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ORIGINAL PAPER

A Typological Approach to Testing the Evolutionary Functions of Human Female Orgasm

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Abstract Building on previous work that identified different types of orgasm in women (King, Belsky, Mah, & Binik, 2011), the goal of the present study was to extend such typological work and determine whether female orgasmic variability tracked potentially evolutionarily salient sexual partner characteristics (e.g., those displaying possible immune-system compatibility). A total of 265 females completed an Internet survey about their orgasmic experience—achieved either with partners or alone. For partnered orgasms, they also provided details of partner characteristics and sexual behaviors. Latent class analysis revealed two orgasm types which were meaningfully distinguishable in terms of sensations and location—either centered on the surface of genitalia or deep inside. Deep orgasms were associated with internal sensations consistent with proposed functions of female orgasm in terms of differential sperm insuck. Such orgasms were associated with partners who were perceived as considerate, dominant, with a noticeably attractive smell, and as providing firm penetration. However, some hypothesized reproductively significant partner characteristics were not differentially associated with deep orgasms (i.e., muscularity, aggression, masculinity). Results were discussed and future research directions outlined. In particular, it is suggested that sexual passion between partners is a non-accidental component of sexual functioning and that this has too frequently been missing in sex research involving humans. Direct physiological measures of the results of female orgasm need to be undertaken. Additionally, the intriguing phenomenon of female ejaculation deserves scientific attention.

Keywords Evolution · Female orgasm · Insuck · Oxytocin · Ejaculation

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Introduction

Why do human females have orgasms? In light of the claim that the biological picture of any trait is incomplete without the adaptive component (Tinbergen, 1963), some scholars assert that female orgasm is an adaptation directly sculpted by natural selection to (somehow) increase reproductive fitness, that is, the dispersion of genes in future generations (e.g., Baker & Bellis, 1993b; Pollet & Nettle, 2009; Thornhill, Gangestad, & Comer, 1995). Others contend, in contrast, that female orgasm exists as the by-product of a male adaptation: Strong selection created sensitive penises to reward male sexual activity and clitorises are inadvertent physical homologues of these (Gould, 1987; Lloyd, 2005; Symons, 1979). This would make female orgasm not adaptive, i.e., not under its own separate selection pressure.

The empirical case has yet to be made linking female orgasm to fitness in support of the adaptationist view (Barash, 2005; Judson, 2005; Pound & Daly, 2000; Puts, 2006; Zuk, 2006). Some suggest, however, that consideration of different types of female orgasms could provide support for adaptationists' claims (Dawood, Kirk, Bailey, Andrews, & Martin, 2005; Judson, 2005). It could be that only some orgasms, or only some features of them, have adaptive significance. As it turns out, the contention that not all female orgasms are the same is commonplace among sex researchers (Bentler & Peeler, 1979; Levin, 1981, 1998, 2001, 2004; Levin & Wagner, 1985; Mah & Binik, 2001, 2002; Singer & Singer, 1972) and sex therapists (e.g., Brody, 2007; Butler, 1976;

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Costa & Brody, 2007; Fisher, 1973; Robertiello, 1970; Sundahl, 2003), as well as evident in informal surveys of women (e.g., Hite, 1976).

The purpose of the research presented herein was two-fold—to test the proposition that there are different kinds of female orgasms, building on recently reported results (King, Belsky, Mah, & Binik, 2011) and to extend such typological inquiry by determining whether, as expected on the basis of evolutionary reasoning, certain partner characteristics and sexual behaviors differentiate with whom and when different types of female orgasm occur.

Arguments for and Against Female Orgasm as Adaptation

Two lines of argument suggest that female orgasm is directly selected for and one that it is a by-product. First, because female orgasm is not actually required for conception, some less direct function must be sought by those contending that it is under its own selection pressure. One proposal is that female orgasm helps to cement pair bonds (Eschler, 2004, 2005; Morris, 1967; Rancour-Laferriere, 1983). Yet, this claim seems contradicted by evidence that primate females, including humans, are as likely to orgasm in extra-pair copulations with dominant or high genetic quality partners as with stable ones (e.g., Thornhill & Gangestad, 1999; Thornhill et al., 1995; Troisi & Carosi, 1998).

