-tracking study, Rupp and Wallen (2007) found endogenous levels of T predicted men's viewing time of sexual stimuli, but did not predict subjective ratings of sexual images (Rupp and Wallen, 2007). Again, however, a lack of an overall relationship between subjective ratings of images and T levels does not necessarily indicate a lack of a relationship between T and ratings of all types of sexual images – it is possible the relationship may be stronger for certain types of sexual images. Thus, the second goal of this study was to examine whether men's endogenous levels of T modulated their subjective ratings of specific types of sexual images.

Method

Participants

45 participants (ages 23 – 35) were recruited for this study: 15 men, 15 naturally cycling (NC) women, and 15 women taking an oral contraceptive (OC). Subjects were recruited via e-mail from graduate and profession schools in the Atlanta, GA metropolitan area. Potential participants were asked to complete a packet containing a consent form and a questionnaire regarding contraceptive use, sexuality, and previous experience with visual sexual stimuli (Rupp and Wallen, 2010). The questionnaire was comprised of questions selected from the Brief Index of Sexual Function (BISF; Taylor, Rosen, and Leiblum, 1994; Appendix A) and the Sexual Permissiveness subscale of the Sexual Attitudes Scale (Hendrick and Hendrick, 1987). The questions from the BISF inquired about the subject's level of sexual motivation in the last month and his/her experience with sexual stimuli using a 0 – 6 Likert scale (0 = none, 6 = very extensive).

The Sexual Permissiveness subscale was used to assess the degree to which the subject's regarded their sexual attitudes as liberal or conservative (0 - 6, with higher numbers indicating more liberal attitudes). Subjects were screened based upon answers to these questions. Due to the explicit sexual nature of the stimuli, only potential subjects with some previous experience with sexually explicit images were recruited for participation in the study. In addition, only self-identified heterosexuals were included in the study. All participants who completed and returned the questionnaire met the criteria for participation in the study.

Stimuli

Subjects saw 72 unique sexually explicit images during three separate test sessions (216 unique images in total). These 216 images were selected from a larger group of 364 images that were downloaded from free, publicly available websites. In order to find a sufficient number of stimuli that depicted the range of sexual acts and camera perspectives necessary for addressing the study questions, a stimulus set was generated instead of using previously screened sexual stimuli from the International Affective Picture System (IAPS; Lang et al., 2008). The final stimulus set was created using the subjective ratings of seven men and seven women who were not subjects in the study and rated each image for level of sexual arousal (1 – 4, least arousing to most arousing). Of the 364 images pilot tested, the 216 images used in the study were those with the highest mean subjective ratings. The image sets used in the three test sessions did not differ by mean pilot ratings of image attractiveness (F (2, 215) = 0.55, p = 0.58; overall mean ± SD = 2.09 ± 0.55; Rupp and Wallen, 2007). All subjects saw all 216 images across three test sessions (72 at each testing session). All subjects saw the same

set of images on the same test session (i.e. the images for everyone's first test sessions were the same, whereas the second test session images differed from session 1, but were the same for all subjects). The order of the images within each test session was randomized by the computer software for every individual, such that each participant saw the 72 images for that test session in a unique order.

The stimulus set included opposite-sex couples engaged in either intercourse (144 images) or oral sex (72 images). The images varied in the amount of context depicted in the image; a subset of the photographs (54 images) included no context, and consisted only of close-up images of the sexual act (genitals only in the case of the intercourse images, and genitals and the opposite-sex partner's face or head in the case of oral sex images). For every no-context image in the stimulus set, there was a matched image that depicted the same actors, engaging in the same sexual behavior, but with a wider camera perspective that typically included the majority of the participant's bodies and more contextual elements (e.g. setting details, such as furnishings or items on walls). Finally, there was a subset of images (15 images) that included emotional details of the scene (e.g. the actors were kissing and the scene implied an emotional relationship between the actors). Two raters independently categorized the images with "emotional context," with 100% agreement between raters for the categorized images used in analyses.

Procedure

Study Design

Subjects attended three testing sessions. For men, each session was spaced approximately 5 – 10 days apart within the span of one month. NC women attended one

session in each stage of their menstrual cycles: the menstrual phase, the perivoulatory phase, and the luteal phase. NC women were asked to report the first day of their menstrual cycles, and cycle phases were approximated based on an average 28-day cycle; the menstrual phase was considered to be days 1 -5, the periovulatory phase days 9 – 13, and the luteal phase days 20 – 25. Periovulatory and luteal phase assignments were subsequently confirmed via hormonal assay of women's blood progesterone (P) levels. Due to a laboratory assay error, estradiol could not also be used to confirm cycle phase. Although OC women do not experience hormonal fluctuations as NC women do, OC women's testing sessions were scheduled the same number of days from menstruation as were NC women. Therefore OC women were tested approximately one week into their pill-packs and then again three weeks into their pill-packs.

NC and OC women were randomly assigned to their first test session, such that 1/3 of NC women and 1/3 of OC women first visited the lab in their menstrual phases, 1/3 of NC and 1/3 of OC women first visited in their periovulatory / one-week pill phases, and 1/3 of NC and 1/3 OC women first in their luteal / three-week pill phases. Although subjects varied regarding the phase of their first test session, all subjects attended the three sessions in the same order (i.e. if the woman started in the periovulatory phase, her next testing session was during the menstrual phase; if she started in the luteal phase, her next session was the menstrual phase, etc).

Testing

At the beginning of each test session, subjects completed a questionnaire that assessed state anxiety (State Trait Anxiety Inventory, Mind Garden Inc.). Before

beginning testing, subjects also provided a blood spot sample. In order to obtain a few drops of blood for the blood spot, a lancet device (BD Consumer Healthcare) was used to pierce the index finger of the subject's left hand, and the subject's finger was held above filter paper (Fisher Scientific, 903 Filter Paper) that had two pre-printed circles that were filled with the blood spots. This is a minimally invasive technique that has been shown to provide a sufficient sample for accurate measurement of circulating gonadal steroids (Worthman and Stallings, 1997). The filter paper was dried overnight, placed in a plastic bag, and stored in a sub-zero freezer (-20 ºC) until the hormone assays could be completed. Testosterone (T) and progesterone (P) were assayed by Yerkes Primate Endocrine Core Laboratory, using commercially-available radioimmunoassay (RIA) kits by Diagnostic Systems Laboratories (Webster, TX; T and P intra-assay coefficients of variation, 4.91% and 5.44%, respectively). All men were able to select the time of the first testing session that best fit with their schedules; therefore, in order to help control for time of day effects on T levels, the subjects were then tested at the same time across the remaining two sessions. Thus, some men were exclusively tested in the morning, some in the mid-afternoon, and some in the evening; however, no significant differences in T were found between testing times (for exact levels, see Rupp and Wallen, 2007).

