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FEMALE SEXUAL RESPONSE: POSSIBLE ADAPTIVE FUNCTIONS OF THE FEMALE ORGASM

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ABSTRACT

Recent research suggests that female orgasm frequency may be related to mate quality in romantic couples. In light of this, we recruited 66 heterosexual romantic couples in which the woman was not taking hormonal contraception. Both partners came in for an initial visit where we collected basic demographic information and took anthropometric and physiological measures related to mate quality. The majority of couples also participated in an online extended study in which they reported their sexual activity and perceived sexual experience by answering brief questionnaires every three days for up to two months. I predicted that there would be a significant interaction between ovulatory cycle phase and relative male genetic quality in predicted female orgasm frequency. This prediction was not supported, but women reported more orgasms during the luteal phase.

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Female Orgasm: By-product or Adaptation?

In order to choose high quality genes for offspring, women must first choose a partner with high quality genes. Research indicates facial characteristics (Cornwell, Boothroyd, Burt, Feinber, Jones, Little, Pitman, Whiten, & Perrett, 2004) such as symmetry (Thornhill & Gangestad, 1994) and dominance (Mazur & Booth, 1998) are cues to detect good genes. Past research suggests that facial symmetry is an indication of fitness and genetic quality (Thornhill & Gangestad, 1993).

Women may have evolved adaptive mechanisms for obtaining good genes for their offspring via preference shifts towards signals of genetic quality at peak fertility. A man's outward appearance can convey many signals regarding his genetic quality. Physically, a man can portray symmetry, attractiveness, masculinity, and dominance through his face, body, and voice. Johnston et al. (2001) found that women become more attracted to men who exhibit higher genetic quality during the follicular (fertile) phase of their menstrual cycle (Gangestad, Thornhill, & Garver- Apgar, 2010).

Just as men can physically portray their genetic quality, women can physically display their fecundity. Men tend to be attracted to youthful and physically attractive women because these are cues to a woman's fertility (Braun & Bryan, 2006) and possible disease resistance (Scheyd, Garver-Apgar, & Gangestad, 2008). Fat tends to distribute in a woman's buttocks, thighs, and hips, which can indicate her fertility (Singh, 1994). Previous studies have been conducted in order to measure men's interpretation of a woman's reproductive ability and attractiveness based upon body mass index (BMI) and waist-to-hip ratio (WHR), and whether a particular body weight or WHR indicates the highest fertility and attractiveness (Braun & Bryan, 2006). Singh (1994) composed six female figure outlines varying in body and WHR. Three figures consisted of low overall body weight and high WHR, and the other three consisted of high overall body weight and low WHR. Singh, along with other researchers, has used these figures to examine BMI and WHR. In these studies, participants were instructed to choose the figure that represented the ideal female body image. The majority of participants chose the figure with a normal, healthy body weight and a WHR of 0.7 (Singh, 1994). This distribution of fat may be indicative of a woman's sexual maturity and fecundity (Puts, 2010).

Because it is known that women's body fat is distributed in this manner, advertising their genetic quality and fertility, studies have been conducted to test whether men's bodies distribute fat in order to convey their genetic quality in a similar way (Braun & Bryan, 2006). Specifically, Braun & Bryan (2006) hypothesized that women would be most attracted to a body structure with wide shoulders and a slender waist and hips (Hughes & Gallup, 2003). Results showed female participants found men more attractive and desirable if they exhibited a 'v' body shape. Men with this body type (e.g. higher shoulder to hip ratio) reported masturbation and sexual intercourse at a young age, along with a high number of sexual partners and encounters. This may be due to a woman's attraction to such a body type that may convey masculinity, attractiveness, dominance, strength, and protection.

The 'v' body shape in men also may be indicative of fighting ability and contest capability (Puts, 2010). Among many species, including humans, females have shown a preference for qualities that can be utilized in contests (Berglund, Bisazza, & Pilastro, 1996). Such physical characteristics may have contributed to men's ability to acquire and obtain territory, resources, and status (Puts, 2010). These findings may clarify why women prefer such traits.

Estrogen has been found to be a genetic link to a woman's reproductive maturity and fertility (Thornhill & Grammer, 1999). If a woman has normal or higher levels of estrogen, she may develop more physically attractive and youthful facial and vocal characteristics. Thus, it has been suggested that estrogen may be a handicapping sex hormone that enables women to develop costly characteristics signaling their high genetic quality to men. Such youthful traits are reliable indicators of a woman's reproductive ability and fertility (Scheyd, Garver-Apgar, & Gangestad, 2008). Therefore, it has been found that feminine and attractive characteristics pertaining to a woman's face and voice are preferred by men (Buss, 1989).