The second adaptationist possibility, one that directly informs the present inquiry, is that female orgasm is a female choice mechanism, aiding females in harvesting sperm from preferred mates (Baker & Bellis, 1993a, 1993b). Such thinking appears consistent with the physiological finding that at least some female orgasms create insuck, a pressure change in the uterus via peristaltic action, which could allow females to select sperm preferentially from particular mates (Fox, 1976; Fox & Fox, 1971; Fox, Wolff, & Baker, 1970; Wildt, Kissler, Licht, & Becker, 1998; Zervomanolakis et al., 2007; but see Levin, 1998, 2002, for a proximately alternative, but functionally equivalent view). It must be acknowledged, however, that Baker and Bellis' (1993a, 1993b) initially promising experimental work, which appeared to demonstrate a role for orgasm in differential sperm selection in humans, has not yet been extended to direct measures (Birkhead, 2000; Pound & Daly, 2000). The findings presented here might suggest some avenues for such extension.

Rejecting a direct adaptive function for female orgasm are those contending that it is nothing more than a by-product of the human male's capacity for orgasm and has no function of its own (Gould, 1987; Lloyd, 2005; Symons, 1979). This is, of course, not a default position in the absence of an adaptive account, because by-products are conceptually and evidentially dependent on adaptations (Lewontin, 1978) and require equally rigorous supporting evidence. For example, if male orgasm is a proximate reward (Skinner, 1938) for males to keep them expending energy in sex (Gould, 1987; Symons, 1979), then this should also apply to females.

There is, however, a well established orgasm-intercourse discrepancy in human females. Penile-vaginal intercourse is inefficient in creating orgasm in females compared with masturbation (Lloyd, 2005; Symons, 1979). This has led some to argue that female orgasm cannot be accurately characterised as an adaptation, given its inefficiency of production during copulation (Gould, 1987; Lloyd, 2005; Symons, 1979). Others have suggested that female orgasm may be a facultative adaptation; rather than occurring in every sexual encounter, it occurs in response to appropriate partner characteristics, such as status or signs of high genetic quality (Pollet & Nettle, 2009; Puts, 2006, 2007; Thornhill et al., 1995). This leads to the prospect (1) that there are different types of orgasms and (2) that they occur under different partner and behavioral conditions.

Different Types of Orgasm?

Masters and Johnson (1965, 1966) failed to detect any uterine peristalsis (pulsing) effect resulting in pressure changes between vagina and uterus that could insuck sperm—as subsequently documented by Fox (1976; Fox & Fox, 1971; Fox et al., 1970). In consequence, both adaptationist thinkers (Baker & Bellis, 1993a, 1993b; Thornhill et al., 1995) and anti-adaptationist theorists (Gould, 1987; Lloyd, 2005) explicitly or implicitly embraced the idea enshrined in Masters and Johnson's (1965, 1966) classic work that all female orgasms are essentially the same, however they are brought about. Certainly neither approach considers the possibility that there might be a difference in orgasms created through masturbation and those created through intercourse. The result is that the Masters and Johnson model of female orgasm has too frequently been accepted by default: One type of orgasm, no matter how brought on or with whom. There have been a couple of notable exceptions to this in the call to recognize the range of female orgasmic experience (e.g., Judson, 2005) and the suggestion that different types of female orgasm may have different adaptive significance (Dawood et al., 2005).

It is important to appreciate that Masters and Johnson's (1965, 1966) six experiments into orgasmic insuck did not involve actual partnered coition, used methods that did not accurately replicate the action of penises in vaginas, (Schultz, van Andel, Sabelis, & Mooyaart, 1999) and covered up important areas of internal sensitivity (Grafenberg, 1950; Komisaruk & Sansone, 2003; Komisaruk et al., 2004; Komisaruk, Whipple, Gerdes, Harkness, & Keyes, 1997; Levin, 2002; Perry & Whipple, 1981). Specifically, these experiments involved only un-partnered masturbation of the—admittedly sensitive—glans of the clitoris (Schober, Meyer-Bahlburg, & Ransley, 2004) rather than stimulation of the full extent of this complex and

largely internal organ (Dickinson, 1949; O'Connell, Hutson, Anderson, & Plenter, 1998; O'Connell, Sanjeevan, & Hutson, 2005). These features of the classic Masters and Johnson's (1965, 1966) work may well have contributed to their failure to detect insuck—and thus different types of orgasms.