After providing a blood spot, subjects viewed the 72 sexual images. All images were presented on a laptop (Dell Inspiron 1024 x 768 pixel screen resolution), and subjects were told they may look at each image as long as they wished, and could advance to the next image by pressing the space-bar on the laptop. All subjects viewed each stimulus set twice; during the first viewing, the subjects' gaze patterns and eye fixations were tracked with Gaze tracker software (Eye Response Technologies,

Charlottesville, VA). Analyses of the eye-tracking data gathered from this larger study can be found in Wallen and Rupp (2010), Rupp and Wallen (2009), and Rupp and Wallen (2007). During the second viewing, subjects' eyes were not tracked, and they were asked to rate each image for perceived level of attractiveness on a 9-point scale (1 = extremely sexually unattractive, 2 = highly sexually unattractive, 3 = moderately sexually unattractive, 4 = slightly sexually unattractive, 5 = neither sexually attractive or unattractive, 6 = slightly sexually attractive, 7 = moderately sexually attractive, 8 = highly sexually attractive, 9 = extremely sexually attractive). During both viewings, the subject was separated from the experimenter by a curtain, and a tone sounded once the subject had finished viewing all images, to indicate the conclusion of the session and to signal the experimenter to enter the room. At the end of each testing session, the subject was monetarily compensated ($15 for first testing session, $20 for the second, and $25 for the third), and the next testing session was scheduled.

Data Analysis

In order to assess the relationship between the hormonal state of women when they entered the study and their subjective ratings of images, a multivariate analysis of variance (MANOVA) with a 2 (pill use [NC women vs. OC women]) X 3 (initial cycle phase [menstrual vs. periovulatory/one week pill vs. luteal/three week pill]) design was conducted on ratings of images with emotional content, context image ratings, and no-context image ratings, as well as on ratings of images depicting male to female oral sex and ratings of images depicting female to male oral sex. To determine the relationship between T and subjective ratings in men, five correlational analyses were performed, one

on each subjective rating of interest: images with emotional content, context images, no-context images, male to female oral sex images and female to male oral sex images.

Results

Participants

14 men, 14 NC women and 14 OC completed all three testing sessions. However, due to technical error, subjective ratings were not collected for one of the sessions for one of the men and one of the NC women. NC women and OC women did not differ in their previous viewing experience (Mean ± SD, NC: 1.89 ± 0.86, OC: 1.93 ± 0.87, $p = 0.92$) or sexual attitudes (Mean ± SD, NC: 49.50 ± 13.34, OC: 47.79 ± 10.81, $p = 0.80$), and NC women and OC women randomly assigned to the different initial testing phase groups did not differ in amount of viewing experience ($p = 0.29$) or sexual attitudes ($p = 0.16$).

Test cycle phase

There was no main effect of women's cycle phase at time of testing on subjective ratings of any of the images ($p > 0.30$, $\eta_p^2 < 0.03$ for all images), nor was there an interaction between OC usage and test cycle phase for subjective ratings of any of the images ($p > 0.58$, $\eta_p^2 < 0.01$ for all images).

Initial cycle phase

Images with emotional content

NC and OC women did not differ in their subjective ratings of images with emotional content, $F(1, 77) = 0.20$, $p = 0.67$, $\eta_p^2 = 0.003$, and there were also no differences between subjective ratings of women who started in different hormonal phase

groups, $F(2, 77) = 0.81$, $p = 0.45$, $\eta_p^2 = 0.02$, nor an interaction between these factors, $F(2, 77) = 1.82$, $p = 0.17$, $\eta_p^2 = 0.045$.

Context images

Figures 1 and 2 illustrate the subjective ratings by cycle start phase for NC and OC women, which did not differ for images with context ($F(1, 77) = 0.00$, $p = 0.99$, $\eta_p^2 = 0.00$); there were also no differences between subjective ratings of women who started in different hormonal phases ($F(2, 77) = 1.00$, $p = 0.37$, $\eta_p^2 = 0.03$) nor an interaction between these factors ($F(2, 77) = 0.56$, $p = 0.57$, $\eta_p^2 = 0.01$).

No-context images

Across all test sessions, analyses revealed a main effect of oral contraceptive use ($F(1, 77) = 18.46$, $p < 0.001$, $\eta_p^2 = 0.19$) and a significant interaction between oral contraceptive use and initial hormonal status ($F(2, 77) = 4,25$, $p = 0.02$, $\eta_p^2 = 0.10$) for no-context images. As displayed in Figure 3, NC women's subjective ratings did not differ by women's initial hormonal condition for no-context images ($F(2, 38) = 1.62$, $p = 0.21$, $\eta_p^2 = 0.08$). NC women and OC women did not differ in their ratings of no-context images when OC women were first tested in their menstrual (pill-free) phase ($p = 0.12$, $\eta_p^2 = 0.08$) nor when they were first tested in their periovulatory phase or the first week of their pill-pack ($p = 0.28$, $\eta_p^2 = 0.05$). However, NC women who were first tested in their luteal phase rated the images significantly more sexually arousing than did OC women who were first tested in the third week of their pill-pack ($F(1, 22) = 28.06$, $p < 0.001$, $\eta_p^2 = 0.56$). Furthermore, OC women who were first tested in the third week of their pill-pack rated no-context images as less arousing than did other OC women ($F(2,$

39) = 9.42, $p < 0.001$, $\eta_p^2 = 0.33$). As shown in Figure 4, women who had taken three weeks of pills rated the images lower than women who began testing after one week of pills ($p = 0.04$, $d = 0.90$), and much lower than did women who were in their menstrual (pill-free) phase, $p < 0.001$, $d = 2.29$).

Images depicting male-to-female oral sex

As illustrated in Figure 5 and Figure 6, NC and OC women did not differ in their subjective ratings of images depicting male-to-female oral sex ($F(1, 77) = 0.04$, $p = 0.85$, $\eta_p^2 = 0.00$) and there were also no differences between subjective ratings of women who started in different hormonal phase groups ($F(2, 77) = 0.28$, $p = 0.75$, $\eta_p^2 = 0.01$) nor an interaction between these factors ($F(2, 77) = 0.59$, $p = 0.56$, $\eta_p^2 = 0.02$).

Images depicting female-to-male oral sex

Across all test sessions, analyses revealed a main effect of initial hormonal status ($F(2, 77) = 4.22$, $p = 0.02$, $\eta_p^2 = 0.10$) for images that depicted female-to-male oral sex; however, as shown in Figure 7, follow-up analyses revealed no significant differences between NC women who started in different cycle phases ($F(2, 38) = 1.31$, $p = 0.28$, $\eta_p^2 = 0.06$), and revealed only significant differences between start phase for OC women ($F(2, 38) = 3.16$, $p = 0.05$, $\eta_p^2 = 0.14$). Figure 8 illustrates that OC women who were first tested in the menstrual (pill-free) phase rated the images significantly higher than did women who were first tested after taking an OC for three weeks ($p = 0.05$, $d = 0.93$).