Genetic quality can also be portrayed through men's facial characteristics. Past studies have examined facial symmetry, attractiveness, masculinity, and dominance (Cornwell et al., 2004). Men possessing such characteristics also have high levels of testosterone, which is considered costly (Peters, 2000). Therefore, it has been speculated that only healthy individuals can produce these traits because increased androgen is immunosuppressant (Grossman, 1985; Folstad & Karter, 1992).

Voice pitch, along with facial characteristics, can also be a marker of mate quality (Apicella & Feinberg, 2009). Similar voice quality can be heard in men with high genetic quality. Along with facial and body characteristics, low voice pitch may be costly to produce (Folstad & Karter, 1992; Chen & Parker, 2004). Puts found that men with low pitch voices reported higher numbers of sex partners (2005) and were also found to have elevated reproductive success (Apicella et al., 2007).

Because women found costly genetic markers more desirable in men, studies were conducted to see whether women were more attracted to these features during a particular phase of their ovulatory cycle. Researchers found that during the follicular (fertile) phase of a woman's menstrual cycle, women were more likely to prefer masculine bodies and faces (Gangestad, Thornhill, & Garver-Apgar, 2010), symmetric facial characteristics (Little & Jones, 2011) and a lower voice pitch (Puts, 2005). Cyclical changes in sexual attraction may aid women when seeking men who possess high genetic quality, which in turn, will benefit their offspring (Gangestad, et al., 2010). Thus, attraction to particular acoustic pitch range may be adaptive in allowing women to detect underlying good genes that may benefit the fitness of their offspring.

Women are attracted to such characteristics; in particular, during the fertile phase of the ovulatory cycle, it is thought, because this is when they are able to conceive. Men who are able to produce masculine facial, vocal, and physical characteristics have increased androgen levels and decreased immune function (Grossman, 1985). However, because these individuals can afford decreased immune function, they may possess greater inherited disease resistance, which is favorable to women. These men have reported higher numbers of sexual partners (Puts, 2005). Therefore, findings imply that women's sexual attractions may be designed to detect and obtain high genetic traits from men who may only be short-term partners (Puts, 2010, p. 165).

The utility of the female orgasm is a question many researchers have examined. Two broad explanations currently exist for the explanation of the evolution of orgasm in women: the by-product hypothesis and the mate-choice hypothesis (reviewed in Puts & Dawood, 2006; Puts, Dawood, & Welling, in press). According to the by-product hypothesis, female orgasm exists as only as a byproduct because of women's similar early development with men. Unlike the male orgasm, which is said to facilitate conception, female orgasm serves no evolutionary function. The mate-choice hypothesis, however, states that female orgasm is an adaptive response that may function in mate selection and, possibly, fertility.

There is growing evidence in favor of the adaptive nature of the female orgasm. Theoretically, female orgasm should be reduced or eliminated in species in which female orgasm did not augment fitness, as female antlers have been reduced in most deer species (Suttie, Fennessy, Lapwood, & Corson, 1995). In humans, female orgasm may function to increase chances of conception. Some evidence suggests that orgasm in women may aid in sperm activation (Puts & Dawood, 2006) and the selective capture of sperm, which may have affected reproductive outcomes during our species' evolutionary history (Baker, & Bellis, 1993). One prediction is that orgasm would selectively capture sperm from males of high genetic quality, though there is little empirical support for this hypothesis (Meston, Levin, Sipski, Hull, & Heiman, 2004). However, because women have tended to invest, via gestation, lactation, and childcare, more in offspring than have men over human evolution, women are choosier than men about their sexual partners (Daly & Wilson, 1983).

Puts & Welling et al. (2012) found that both control, random women, and women mated to men they perceived them to be both dominant and masculine. Women mated to these men also reported orgasms earlier and more frequently. Having an orgasm may not only aid in fertilization by transporting sperm via contractions of the uterus, but may also releases oxytocin that guides semen to "the oviduct with the dominant follicle" (Wildt et al., 1998). Meston et al. (2004) reported that contractions caused during orgasm aid the movement of sperm into the uterus through the cervix, and eventually into the fallopian tubes.

In light of these findings, we tested for evidence of adaptive orgasm in partnered heterosexual women. More specifically, we tested whether 1) women would be more likely to experience orgasm if their partner was of high genetic quality, and 2) whether this would be especially true during the fertile phase of their ovulatory cycle. In short, I predicted that there would be a significant interaction between ovulatory cycle phase and relative male genetic quality in predicted female orgasm frequency.