Evidence of an insuck effect in human females comes from other research into copulatory, rather than masturbatory, orgasms. Using inserted radio-telemetry devices during real coitus, Fox (1970; Fox & Fox, 1971) found evidence for an insuck function to orgasm which would have fertility implications, something that was subsequently confirmed in studies with high ecological validity (Fox et al., 1970). This insuck mechanism is at the heart of evolutionary claims about orgasms being a female choice mechanism, and thus the hypothesis tested by King et al. (2011) that there are different types of female orgasm, ones which involve peristaltic action and ones which do not. Important to appreciate is that humans are not unique in experiencing uterine peristalsis mechanisms during coition with selected partners leading to preferential sperm selection. Indeed, this is regularly utilised in sections of the farming industry to improve fertility with artificial insemination in the cases of, for example, pigs (Gill, 2007; Knox, 2010). In this industry, debate typically centers on the respective importance of male animal presence, appropriate physical stimulation, and methods of oxytocin (and other hormones) inception to produce such peristalsis, whose existence and role in sperm transport is not questioned (Knox, 2010; Levis, 2000). This functional process also occurs in a range of mammals, including rats, cows, dogs, horses, rabbits, and macaques (e.g., Ammersbach, 1930; Evans, 1933; Genell, 1939; Goldfoot, Westerborg-vanLoon, Groeneveld, & Slob, 1980; Hartman & Ball, 1931; Krehbiel & Carstens, 1939; Millar, 1952; Toner & Adler, 1986; Trapl, 1943; VanDemark & Moeller, 1951). Such cross-species commonality is exactly what would be expected if female orgasm evolved to serve an adaptive function (West-Eberhard, 1992).

It is thus hypothesized that one can only expect potentially sperm-selecting uterine peristalsis to be induced when female orgasms include deep, vagino-cervical stimulating (Grimes, 1999; Komisaruk et al., 2004), penetrative behaviors (e.g., coition) (Fox, 1976; Fox & Fox, 1971; Fox et al., 1970) which interact with neurologically sensitive areas in appropriately aroused females (Komisaruk & Sansone, 2003; Komisaruk et al., 1997, 2004; Levin, 2002; O'Connell et al., 1998, 2005; Perry & Whipple, 1981), perhaps due to the mediational effect of oxytocin (see below). Were this the case, different types of orgasm would be expected, namely, those that do and do not generate uterine peristalsis. This prediction is tested—indirectly—in the research to be described, based as it is on female reports of orgasmic experience. In so doing, the present report extends King et al.'s (2011) work documenting two different kinds of female orgasm, one that appeared to involve insuck and one that did not. Because King et al.'s (2011) research was based on the secondary analysis of data not originally collected with insuck in mind, the present study incorporated more detailed measurements of insuck-related orgasmic experiences.

In addition to being asked about specific insuck-related bodily sensations (e.g., internal sucking sensations), women were also queried about the presence of calm feelings following orgasm. Such questioning was based on the proposition that sperm-selecting female orgasms would involve the release of oxytocin, given evidence that peristaltic effects are mediated by oxytocin in humans (Wildt et al., 1998), just as they are in other mammals; that oxytocin is associated with feelings of calm and security (Zak, Kurzban, & Matzner, 2005), as well as uterine contractions of all sorts (Ayinde, Onwukaeme, & Nworgu, 2006; Russell, Leng, & Douglas, 2003); and that the latter is especially true in the case of female arousal and orgasm (Blaicher et al., 1999; Carmichael, Warburton, Dixen, & Davidson, 1994). Wildt et al. (1998) described this oxytocin-linked process as a peristaltic pump for transporting appropriate fluids—sperm—into the fallopian tubes. Indeed, they found that such transport was preferentially directed to the ovary bearing the dominant follicle (Zervomanolakis et al., 2007). Thus, there is a good case for a proximate mechanism for potential differential sperm selection, via uterine insuck, through oxytocin-rich female orgasms—and thus for different types of orgasms (i.e., ones that do and do not produce uterine peristalsis). If these occur infrequently, then an obvious line of inquiry is to investigate whether such fertility-related effects are responsive to different partner characteristics.