Men's subjective ratings

Testosterone levels were not related to subjective ratings for any of the images ($r > 0.3$, $p > 0.1$ for all correlations). It appeared that the variability in men's rating differed by context. We compared variability in ratings by calculating coefficients of variation (CVs) for no-context images (CV = 24.82) and context images (CV = 12.01) and found that no-context images were significantly more variable than ratings for context images ($F(1, 42) = 4.21$, $p < 0.05$). Therefore, in order to more fully explore to the source of this variability, and whether these factors differ based upon the content of the image, multiple regression analyses were performed, with testosterone, state anxiety, sexual attitude scores, sexual motivation, and previous viewing experience entered as predictors. This model did not explain a significant portion of the variance for images with emotional content, context images, no-context images, or images depicting male to female oral sex ($p > 0.1$ for all models). No variables in the models predicting ratings of images with emotional content or male to female oral sex were significant ($p > 0.1$ for all variables in both models). However, as shown in Figures 9 and 10, when controlling for the other variables in the model, sexual attitudes significantly predicted subjective ratings for both context images ($t(34) = 2.32$, $p = 0.03$) and no-context images ($t(34) = 2.36$, $p = 0.02$), such that men with more liberal sexual attitudes rated these images as more arousing. Further, this regression model explained a significant portion of the variance in ratings of images depicting female to male oral sex ($R^2 = 0.48$, $F(5, 34) = 5.50$, $p = 0.001$). In this model, when controlling for the other variables, sexual attitudes was once again the only significant predictor of subjective ratings ($t(34) = 3.58$, $p = 0.001$); as displayed in Figure 11, men espousing more liberal sexual attitudes rated these images as more arousing.

Discussion

We found OC women's initial hormonal condition was related to their subjective ratings of sexual images and that this effect of initial hormonal condition varied with the specific content of the images. Women who were in the third week of their pill cycle when they entered the study rated images with very little contextual information as less arousing than all other OC and NC women in the study. Of particular note is that after three weeks of pills, OC women not only rated the images as less arousing than did other women, but they were also the only group of women to rate these images negatively. The effects of the women's initial hormonal condition persisted across testing sessions, such that these women continued to rate no-context images as aversive in their second and third testing sessions, even though their hormonal condition in these later sessions was markedly different than in their initial session. OC women's initial hormonal condition also affected their ratings of images depicting female-to-male oral sex. OC women in the third week of their pill cycle rated these images lower across all sessions than women who entered in the pill-free week of their cycle.

The relationship between women's initial hormonal condition and subjective ratings of images identified here supports findings of previous studies, in which women's initial hormonal condition was shown to affect their interest in and arousal to sexual images across testing sessions (Slob et al., 1996; Slob et al., 1991; Wallen and Rupp, 2010). Although this effect has now been identified using two different measures of cognitive interest and one measure of physiological arousal, the mechanisms driving this phenomenon remain unclear.

OC women who were in the first week of their regular pill cycle when they entered the study and OC women who were in the pill-free week of their regular pill cycle did not differ from NC women in any of their ratings of the sexual images. Furthermore, NC women's subjective ratings of the images did not differ based upon their initial hormonal condition. This difference in the impact of initial hormonal condition may reflect the unique hormonal nature of women later in their OC pill cycle. Women who entered the study after taking OCs for three weeks differed from these other groups of women in two important ways. They experienced greater cumulative exposure to high levels of progestins in the time *preceding* their first testing session, and they were experiencing greater progestational activity *during* their first testing session.

OC women who began in the pill-free week experienced relatively low levels of progestins immediately before the time of testing, and those in their first week of taking OCs had experienced decreased progestins just one week prior to testing. Similarly, NC women's levels of progesterone are very low for the entire follicular phase of their cycle, and thus the only NC women who were exposed to high progesterone levels before their initial testing time were those who began the study in their luteal phase. However, women in the luteal phase experience high levels of progesterone for 14 days or less (Stricker et al., 2006). Therefore, even women tested toward the end of their luteal phase were not hormonally similar to OC women after 3 weeks of pills.

3 week OC women's plasma levels of progestins during time of testing were also higher than women in the other experimental groups. For example, even for women taking monophasic OCs, serum levels of progestins are higher in their third week of taking OCs than in their first week (e.g., Bayer HealthCare Pharmaceuticals Inc., 2012;

Warner Chilcott, 2009). This may account for why OC women beginning in the third week of their cycle rated images lower than OC women beginning in the first week of their pill cycle. Furthermore, when one takes into account the levels of progestins OCs induce in the blood by the third week of a pill-cycle, and the relative binding affinity of a number of these progestins for the progesterone receptor, women taking certain OCs may experience greater progestational activity than NC women in the luteal phase of their cycles (Bayer HealthCare Pharmaceuticals Inc., 2012, Warner Chilcott, 2009 and Sitruk-Ware, 2006; as compared to Stricker et al., 2006).

Recent data suggest that progesterone is the hormone that accounts for the largest amount of the variance in feelings of sexual desire. Roney and Simmons (in press) found that as progesterone levels increase, sexual desire decreases. It is possible that progestin levels mediate OC women's subjective ratings of the sexual stimuli in the present study. However, for subjective ratings of sexual images, which are particularly subject to other social or personal factors, progestin mediation may become apparent only under specific conditions. In the case of the present study, this effect was revealed only for the group of women who had been exposed to the highest amount of progestins, and therefore the group for whom sexual desire may be lowest.

Basson (2000) suggested that environmental/contextual cues are particularly important for facilitating or dampening sexual arousal in women. She emphasized the "responsive" nature of desire, in that it does not just arise internally, but rather is a response to arousal, which is a response to the context. Basson's model of sexual desire is unique from other proposed models in the importance it places on context as a necessary element for arousal and desire. Interestingly, Sand and Fisher (2007) reported that this is

the model of sexual desire most readily identified with by women who report having problems with sexual arousal and desire; this indicates that contextual elements of a sexual scene may be of particular importance for women with low sexual desire.

OC women's initial hormonal condition affected their ratings of no-context images, but did not affect their ratings of images with contextual information. In no-context images, which depicted only genitals (in the case of no-context intercourse images), or genitals and the opposite-sex partner's face (in the case of no-context oral sex images), subjects were unable to divert their attention to the background, the actors' faces, or some other nonsexual aspect of the scene that might aid in inducing arousal when viewing these images. Thus, it is perhaps not surprising that initial hormonal condition affected ratings of these images, as contextual elements could not help compensate for lower internal sexual desire.