METHODS

Participants

Sixty-six women (Mean age=19.3 years, SD=1.42, Range=18-24) and their male partners (Mean age=19.9 years, SD=1.93, Range=18-28) participated in the initial part of our study. Of the 132 participants, 21 women (7 Asian, 4 African-American, 1 Bi-racial, 1 Asian Indian, 8 Hispanic descent) and 25 men (9 Asian, 9 African-American, 2 Asian Indian, 5 Hispanic descent) report ethnicities other than Caucasian.

To be eligible to participate, couples were required to be heterosexual, in a committed relationship for a minimum of one month (Mean relationship length=12.91 months, SD=15.32, Range=1-91 months), to be sexually active, and to not be using hormonal contraceptives. However, 6 women reported having stopped hormonal contraceptive use within the last 3 months, 1 woman reported currently using hormonal contraceptives, 1 woman reported currently being pregnant, and 2 women did not report any of their menstrual cycle data. These women and their male partners were thus excluded from further analysis, leaving us with 56 couples.

Of these 56 couples, 35 women and 35 male partners opted to participate in our study, which was a voluntary follow-up of their initial session. Of these 35 women, two were excluded for discontinuing the study before enough data had been obtained.

Recruitment was done through the Psychology Department subject pool at the Pennsylvania State University and participants had to 1) be in a serious romantic relationship for at least one month, 2) be sexually active, 3) have a partner who was willing and able to participate, and 4) not be using hormonal contraception (or have a partner who is not using hormonal contraception, if male) to be eligible to take part. Participants received either course credit or US $10 in compensation for their participation.

Procedure

Both partners attended their initial laboratory test session together and were greeted by two research assistants who obtained informed consent from each participant. Demographic information, such as name, age, and academic credit or cash compensation was recorded in a sign-in book. Participants were each given a glass of water to drink to clean their mouths because both saliva and cheek cell DNA samples were later collected (see below). Finally, each participant was given a data sheet on which to indicate his/her most recent caffeine consumption, current medication, and tobacco use. This was to ensure that the participants were not taking any supplements that might affect hormone levels.

Once all forms were completed, each participant had their first passive drool sample collected for hormonal analysis of testosterone, progesterone, estradiol, and cortisol levels (not reported here). The participants were instructed to passively drool through a straw into a small vial. Then, they either completed a series of anthropometric measurements or, in a separate room, a series of questionnaires. Although all participants completed both anthropometric measurements and the questionnaires, whether the male or female participant completed the questionnaire first was counterbalanced. Once saliva was collected, the participants either began the questionnaires or the research assistant began taking anthropometric measurements.

Anthropometric measurements included height, weight, hand-grip strength, biceps circumference (flexed and relaxed), waist circumference at the smallest point, shoulder circumference, hip circumference at the widest point, and chest circumference (men only). Using these data, we were able to measure waist to hip ratio (WHR) in women and both shoulder to hip (SHR) and waist to chest (WCR) ratio in men. Next, a 2D photograph was taken using a 12-megapixel camera with a mounted flash that was placed at a distance of 2 m. Participants were asked to remove all earrings, glasses, and facial jewelry, and to use a headband if any hair was obstructing their facial features. This allowed participant's hairline and ears to be visible. They were asked to sit upright in a chair and to maintain a neutral expression with their mouths closed. Next, participants were guided into a small recording booth where they were asked to read and excerpt from the rainbow passage (Fairbanks, 1960). Speaking clearly, enunciating, and speaking at a normal pace was emphasized. Vocal pitch was obtained by way of acoustic analysis performed in Praat (version 3.3.12). We utilized a software script to extract pitch values.

The questionnaires, which were completed online and accessed using passwords unique to each participant, consisted of the Mate Retention Inventory-Short Form (Buss, Shackelford, & McKibbin, 2008), the Revised Sociosexual Orientation Inventory (SOI-R, Penke, 2011), the Kinsey Sexual Orientation Questionnaire (Kinsey, Pomeroy, & Martin, 1948), the Relationship Satisfaction Scale (which measures relationship satisfaction, see Hendrick, 1988), and a menstrual cycle questionnaire (if female) to ascertain menstrual cycle phase and any former hormone replacement therapy (HRT) or hormonal contraceptive use. Participants also completed a partner questionnaire, which asked them to rate their partner's attractiveness, masculinity or femininity, dominance (women only) and fighting ability (women only). Additionally, participants completed a sexual activity questionnaire regarding questions about their sexual preferences, sexual activity, orgasm frequency, and subjective sexual experience. Upon completion of the measurements and questionnaire, each participant provided a final saliva sample via a mouthwash, from which cheek cell DNA was extracted (for use as part of other studies). Participants were asked to swish the 15 ml of mouthwash, contained in a plastic tube, vigorously in their mouth for thirty seconds and to spit the mouthwash back into the plastic tube through a straw.