Different Types of Partner: Female Sexuality and Female Choice

Across sexually reproducing species, the sex that invests the most tends to be the choosiest (Trivers, 1972). Typically, this is the female, as egg production, gestation, and later parental care, if any, tend to fall upon her. A key underlying assumption of the present study is that human females exert choice, both via selection of partner characteristics before sex is undertaken, and after that—where the sexual encounter provides further tests of partner quality. This leads to the expectation that different types of orgasms should be associated with different types of partners and, more specifically, that putatively sperm-selecting orgasms involving uterine peristalsis should be associated with higher-quality, in a fitness sense, partners.

The human sexual encounter, from this perspective, is not just the end result of coy, passive, female acquiescence to aggressive male pursuit (Gowaty, 1997; Hrdy, 1981, 1986; Judson, 2003; Zuk, 2002). Intercourse is an active test of partner quality that females are, in effect, judging (Eberhard,

1996)—differentially selecting sperm from males who display relevant signs of quality.

Possible Signs of Male Quality

There are a number of ways that males could honestly signal (Zahavi, 1975) quality to partners, both before and during the sexual encounter. An honest signal is one that exerts a cost on the signaller—so that weak exponents will fail to produce the signal to potential mates. For example, only genuinely high-quality peacocks can afford to grow long and costly trains to advertise this quality (Petrie, 2002). Given the deleterious effect of testosterone on immune systems, honest markers of this hormone could constitute such signals (Folstad & Karter, 1992). Therefore, indicators such as muscularity (Frederick & Haselton, 2007)—which might correlate with conspicuously masculine morphology and behaviors such as aggression (Bahrke, Yesalis, & Wright, 1990; Pope & Katz, 1994) and dominance (Jozifkova & Flegr, 2006; Jozifkova & Konvicka, 2009)—would all be predicted to be more reliably associated with sperm-selecting orgasms. Also of importance to females in selecting mates would be general partner health and vitality, signalled perhaps through vigorous penetrative intercourse (Dawkins, 2006). In addition, immune system compatibility, via MHC (Wedekind, Escher, Van de Waal & Frei, 2007), detectable by an increased female smell receptivity when compared to males (Havlicek et al., 2008), is a key fitness indicator—given that a major role for sexual reproduction is the formulation of compatible immune systems (Hamilton, 1982; Hamilton & Zuk, 1982; Thornhill & Gangestad, 1999; Wedekind & Penn, 2000). Finally, because partner self-assurance and competence, as shown in lovemaking, are attractive qualities (Eschler, 2004, 2005), these characteristics might also be predictive of sperm-selecting features of orgasm.

Current Study

The goals of the present study were to further evaluate the evolutionary-inspired proposition that female orgasms have distinct types, using within-subjects measures rather than the between-subjects measures used previously (King et al., 2011), as well as assessments that focus more on internal peristaltic sensations. In addition to using latent-class analysis to identify different types of orgasm based on female participants characterizations of them, efforts were undertaken, just as in the earlier work, to validate the types discerned before testing the partner-characteristics' propositions outlined in the preceding section. More specifically, it was predicted that putatively and apparently sperm-selecting orgasms should be significantly more likely to occur with a partner present, with penetrative sexual activities, yet be no more difficult to bring about (in terms of time) as non-sperm-selecting ones. Intriguingly, the first two of these validational predictions contradict accounts of female orgasm that assume that it to be a unitary phenomenon, with masturbation and coition being orgasmically equivalent (Baker & Bellis, 1993a; Gould, 1987; Lloyd, 2005; Masters & Johnson, 1965, 1966; Symons, 1979). Note, too, that the latter prediction runs counter to claims that the induction of female orgasm via coition is of necessity a lengthy, tedious, highly technical process that humans are ill-suited to achieve (Eschler, 2004; Gould, 1987; Lloyd, 2005; Maines, 1999; Symons, 1979).