Similarly, OC women's initial hormonal condition affected their ratings of images depicting female-to-male oral sex, but not images depicting male-to-female oral sex. As with ratings of no-context images, lower ratings of female-to-male oral sex images may be driven by decreased sexual desire, as mediated by progestins. In the case of images depicting female-to-male oral sex, however, slightly different processes may be operating. Images depicting female-to-male oral sex are unique from other images, because in these images, women were required to rate the depiction of a female-initiated sexual behavior. Women have been reported when viewing sexual images to imagine themselves as the woman in the sexual scene depicted (Janssen, Carpet, and Graham, 2003; Rupp and Wallen, 2009). If women used such a viewing strategy when viewing images depicting female-to-male oral sex, the women would have to imagine initiating

sexual behavior, unlike images of intercourse or images of male-to-female oral sex, where the woman could imagine taking on a passive role, as the recipient of sexual behavior initiated by the male. Previous studies of sexual behavior across the menstrual cycle have found that women engage in more proceptive sexual behavior around the time of ovulation, and that this increase is suppressed in women taking OCs (Adams et al., 1987; Van Goozen et al., 1997). Thus, feelings of sexual desire, as mediated by hormones, may have a greater influence on subjective ratings of images depicting female-initiated/proceptive sexual behavior than on others.

In men, there was no relationship between endogenous T levels and subjective ratings for any of the sexual images. There was significantly more variability in men's ratings of no-context images than in those with context; however, men's sexual attitudes most affected their ratings of images. That T was not related to subjective ratings is not particularly surprising, as much of the previous research examining endogenous T and men's sexual interest has been inconclusive (e.g. Bagatell, 1994; Buena et al., 1993). Indeed, although reported level of sexual desire is significantly lower among hypogonadal men, endogenous T in eugonadal males has been found to explain only a small portion of the variance in reported sexual desire (Travison et al., 2006). Previous experimental work has revealed a relationship between endogenous levels of T and the amount of time men choose to spend looking at sexual images in a laboratory; however, looking time is a much more sensitive measure than are subjective ratings of images (Rupp and Wallen, 2007). In men, as appears to also be the case in women, subjective ratings of images may not be a sensitive enough measure to detect more subtle influences of endogenous hormone levels on evaluations of sexual stimuli.

A limitation of the current study is the relatively small sample size for each hormonal group. A larger sample size among the men might yield a greater range of endogenous T levels, which would provide enough power to reveal of a relationship between T and subjective response to sexual stimuli, if one exists. In order to more fully explore the relationship between initial hormonal phase and response to sexual images in OC women, future studies should increase the sample size in each group, and follow the women across more than one cycle. An experiment such as this would help determine whether response patterns persist, and carry over from the previous cycle. Furthermore, viewing patterns of sexual images from women in these different initial hormonal conditions should be evaluated, so as to examine whether women's differential subjective responses also reflect differences in how they attend to sexual images.

Taken together, the data from the present study indicate that hormones are related to subjective ratings of sexual images only under specific conditions – subjective ratings were only related to women's initial hormonal state when women who entered the study after taking OCs for three weeks rated images with little contextual information or images depicting female-initiated sexual behavior. It is of particular note that subjective ratings were not affected by women's hormonal conditions at the time of testing, but rather their hormonal condition under which they entered the study. Women's initial hormonal condition predicting their subsequent response to sexual images has been shown previously, with a genital measurement of arousal, and with another cognitive measure of interest (time spent looking at sexual images). It is possible these results reflect a conditioned response to a laboratory setting or to sexual stimuli themselves. Indeed, classical sexual conditioning has been evidenced in nonhuman animals and in

humans in both experimental and field settings (e.g. Hoffmann, Peterson, and Garner, 2012, and for review see Pfaus, Kippin, and Centeno, 2001). Thus, although the effect of initial hormonal state may be an artifact of laboratory testing, there is the possibility that such long-term effects of initial hormonal state on subjective ratings of images have analogs in women's daily behaviors, such as in subjective assessment of potential sexual partners and in mate-choice decisions.

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Appendix

The following questions come from a questionnaire called the Brief Index of Sexual Function. This index covers material that is sensitive and personal. Your responses will be kept completely confidential. If you are unable or do not wish to answer any question, you may leave it blank.

1. Have you been sexually active during the past month?
Yes___No___

2. During the past month, how frequently have you had sexual thoughts, fantasies, or erotic dreams? (please circle the most appropriate response)
(0) Not at all
(1) Once
(2) 2 or 3 times
(3) Once a week
(4) 2 or 3 times a week
(5) Once a day
(6) More than once a day

3. How frequently have you felt a desire to engage in any sexual activity in the past month? (please circle the most appropriate response)
(0) Not at all
(1) Once
(2) 2 or 3 times
(3) Once a week
(4) 2 or 3 times a week
(5) Once a day
(6) More than once a day

4. Please circle the number that corresponds to the statement that best describes your sexual experience.
(1) Entirely heterosexual
(2) Largely heterosexual, but some homosexual experience
(3) Largely heterosexual, but considerable homosexual experience
(4) Equally heterosexual and homosexual
(5) Largely homosexual, but considerable heterosexual experience
(6) Largely homosexual, but some heterosexual experience
(7) Entirely homosexual

5. Please circle the number that corresponds to the statement that best describes your sexual desires.
(1) Entirely heterosexual
(2) Largely heterosexual, but some homosexual experience
(3) Largely heterosexual, but considerable homosexual experience
(4) Equally heterosexual and homosexual

(5) Largely homosexual, but considerable heterosexual experience
(6) Largely homosexual, but some heterosexual experience
(7) Entirely homosexual

6. In your lifetime, how much viewing exposure have you had to visual erotica or pornography? This would include films, magazines, or other explicit visual material showing nude persons. Do not include commercially produced R-rated films in your estimate. (please circle the most appropriate response)
(0) No viewing experience
(1) One experience
(2) A few isolated viewing responses
(3) A modest amount of viewing experience
(4) A moderate amount of viewing experience
(5) A substantial amount of viewing experience
(6) Very extensive viewing experience

7. During the past month, how frequently have you viewed visual erotica or pornography? This would include films, magazines, or other explicit visual material showing nude persons. Do not include commercially produced R-rated films in your estimate. (please circle the most appropriate response)
(0) Not at all
(1) Once
(2) 2 or 3 times
(3) Once a week
(4) 2 or 3 times a week
(5) Once a day
(6) More than once a day

Figure Captions

Figure 1. NC women's mean subjective ratings (± SE) for context images across all test sessions, as separated by women's initial hormonal condition. Subjective ratings did not differ by NC women's initial hormonal condition or across test sessions.

Figure 2. OC women's mean subjective ratings (± SE) for context images across all test sessions, as separated by women's initial hormonal condition. Subjective ratings did not differ by OC women's initial hormonal condition or across test sessions.

Figure 3. NC women's mean subjective ratings (± SE) for no-context images across all test sessions, as separated by women's initial hormonal condition. Subjective ratings did not differ by NC women's initial hormonal condition or across test sessions.

Figure 4. OC women's mean subjective ratings (± SE) for no-context images across all test sessions, as separated by women's initial hormonal condition. Women who entered the study after taking OC's for three weeks rated these images lower than women who had been taking OCs for one week (*$p < 0.05$, $d = 0.90$), and much lower than women who were in their menstrual (pill-free) phase (***$p < 0.001$, $d = 2.29$).