Each participant was also asked to participate in an online extended study in which they had the opportunity to report on their sexual activity and perceived sexual experience by answering brief questionnaires from the initial session every three days for up to two months. Questionnaires included The Relationship Satisfaction Scale (Hendrick, 1988), the Partner Questionnaire, the Sexual Activity Questionnaire, and the Menstrual Cycle Questionnaire (women only). Every three days, participants opting to take part in the extended study were sent a reminder email that included a link to our online questionnaire. Each time a participant completed a session, he/she was paid US $2. Participants who completed all 20 sessions received a total of US $40 and were entered into a drawing to win one of two US $50 cash prizes. However, if a participant missed two sessions in a row or three sessions in total, s/he was dropped from the study but was compensated for each session completed.

Ratings Methods

One hundred and twenty-four females and 97 male raters were recruited through SONA, the Psychology Department Subject Pool. Participants provided information pertaining to their sex, age, and ethnicity. We randomly assigned the vocal recordings and photographed faces of every couples study participant into one of 4 stimulus sets, with a total 33 voices and faces in each of the 4 sets. Each rater was randomly assigned to rate the 33 voices and faces of 1 stimulus set. Each rater did not rate every couples study participant, but only one of the 4 subsets of couples study participants. Each rater scored either 16 male and 17 females or 17 males and 16 females.

We asked all participants to rate each voice and face for 1) attractiveness (measured on a Likert scale with 1 indicating very unattractive and 7 very attractive), 2) dominance, (measured on a Likert scale with 1 indicating not very dominant and 7 very dominant, 3) age (measured using the following scale: 1=less than 18 years, 2=18-19 years, 3=20-21 years, 4=22-23 years, 5=24-25 years, 6=26-27 years, 7=28-29 years, 8=30 years, 9=more than 30 years), 4) masculinity and femininity, (measured on a Likert scale with 1 indicating not very masculine/feminine and 7 very masculine/feminine). Therefore, each rater rated 8 stimulus blocks: 4 voice blocks and 4 face blocks.

Voice and face blocks were paired together for each type of question. For example, if we asked about vocal attractiveness first, we asked about facial attractiveness subsequently. The paired blocks were presented in a random order. Whether face or voice questions came first within the paired block was also random. All the ratings we collected for each voice and face stimulus were averaged to arrive at a single numerical rating for vocal and facial attractiveness, dominance, age, and masculinity or femininity.

RESULTS

Female Data

The ratings of women's faces and voices along different dimensions were highly correlated suggesting that they measure a common underlying variable related to femininity, dominance, and attractiveness. Significant correlations were found between other-rated facial dominance score and other-rated facial attractiveness score ($r = .563, p < .001$), other-rated femininity score and other-rated facial attractiveness score ($r = .903, p < .001$), and other-rated facial dominance and other-rated femininity ($r = .400, p < .001$). Significant correlations were also found between other-rated vocal dominance and other-rated vocal attractiveness ($r = .731, p < .000$), other-rated vocal femininity and other-rated vocal attractiveness ($r = .823, p < .001$), and other-rated vocal femininity and other-rated vocal dominance ($r = .468, p < .001$). Finally, a significant correlation was found between male partner-rated femininity and male partner-rated attractiveness ($r = .505, p < .000$).