Because it is hypothesized that a key feature of some, but not all, female orgasms is that they preferentially select sperm through oxytocin-mediated uterine peristalsis, the primary hypotheses pertain to the phenomenology of such putatively oxytocin-mediated effects; this prescribes a focus on deep peristaltic sensations, subsequent feeling of partner merging and to partner characteristics and sexual behaviors thought to distinguish higher from lower quality partners. Given that there is an increasing body of evidence that Internet-based surveys can provide both reliable and valid sources of data, when sensitively and intelligently handled (Binik, 2001; Fraley, 2004; Nosek, Banaji, & Greenwald, 2002), it was considered appropriate to collect data in this way to maximize the sample size, and gain some measure of cross-cultural representativeness (Gosling, Vazire, Srivastava, & John, 2004).

Method

Participants

The sample was recruited using an Internet survey about female sexual experiences (see Procedure). Women who were at least 18 years of age were invited to take part. Potential participants were informed that they would be asked intimate and private questions about female orgasms and were assured of total confidentiality.

A total of 265 participants were selected from 360 initial participants based on inclusion criteria. Inclusion criteria were especially strict given that the topic area seemed likely to attract mischievous or merely inquisitive pseudo-participants (see "Procedure" section). The final group retained for analysis were between the ages of 18 and 76 years ($M = 32.19$, $SD = 11.92$). Participants' age of first intercourse ranged from 12 to 38 years ($M = 17.22$, $SD = 3.94$). The frequencies and percentages of demographic variables for the 265 participants are shown in Table 1. The majority of the sample was either European (58.5 %) or North American (34.7 %) in origin, heterosexual (72.7 % of those declaring an orientation), and having some level of university education (78.5 %) while being childless (63 %). Given both that female sexual orientation is known to be more fluid than male (e.g., Kinsey, Pomeroy, Martin, & Gebhard, 1953) and that lesbian sexual interactions leading to orgasm may well have

Table 1 Frequencies and percentages of demographic variables

Demographics	*n*	Participant sample ($n = 265$) %
Region of origin		
UK/Ireland	56	21.1
Northern/Western Europe	6	2.3
Eastern/Southern Europe	93	35.1
North America	92	34.7
Central/South America/Asia/Middle East/ Africa/Australia/New Zealand/other	18	6.8
Highest level of education		
Finished primary school	1	0.4
At least some secondary/high school education	52	19.6
At least some university/college education	165	62.3
At least some post-graduate education	43	16.2
Other	4	1.5
Sexual orientation		
Exclusively heterosexual	72	27.2
Predominantly heterosexual, incidentally homosexual	16	6.0
Predominantly hetero, more than incidentally homosexual	8	3.0
Equally heterosexual and homosexual	2	0.8
Predominantly homosexual more than incidentally heterosexual	1	0.4
Predominantly homosexual, only incidentally heterosexual	0	0
Exclusively homosexual	0	0
Declined to answer	166	62.6
Reproductive status		
Taking contraceptive pill	70	26.4
Pregnant	4	1.5
Never had children	167	63.0
Has one child	36	13.6
Has two children	45	17.0
Has three or more children (max 7)	17	6.4
Had hysterectomy	5	1.9
Reached menopause	25	9.4

evolutionary significance all their own it was decided to include those of all declared orientations in the study.

Procedure

The survey was posted on the Internet with the title "Female Orgasm Survey." The web address (http://www.surveymonkey.com/s.aspx?sm=RQ9Q3XIf1RbEBLqu31Bitw_3d_3d%22%3E) was hosted by the company Survey Monkey™. *Scarlet Magazine*™ provided a link from their online site. Participants were not solicited actively in any way and were notified on the first page of the survey that their participation was entirely voluntary and totally anonymous. All study procedures were approved by the ethics committee of the School of Psychology, Birkbeck University of London. One early question in the survey asked participants to tell how they learned of it. The majority reported finding it through some means other than those listed as alternative choices to select ($n = 182, 68.7\,\%$), "friend referral" ($n = 37, 14.0\,\%$), link from newspaper article ($n = 31, 11.7\,\%$), and through the Birkbeck website ($n = 11, 4.2\,\%$). Four people (1.5 %) declined to answer.