Figure 5. NC women's mean subjective ratings (± SE) for images depicting male-to-female oral sex, shown across all test sessions, and separated by women's initial hormonal condition. Subjective ratings did not differ by NC women's initial hormonal condition or across test sessions.

Figure 6. OC women's mean subjective ratings (± SE) for images depicting male-to-female oral sex, shown across all test sessions, and separated by women's initial

hormonal condition. Subjective ratings did not differ by OC women's initial hormonal condition or across test sessions.

Figure 7. NC women's mean subjective ratings (± SE) for images depicting female-to-male oral sex, shown across all test sessions, and separated by women's initial hormonal condition. Subjective ratings did not differ by NC women's initial hormonal condition or across test sessions.

Figure 8. OC women's mean subjective ratings (± SE) for images depicting female-to-male oral sex, shown across all test sessions, and separated by women's initial hormonal condition. OC women who entered the study after taking OC's for three weeks rated these images lower than women who entered the study in the menstrual (pill-free) phase of their cycles (*$p = 0.05$, $d = 0.93$).

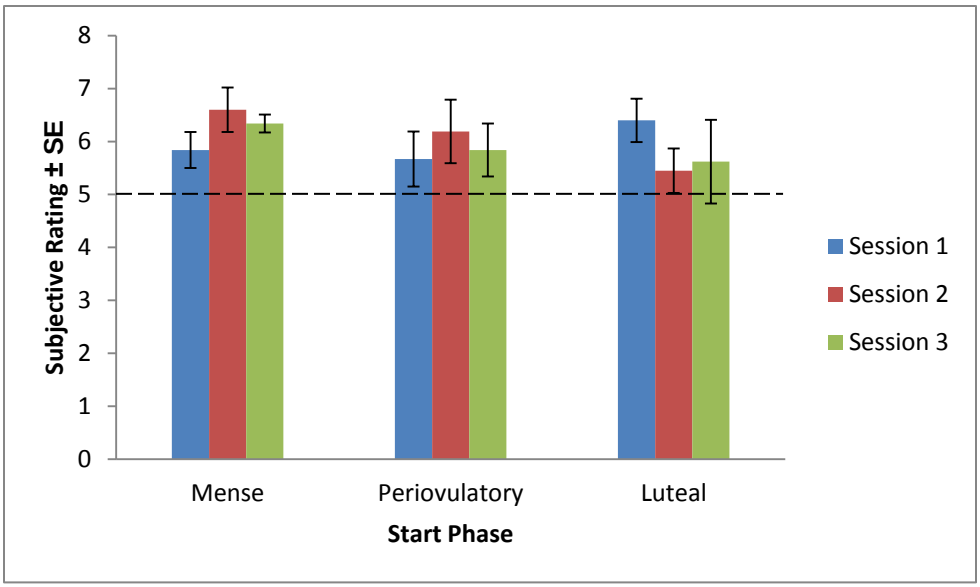
Figure 9. Scatterplot depicting the relationship between men's subjective ratings of context images and their sexual attitudes, when controlling for T levels, sexual motivation, and previous viewing experience. Men with more liberal sexual attitudes rated these images as more arousing ($p < 0.05$).

Figure 10. Scatterplot depicting the relationship between men's subjective ratings of no-context images and their sexual attitudes, when controlling for T levels, sexual motivation, and previous viewing experience. Men with more liberal sexual attitudes rated these images as more arousing ($p < 0.05$).

Figure 11. Scatterplot depicting the relationship between men's subjective ratings of female-to-male oral sex images and their sexual attitudes, when controlling for T levels,

sexual motivation, and previous viewing experience. Men with more liberal sexual attitudes rated these images as more arousing ($p < 0.001$).

Figure 1.


8
7
6
5
4
3
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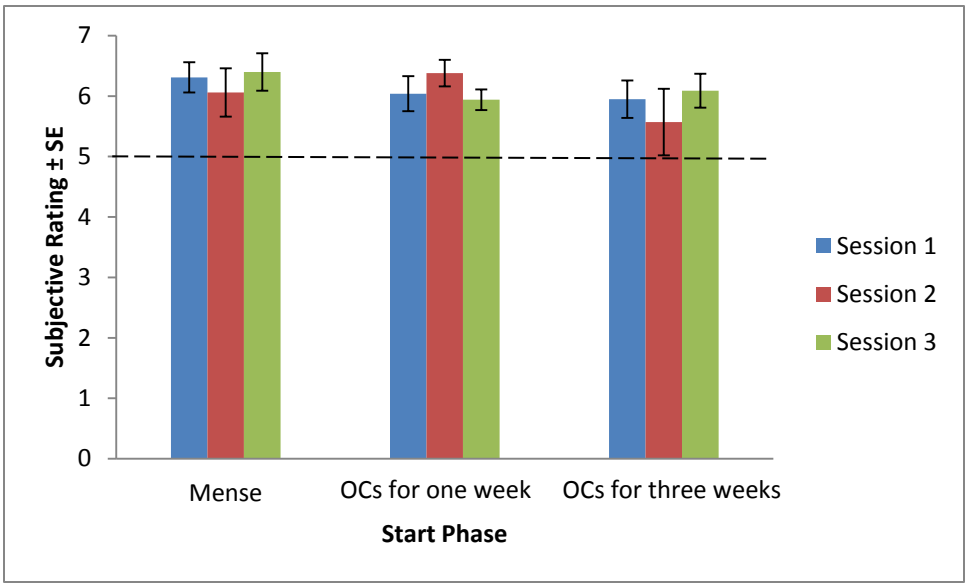
1
0
Subjective Rating ± SE
Mense
Periovulatory
Luteal
Start Phase
Session 1
Session 2
Session 3

Figure 2.


Subjective Rating ± SE
7
6
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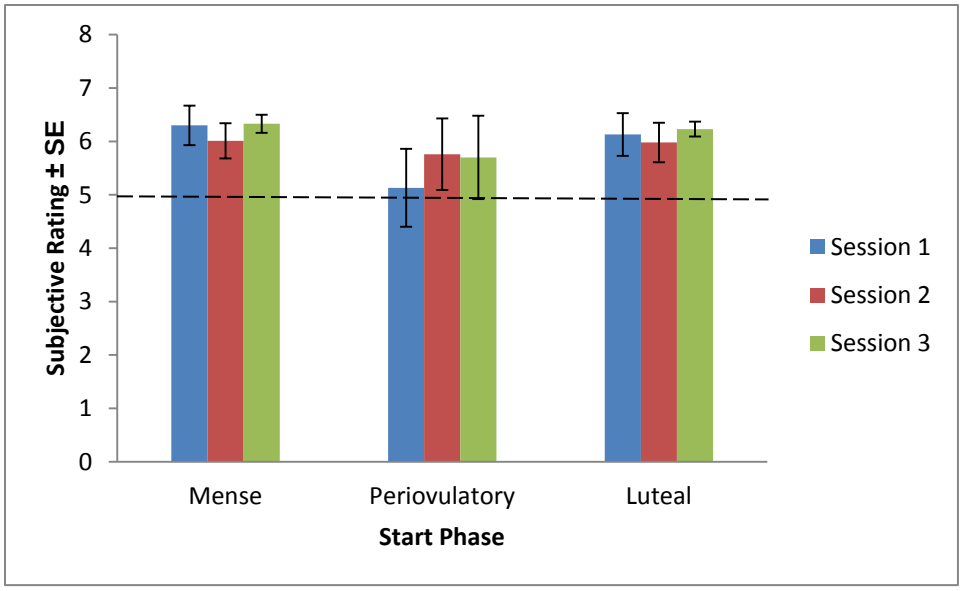
1
0
Mense
OCs for one week
OCs for three weeks
Start Phase
Session 1
Session 2
Session 3