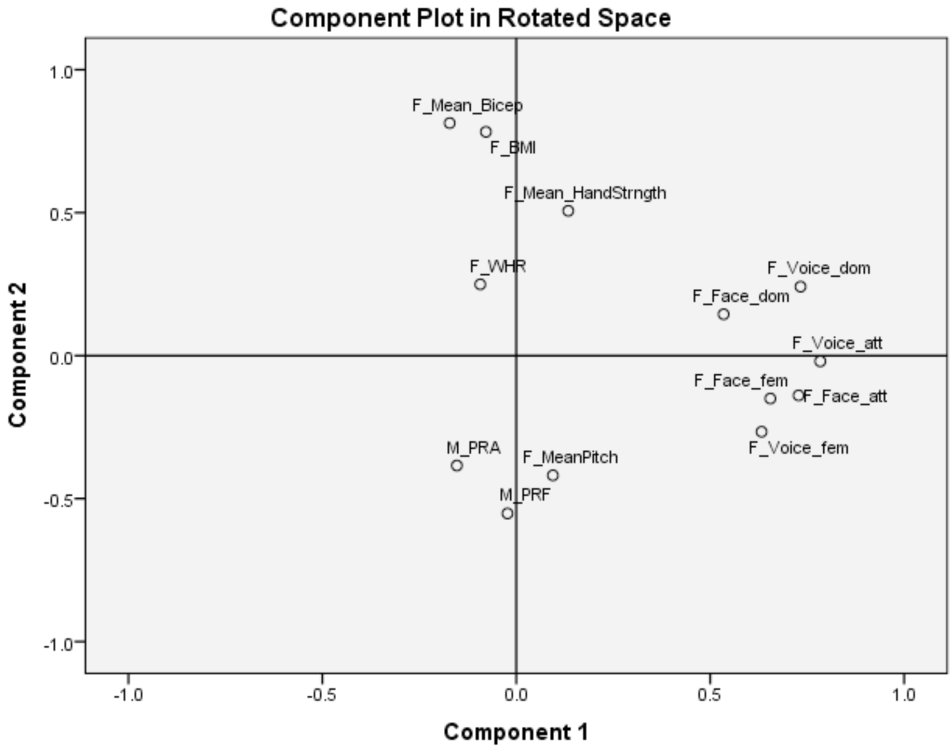
The Bartlett's test tests whether dependent variables are significantly intercorrelated, and if so, the researcher may proceed in conducting a multiple analysis of variance (Garson, 2009). The appropriateness of factor analysis is supported by Bartlett's test ($\chi2(78) = 416.23$, $p < .001$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling (KMO = .468). The following 13 variables were included in a principal components analysis (PCA): mean hand-grip strength, mean bicep circumference, WHR, BMI, mean pitch, vocal attractiveness, vocal dominance, vocal femininity, facial attractiveness, facial femininity, facial dominance, male partner-rated attractiveness and male partner-rated femininity. Principle Components Analysis (PCA) revealed two components (see Table 1). Component 1 was comprised of 6 variables, which included vocal attractiveness, vocal dominance, vocal femininity, facial attractiveness, facial femininity and facial dominance. Component 2 consisted of 7 variables, which included mean hand-grip strength, mean bicep circumference, WHR, BMI, male partner-rated attractiveness, male partner-rated femininity, and mean pitch (see Figure 1). Component 1 accounted for 22.2% of variance while component 2 accounted for 18.5% of variance. Combined, component 1 and 2 accounted for 40.8% of variance.

Table 1. Rotated Component Matrix (female data)

	Component 1 EV= 3.0, 22.2%	Component 2 EV= 2.3, 18.5%
Female Mean Hand Strength	.1	.5
Female Mean Bicep	-.1	.8
Female WHR	-.0	.2
Female BMI	-.0	.7
Female Mean Pitch	.0	-.4
Female other-rated facial attractiveness score	.7	-.1
Female other-rated facial dominance score	.5	.1
Female other-rated femininity score	.6	-.1
Female other-rated vocal attractiveness score	.7	-.0
Female other-rated vocal dominance score	.7	.2
Female other-rated vocal femininity score	.6	-.2
Male partner-rated attractiveness	-.1	-.3
Male partner-rated femininity	-.0	-.5

Extraction Method:Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization
EV = Eigenvalue, percentages refer to the amount of variance explained.

Figure 1. Component Plot in Rotated Space (female data)



Male Data

The ratings of dominance, attractiveness, fighting ability, and masculinity of men's faces and voices were highly correlated suggesting that they measure a common underlying variable related to mate quality and/or competitiveness. Significant correlations were found between female partner-rated: attractiveness and masculinity (r = .666, p < .001), attractiveness and dominance (r = .681, p < .001), attractiveness and fighting ability (r = .613, p < .001), masculinity and dominance (r = .799, p < .001), masculinity and fighting ability (r = .821, p < .001), and dominance and fighting ability (r = .710, p < .001). Significant correlations were also found between male other-rated facial: dominance and attractiveness (r = .621, p < .000), masculinity and attractiveness (r = .527, p < .001), and masculinity and dominance (r = .922, p < .001). Additionally, significant correlations were found between other-rated vocal: dominance and attractiveness ($r = .822$, $p < .001$), masculinity and attractiveness ($r = .725$, $p < .001$), and masculinity and dominance ($r = .821$, $p < .001$). Finally, significant correlations were also found between mean bicep circumference and both other-rated facial dominance ($r = .524$, $p < .001$) and other-rated facial masculinity ($r = .510$, $p < .001$).