Unreliable participants were eliminated from the data set ($n = 95$) in a way designed to separate the authentic from the dishonest. This was done by asking separate questions about (1) date of last menstrual period and (2) typical cycle length in separate parts of the survey and in a manner whereby answers to the first question could not be re-visited upon addressing the second. All participants who provided either no answers or answers that would be physically impossible given the dates provided to these paired questions were automatically excluded on the assumption that males or otherwise deceitful participants would not be able to provide plausible responses to the two questions. For example, if someone started the survey on 27 July 2008, claimed to have a typical cycle length of 28 days, and had their last period finish one week ago, then, when asked about when their next period was due, some date close to 18 August 2008 would be expected for the next period to start. Given the degree of separation in the survey itself of these two questions (i.e., $\sim$0 min or more) and the impossibility of going back to check or alter the first answer, it was reasoned that only those telling the truth would be able to provide answers that fitted to these questions or plausible reasons why no such answer was provided. The 29 participants who fell into this latter category included those who stated that they had polycystic ovaries, were post-menopausal, or had had hysterectomies. Only one survey per computer could be completed. Surveys could not be returned to later nor could earlier entries be revised.

Measures

A pilot qualitative face-to-face interview study facilitated the development of close-ended questions about orgasmic experience.[1] Women in the pilot study were asked to tell us what we should be asking women about their experience of orgasm. Both the types of experience women were asked to report on (e.g., internal sucking sensations) and the degree to which they experienced them were based on pilot study findings. Women were asked a number of questions about orgasmic phenomenology and, in the case of partnered orgasms, partner characteristics. More specifically, they were first asked to think back to their most recent orgasm and describe it by responding

[1] Details of the questions asked in the pilot are available from the corresponding author.

to a series of questions about that particular orgasm, but the question sequence was such that there was no way a participant would know at this juncture that she would be given the opportunity to describe, subsequently, orgasms that differed from the initial one described. A total of five different types of orgasms could be described, although no participant offered more than four sets of descriptions. After asking questions pertaining to the phenomenology of a particular orgasm, participants were asked whether the orgasm in question (i.e., first described, second described, etc.) was experienced with a partner. If it was, then a set of questions were asked about the partner. Irrespective of whether a partner was involved, a further set of questions pertaining to the sexual activities that led up to orgasm were asked.

Thirteen questions about the phenomenology of each orgasm were posed and all of these, bar the last one, were analyzed in order to draw out underlying orgasmic typology. The final question was used to help validate some of the predictions made about orgasm typology. The questions asked were: (1) presence/degree of internal sucking sensations; (2) clarity of thought after orgasm; (3) relaxedness following orgasm; (4) relaxedness prior to orgasm; (5) whether orgasm was localized; (6) amount of noise made by self during orgasm. There were also questions with binary responses, pertaining to (7) where the orgasm was centered; (8) whether there were any post-orgasm floating sensations; or (9) any apnea; (10) sense of loss of self; (11) ejaculation; or (12) sensation akin to urination. One final question, not used in the latent-class analysis to identify type of orgasm, concerned (13) length of time it took to bring the orgasm about.

If the orgasm described occurred with a partner, seven further questions about the partner were asked: (1) aggressiveness of partner's behavior during sex; (2) considerateness of partner's behavior during sex; (3) partner; (4) partner; (5) attractiveness of partner smell; (6) dominance of partner's behavior during sex; and (7) vigorousness of penetration—if any. Details of questions and possible answers are given in the "Appendix" section.

Finally, participants were asked to provide details of (non-mutually-exclusive) sexual practices, using a list of possibilities that were occurring at the time of the orgasm in question, either with or without a sexual partner. In spite of earlier comments regarding clitoral anatomy (Dickinson, 1949; O'Connell et al., 1998, 2005), the terms "clitoral" and "vaginal" were used to index "external" and "internal" stimulation due to terminology used in the pilot interviews by participants. Thus, these terms were used in the survey when asking about stimulation activities, but were not used here to classify orgasms. Practices that were included were: (1) clitoral stimulation (self), (2) manual clitoral stimulation (partner), (3) vaginal stimulation (self), (4) vaginal stimulation (partner), (5) clitoral stimulation (external vibrator), (6) vaginal stimulation via dildo/vibrator, (7) oral stimulation, (8) anal penetration, (9) breast stimulation, and (10) talking dirty. Also, various (mutually exclusive) sexual positions were endorsed for the sex with a partner condition at time of orgasm: (11) missionary, (12) missionary with legs raised, (13) missionary with legs bent back over head, (14) doggy style, (15) cowboy (woman on top), and (15) reverse cowboy (woman on top facing towards partner's feet). There was also a write-in option for other positions.