Figure 3.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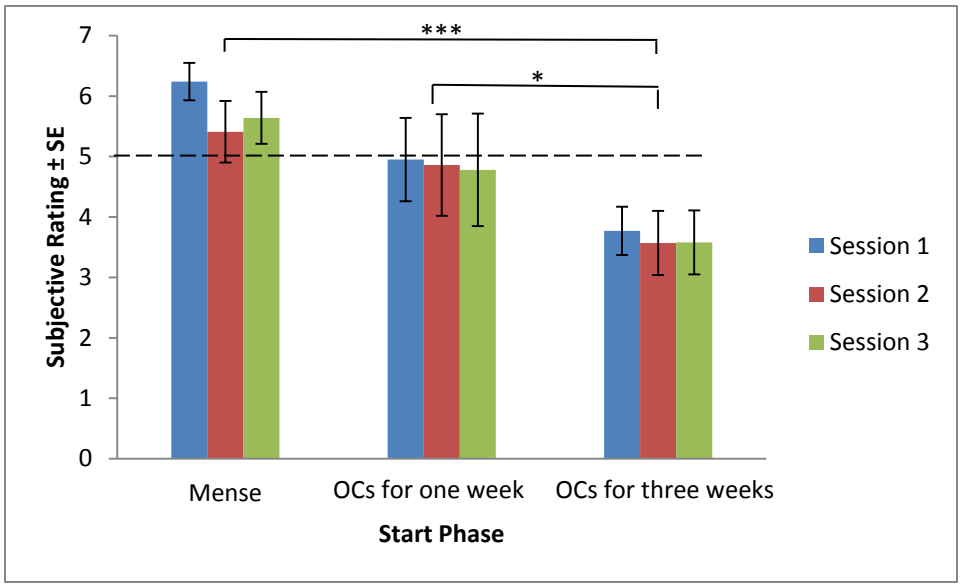
Subjective Rating ± SE
Mense
Periovulatory
Luteal
Start Phase
Session 1
Session 2
Session 3

Figure 4.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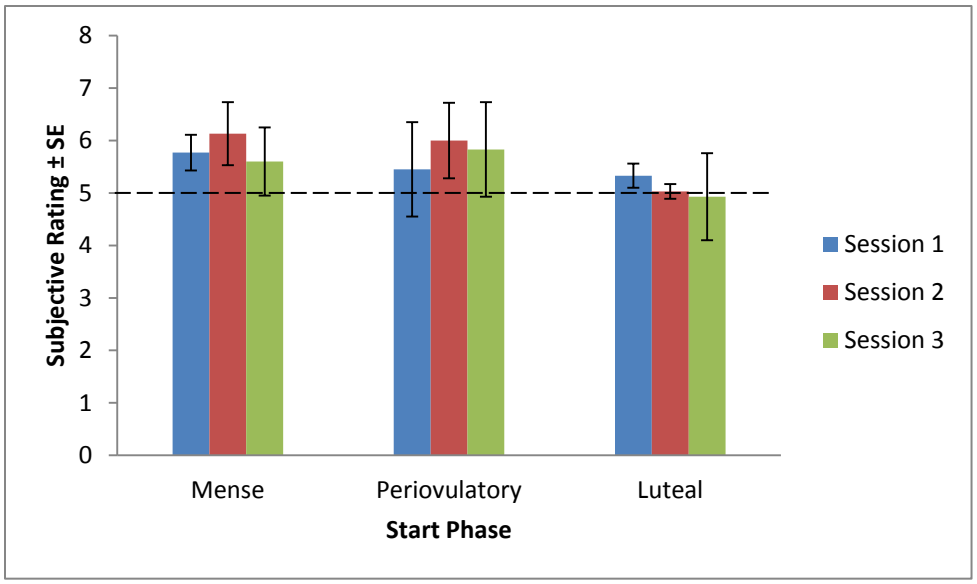
Subjective Rating ± SE
Mense
OCs for one week
OCs for three weeks
Start Phase
Session 1
Session 2
Session 3

Figure 5.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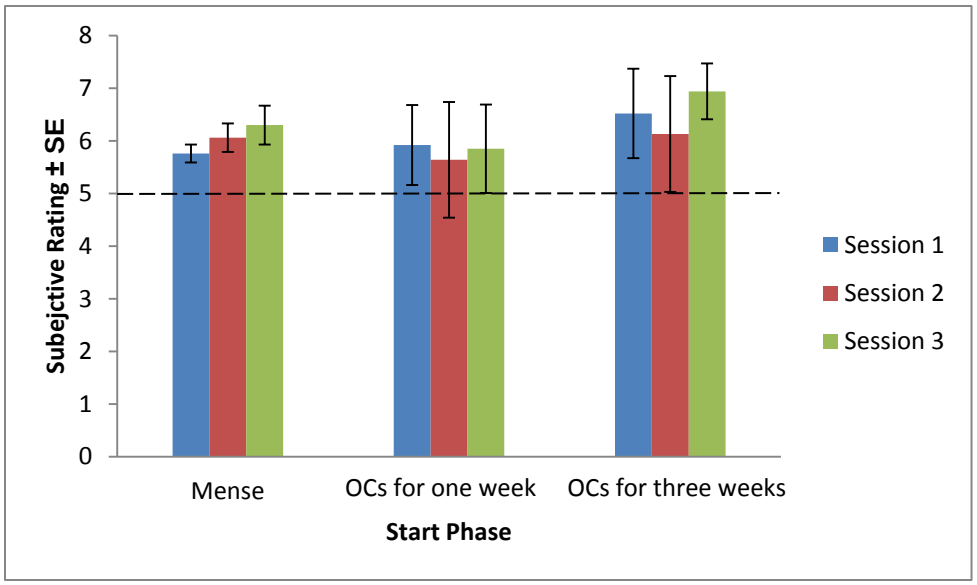
Subjective Rating ± SE
Mense
Periovulatory
Luteal
Start Phase
Session 1
Session 2
Session 3

Figure 6.