The appropriateness of factor analysis is supported by Bartlett's test ($\chi2(105) = 686.993$, $p < .001$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling (KMO = .672). Fifteen variables were included in a PCA that encompassed physical traits: mean hand-grip strength, mean biceps circumference, shoulder-to-waist ratio, BMI, male other-rated traits: facial and vocal attractiveness, dominance, and masculinity, female partner-rated traits: attractiveness, masculinity, dominance, and fighting ability, and finally mean pitch. PCA revealed two components (see Table 2). Component 1 was comprised of 9 variables, which included vocal dominance, vocal attractiveness, vocal masculinity, facial masculinity, facial attractiveness, facial dominance, BMI, mean biceps circumference, and mean hand-grip strength. Component 2 consisted of 6 variables, which included female partner-rated masculinity, attractiveness, dominance, and fighting ability, male shoulder-to-waist ratio, and mean pitch (see Figure 2). Component 1 accounted for 28.1% of variance while component 2 accounted for 24.1% of variance. Combined, component 1 and 2 accounted for 52.3% of variance.

Main Analysis

The results from a repeated-measures ANCOVA with menstrual cycle phase as a within-subjects repeated measure, female partner genetic quality and male partner genetic quality as between subjects covariates, and orgasm frequency timing and quality as outcome variables are reported in Table 3**.** A main effect of cycle phase was found, in that more orgasms were reported in the luteal phase $F(1, 26) = 5.368$, $p < .029$). A non-significant, but suggestive, interaction was found between male PCA 1 with menstrual cycle phase $F(1, 26) = 1.891$, $p < .181$).

Table 2. Rotated Component Matrix (male data)

	Component 1 EV= 4.2, 28.1%	Component 2 EV=3.5, 24.1%
Female partner-rated attractiveness	-.0	.7
Female partner-rated masculinity	-.0	.8
Female partner-rated dominance	.0	.8
Female partner-rated fighting ability	-.0	.8
Male Mean Hand Strength	.3	.4
Male Mean Bicep	.7	.4
Male SWR	-.2	-.1
Male BMI	.6	.2
Male Mean Pitch	.0	-.2
Male other-rated facial attractiveness score	.4	-.0
Male other-rated facial dominance score	.7	.0
Male other-rated facial masculinity score	.7	-.0
Male other-rated vocal attractiveness score	.7	-.2
Male other-rated vocal dominance score	.7	-.2
Male other-rated vocal masculinity score	.7	-.0

Extraction Method:Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization
EV = Eigenvalue, percentages refer to the amount of variance explained.

Figure 2. Component Plot in Rotated Space (male data)