Results

Descriptive Results

Table 2 presents data on how many different types of orgasm were reported and the mean age of participants reporting a particular number of orgasms. Inspection of Table 2 reveals that by far the largest number of participants reported one or two types of orgasms, with a small percentage reporting none or three or more. A sign test indicated that this difference was significant, $Z = 14.3$, $p < .0001$. Comparisons were made between participants reporting only one and those reporting more than one type of orgasm on age, age at first intercourse, average length of menstrual cycle, number of children (if any), degree of hetero/homosexuality, and educational level. Because only age distinguished the two groups, with participants reporting just one type of orgasm being, on average, younger ($M = 29.9$ years, $SD = 11.2$) than those reporting more than one ($M = 33.0$ years, $SD = 12.4$), $F(1, 224) = 3.84$, $p < .05$, $\eta^2 = .017$, age was controlled for, where possible, in subsequent analysis.

Taken together, a total of 360 orgasmic experiences, some solitary and some partnered, were reported by the 225 participants. Tables 4 and 5 show, respectively, the sexual activities and positions that led up to these 360 orgasms. The percentages do not sum to 100 in Table 4 because multiple sexual practices were possible. Table 6 presents the sex of the sexual partner and whether vaginal penetration was reported (by natural or artificial penis or manually).

With respect to Table 3, the most common activity leading up to orgasm was stimulation of the breasts; least common was internal vaginal stimulation by the self, although the overall figure for internal vaginal stimulation increased considerably when partner action and vibrator/dildo use were factored in. Inspection of Table 4 shows that the most common sexual position at orgasm was some variant of the man on top ("missionary") position, occurring nearly half the time

Table 2 Frequencies and percentages of orgasm type ($n = 265$)

Number of orgasm types	*n*	%	*M* Age (in years) (*SD*)
None	21	7.9	27.89 (17.02)
One	90	34.0	29.87 (11.23)
Two	135	50.9	33.04 (12.35)
Three	18	6.8	34.33 (10.51)
Four[a]	1	0.4	38 (0)

[a] Note that no participant offered more than four types of orgasm

Table 3 Frequencies and percentages of sexual practices ($n = 360$)

Sexual activities leading up to orgasm	*n*	%
Clitoral stimulation by self	72	20.0
Clitoral stimulation by partner	97	26.9
Vaginal stimulation by self (manual)	24	6.7
Vaginal stimulation by partner (manual)	79	21.9
Clitoral stimulation by external vibrator	32	8.9
Insertion of vibrator/dildo	37	10.3
Oral stimulation of genital region	87	24.2
Anal penetration	29	8.1
Breast stimulation	112	31.1
Aural stimulation ("talking dirty")	40	11.1

Table 4 Frequencies and percentages of sexual positions at orgasm ($n = 207$)

Sexual position	*n*	%
Missionary position	34	16.4
Missionary position legs up	41	19.8
Missionary position bent over backwards	26	12.5
Rear entry ("doggy style")	33	15.9
Cowboy position (woman superior)	57	27.5
Reverse cowboy (woman superior, facing backwards)	12	5.8
Other position (write-in option)	4	1.9

(48.7 %). One-third of the time the sexual position was some variant of the woman being on top, with the remainder of the sexual positions described being either rear entry (e.g., "doggy style") or some write-in option, such as with the woman lying on her side with the man curled up behind her on his side. From the data in Tables 3 and 4, it was easy to determine the number of orgasms that occurred through penetration alone, with no external ("clitoral") stimulation reported—13.5 % (28 times). Table 5 shows the data on the sex of the partner in partnered orgasms and whether any form of vaginal penetration was occurring leading up to orgasm. Most orgasms recorded were with male partners and involved vaginal penetration.