Subejctive Rating ± SE
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2
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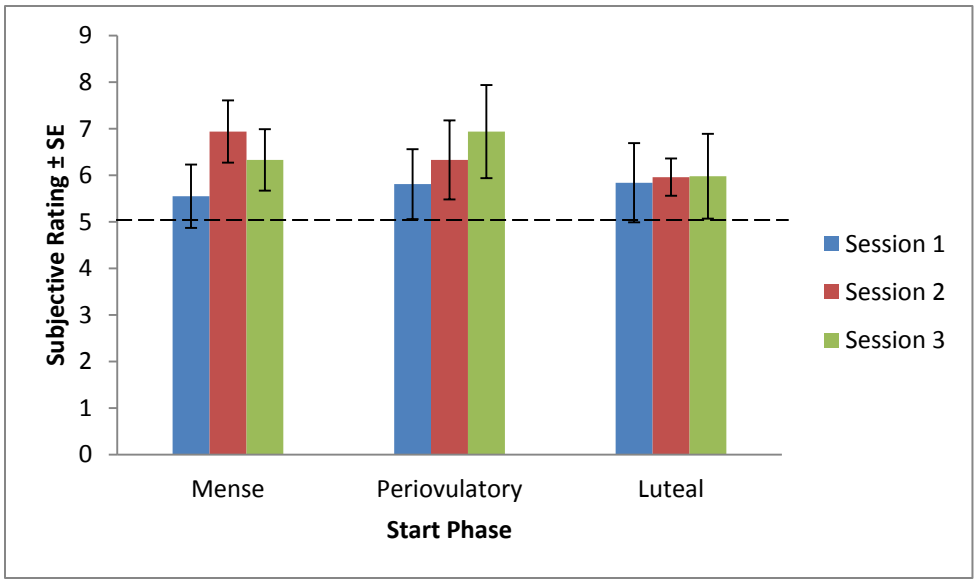
0
Mense
OCs for one week
OCs for three weeks
Start Phase
Session 1
Session 2
Session 3

Figure 7.


Subjective Rating ± SE
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8
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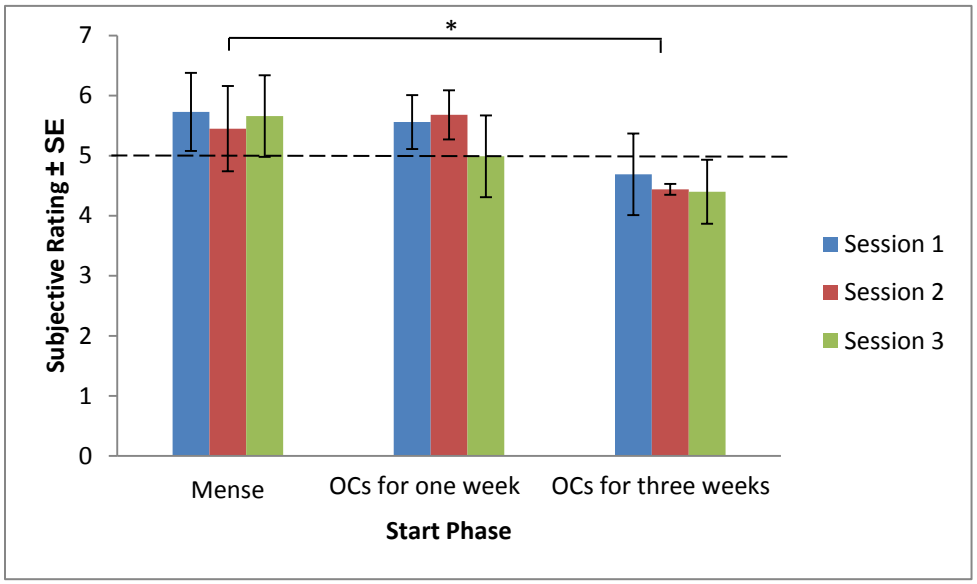
Mense
Periovulatory
Luteal
Start Phase
Session 1
Session 2
Session 3

Figure 8.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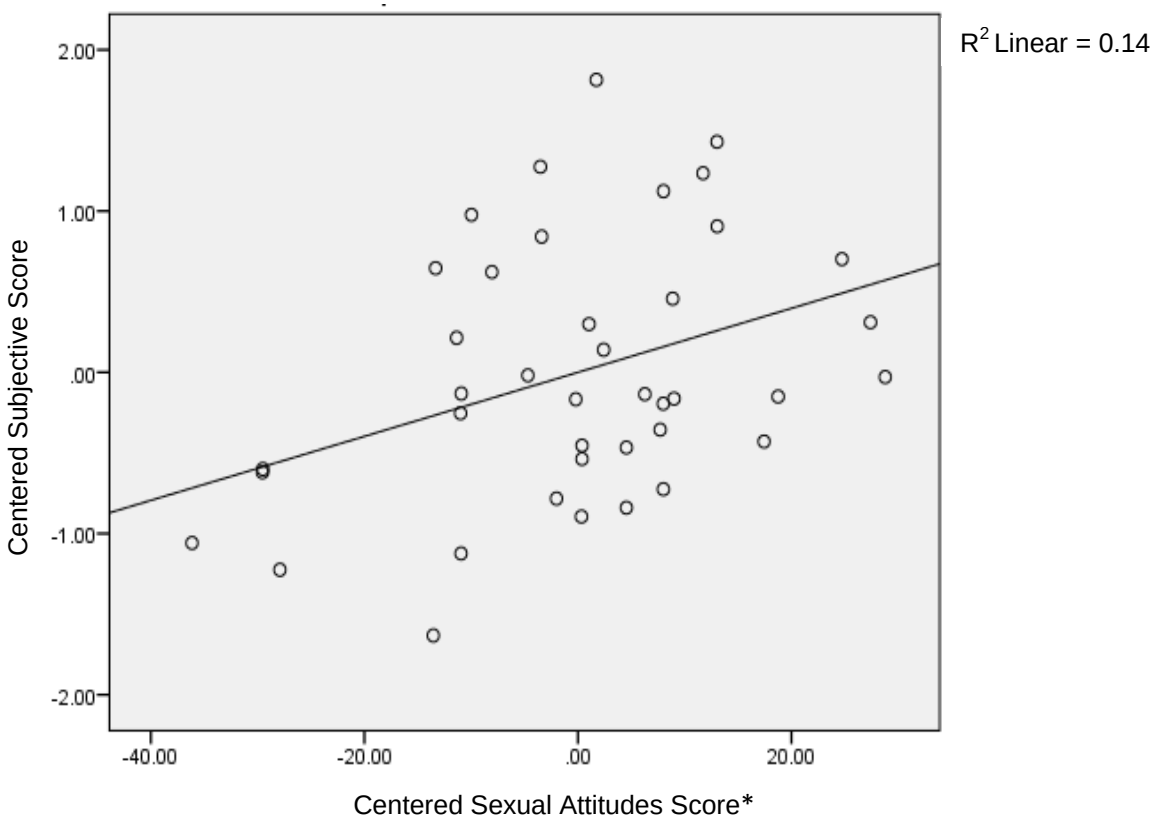
Subjective Rating ± SE
Mense
OCs for one week
OCs for three weeks
Start Phase
Session 1
Session 2
Session 3