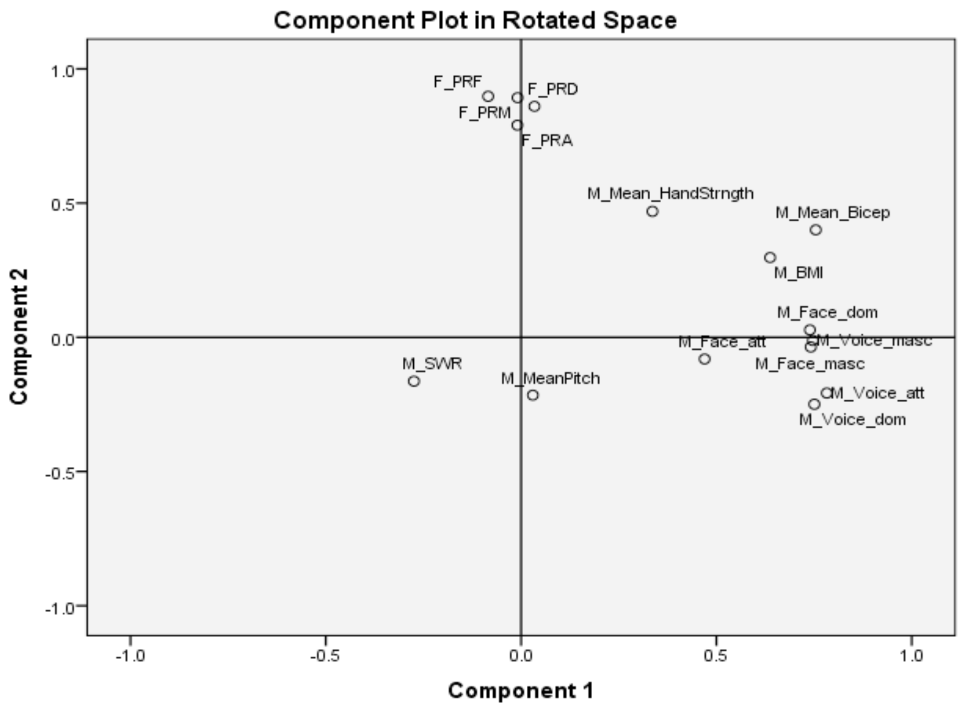


Table 3. Tests of Within-Subjects Contrasts

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	CPhase	Type III Sum of Squares	df	Mean Square	F	Sig.
CPhase	Linear	.138	1	.138	5.368	.029
CPhase * F_PCA_Att1	Linear	.003	1	.003	.103	.751
CPhase * F_PCA_Att2	Linear	.003	1	.003	.099	.756
CPhase * M_PCA_Att1	Linear	.049	1	.049	1.891	.181
CPhase * M_PCA_Att2	Linear	.005	1	.005	.207	.653
Error(CPhase)	Linear	.667	26	.026		

DISCUSSION

Counter to our original predictions, the proportion of orgasms was not greater during the follicular phase of the woman's cycle. In fact, the opposite was found; a higher proportion of orgasms was reported during the luteal phase. These results are difficult to explain in light of prevailing hypotheses of the putative function of women's orgasms. We expected a higher frequency of orgasms during the follicular phase, especially if the woman's partner was of high genetic quality, in order to increase the chance of conception.

This study compared women's orgasms in the luteal and follicular phases of the ovulatory cycle to determine whether orgasm is mediated by four covariates: female components included vocal/facial characteristics and body composition, male components included vocal/ facial characteristics and partner-rated characteristics. We used the proportion of sexual encounters that led to orgasm and predicted that women would have a higher frequency of orgasms during the follicular phase if her partner were of high genetic quality. However, our hypothesis was not supported: women reported more orgasms during the luteal, rather than follicular, phase.

This result may support a long-term mate effect. If women are experiencing more orgasms outside of the follicular phase, orgasm may not be functioning for sire, but for selecting a long-term, investing mate. Measures of female mate quality were related to other female-rated data, such as dominance. We found a non-significant trend toward an interaction $F(1, 26) = 1.9$, $p = .18$) between cycle phase and measure of male's quality: male other-rated masculinity, attractiveness, dominance, mean biceps circumference, and BMI, but further analysis is needed to determine the direction of the effect.

The sire choice hypothesis states that women experience a higher frequency of orgasms while in the late follicular phase if their partners are of high genetic quality. However, there may be some deception by the female. If a woman feigns an orgasm, or had orgasms throughout her various cycles, the man would not be able to determine whether he was selected for his gene quality or investment. Luteal phase orgasm may serve the same function.

These findings support the pair-bonding hypothesis. Oxytocin is released during orgasm, which is thought to facilitate pair-bonding (Meston et al., 2004). Because women reported experiencing more orgasms during the luteal phase, it is possible that their partners, who have invested in their relationship, are more likely and able to stimulate their partners to orgasm (Puts, Dawood, & Welling, in press). This, in turn, may aid in obtaining and maintaining a long-term relationship (Morris, 1967; Hamburg, 1978) and suggests that women who are dating men with lower quality genes may experience orgasm due to other qualities of their partner, such as satisfaction, love, and relationship quality (Costa and Brody, 2007). Alternatively, it could be that women are more attracted to their partners in the luteal phase. This is also a point in the cycle when women are less likely to fantasize about extra-pair copulations because relationship satisfaction may also be higher in this phase (Gangestad, Thornhill, & Garver, 2002). These hypotheses cannot be fully supported by the present data.

These results neither support nor refute the sire choice hypothesis, which implies that women have more orgasms during the follicular phase with men of high genetic quality (Puts et al., in press). Udry and Morris (1968) found that women reported higher frequency of orgasms during the follicular phase. Instead, we found that women reported a higher frequency of orgasms during the luteal phase, during which they should be *less* attracted to masculinity, dominance, and attractiveness while seeking short-term relationships (Pillsworth & Haselton, 2006). These results also contradict the by-product hypothesis because there is still a difference in orgasms reported throughout the cycle. If female orgasm were a byproduct, no difference in phase would be observed.

Finally, evidence suggesting that female orgasm promotes fertilization was neither supported nor contradicted by these findings. The sensation of the female orgasm may trigger orgasm in the female's partner, which in turn might aid in fertilization. However, because more orgasms were reported during the luteal phase, they could not have aided in fertilization. If the function of female orgasm were solely for aiding in fertilization, then we would expect orgasm to occur only during the follicular phase.

Limitations

The results may have been affected by several limitations of this study. First, we separated the ovulatory cycle into only two phases, which may not be representative of all the cyclical shifts during the female menstrual cycle. For instance, we omitted the menstrual phase as well as the late follicular phase, which is the most fertile window in the cycle. The late follicular phase, therefore, is particularly relevant to the study of female orgasm. In addition, we made no attempt to reduce the variables prior to the PCA. For example, BMI, hand-grip strength, and mean biceps circumference might have been reduced to a single variable for physical strength.

Second, more vocal parameters should have been analyzed along with facial photograph analysis for symmetry and masculinity/ femininity. These are important characteristics that reveal mate quality (Puts, Jones, & DeBruine, 2012). Analysis of these characteristics may have significant relevance over mate quality. Since these data needed processing, time constraints prevented inclusion in this study.

Third, due to attrition during the online extended study, we have data from relatively few couples that spanned the entire two months. More data are needed for the online portion of the study. Second of all, the data on sexual behavior, including orgasm, were self-report. We asked each participant to recall sexual activity over three day spans in which inaccuracy may have been reported. Participants may have also felt they needed to give a certain impression for the study, which may have negatively affected the quality of the data.

Further Study

In order to determine or predict orgasm outside of the late follicular phase, we will measure long-term mate quality in depth. We also will test for a correlation between male facial and vocal characteristics (PCA component 1) and partner's orgasms in the follicular and luteal phases in predicting that it would be stronger during follicular phase.

We will continue to analyze the data by performing a post-hoc test to help distinguish if there is a correlation between PCA component 1 and women's orgasm in the follicular phase, specifically late follicular phase. We will perform a PCA on all the orgasm variables, such as how the orgasm was achieved, how the orgasm felt, and when the orgasm was achieved.

From these data, we will perform further analysis (e.g. PCA) on the sensation variables to test for a correlation. We will perform another PCA on the timing of the orgasm to test for a correlation. Once these data are analyzed, we will test if these data correlate with a woman's cycle phase and mate quality. This further data analysis will expand the correlations between women's cycle phase, mate quality, and frequency of orgasms.

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VITA

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Curriculum Vitae

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Education

The Pennsylvania State University, University Park, PA **2008-Present**
Bachelor of Arts in Psychology with a minor in Sexuality and Gender Studies

Honors Thesis: "Female Sexual Response: Possible Adaptive Functions of the Female Orgasm" under the supervision of Dr. David Puts.
Diploma expected June 2012.

Academic Honors and Awards

2008, 2010, and 2011 Snayberger Memorial Foundation Scholarship recipient
2008 and 2009 Penn State Schuylkill Chancellor's Award recipient
2008 Penn State Schuylkill Academic Leaders Award

Academic Memberships and Activities

2012 Phi Beta Kappa
2011 American Association of Sexuality Educators
Counselors, and Therapists (AASECT)
2011 Golden Key International Honour Society
2010 Psi Chi International Honor Society in Psychology
2009-Present Schreyer Honors College member
2008-Present Penn State Academic Dean's List member
2008-2010 Penn State Schuylkill THON member

Research Experience

Research Assistant in the Bioanthropology Anthropometric Laboratory headed by Dr. David Puts, Ph. D. (Spring 2011- Present**)**

Thesis Research: My thesis research focuses on the female sexual response, exploring whether objective measures of mate quality and compatibility (e.g., genetic markers, hormone levels, and anthropometry) predict the quality of a couple's sex lives, and especially whether these effects are moderated by changes in conception risk across the woman's ovulatory cycle.

Additional responsibilities: IRB process, running participants, collecting anthropometric measurements, collecting saliva and DNA samples, voice recordings, 2D and 3D photos, hand scans, administering questionnaires, and analyzing hormone levels.

Research Assistant in the Emotion and Gender Laboratory headed by Dr. Stephanie A. Shields, Ph.D. (Fall 2010**)**

Responsibilities: Ran participants, collected data, and administered questionnaires.

Media

Participated in the National Geographic television documentary "How Sex Works" on 20 November 2011 about relationship and sexual satisfaction, currently unaired. This documentary showcases some research on female sexuality and inter-couple behavior that I was involved in collecting.

Part-time Work Experience

Fall 2011- Present	Penn State Room associate and cashier *McLanahan's Store*
Summer 2010- Present	Hostess and server *Oak Hill Inn*
February 2010- July 2010	Server *Roman Delight*

Volunteer Work

2011 LGBTA Student Resource Center (volunteer front desk receptionist)
2010 Psi Chi THON Canning Chair

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