Figure 9.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1.00
.00
-1.00
-2.00
Centered Subjective Score
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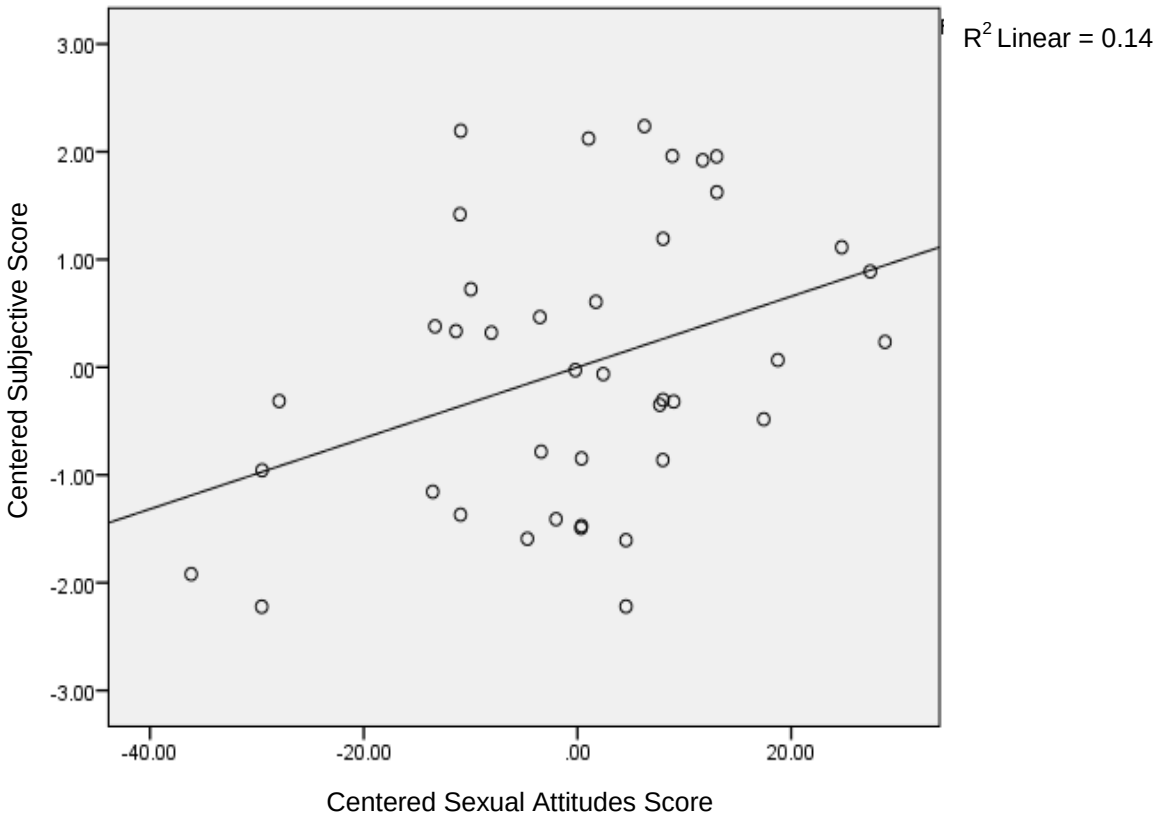
-20.00
.00
20.00
Centered Sexual Attitudes Score*
R² Linear = 0.14

Figure 10.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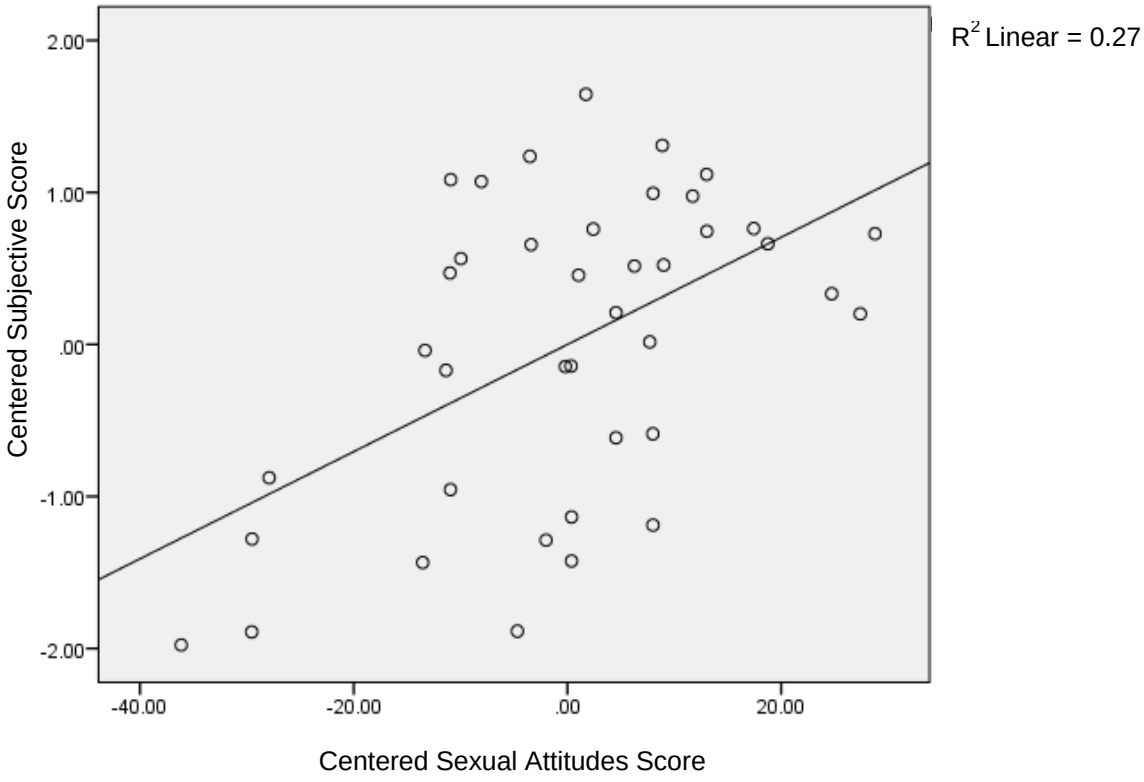
20.00
Centered Sexual Attitudes Score

Figure 11.


Centered Subjective Score
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1.00
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-1.00
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.00
20.00
Centered Sexual Attitudes Score
R² Linear = 0.27