Types of Female Orgasms

Recall that participants provided orgasmic descriptions in terms of internal sucking sensations, clarity of thought, relaxation both before and afterwards, localization of pleasure, noise, source of sensation, loss of a sense of self, and whether sensations pertaining to ejaculation, urination or apnea were present. These 12 phenomenological descriptions (i.e., presence/absence or degree of subjective strength of feeling) of orgasm were subjected to three separate latent class analyses. The first used only the first orgasm description offered ($n = 225$), the second only the second offered ($n = 135$), if any. Both of these analyses used age and age squared as covariates in order to control for some linear and curvilinear age-related effects on the reporting of orgasm types as indicated above. Additionally, for reasons to be explained below, the data from both sets of descriptions (i.e., first orgasm, second orgasm) were combined in a single data set to allow for planned multivariate comparisons. It is the results of this third set of analysis that will form the focus of the rest of this report.

Table 5 Frequencies and percentages of partner gender ($n = 251$)

Partner gender	*n*	%
Male	233	92.8
Female	10	4.0
Did not answer	8	3.2
Vaginal penetration reported (male partner)	221	94.8
Vaginal penetration reported (female partner)	6	60

Table 6 BIC model fit statistics for latent-class analysis for first, second, and combined orgasm data

No. of Clusters	First orgasm		Second orgasm		Combined	
	BIC (LL)[a]	BIC (L2)	BIC (LL)[a]	BIC (L2)	BIC (LL)[a]	BIC (L2)
1	4669.16	3684.53	3000.95	2517.98	7664.04	3377.63
2	**4619.79**	**3553.91**	**2859.49**	**2303.05**	**7421.93**	**3059.04**
3	4663.47	3516.36	2874.23	2244.33	7424.34	2984.96
4	4703.81	3475.45	2910.53	2207.16	7453.21	2937.35

The two-cluster model (*bold*) was the best fit for the data in all analyses

[a] LL refers to log likelihood

In each of the three latent class analyses, a two-class model fit the data best (see Table 6), that is, the two-class model always had the lowest BIC. All subsequent analyses focusing on partner characteristics that might have proven related to orgasm type drew on the third set of latent class results.[2] This was due to the fact that there were only 23 partnered, Type II (surface) orgasms in the second set of data (i.e., second orgasm), a number judged insufficient to perform planned multivariate analysis on this set while providing sufficient power (Ito, 1962; Läuter, 1978; Olson, 1976; Pillai & Jayachandran, 1967; Tabachnick & Fidell, 2001). This seemed a reasonable way to proceed in view of the fact that latent class results from the analysis of first orgasms only, second orgasms only, and the two combined yielded essentially the same typological results (Table 6).

Results of all three latent-class analyses indicated that Type I orgasms were characterized as having more full-body sensations, more internal sucking sensations, and greater

[2] Tables paralleling the remaining (third) set of data, with comparison to the first and second sets of data, are available from the corresponding author.

Table 7 Profile of combined orgasm typologies

Variable	Type I (deep) ($n = 216$)	Type II (surface) ($n = 144$)
Origin deep (%)	70.2	28.3
Origin surface (%)	30.0	71.7
Floating sensation (%)	77.7	24.0
Apnea (%)	62.2	25.0
Loss of self (%)	80.5	20.5
Peeing sensation (%)	54.7	27.2
Ejaculation (%)	43.4	18.5
Sucking sensation	2.64 (1.14)	1.96 (1.06)
Localization	2.41 (0.66)	1.92 (0.70)
Noise	2.36 (0.58)	1.66 (0.61)
Clarity of thought	1.21 (0.49)	1.71 (0.64)
Anxiety during	1.84 (0.95)	2.28 (0.93)
Relaxation after	1.45 (0.89)	1.72 (0.79)

likelihood of sensations such as apnea and loss of self/clarity whereas Type II orgasms were characterized as producing various feelings of relaxation and being more localized in intensity. Table 7 summarizes the comparison between orgasm types. These two types of orgasm were thus labeled, respectively, *deep* and *surface,* given that Type I orgasms were much more likely to be described as having originated deep inside the body and Type II orgasms on the surface of the genitalia. Figure 1 graphically represents the differences between the types across the measurements included in the latent-class analyses. The bars (either light grey or black with white dots) on the left represent percentage chances of particular sensations (such as floating) or behaviors (such as apnea) being reported. The bars (either hatched or dark grey) on the right display the subjective assessments of the degree of particular sensations, such as degree of relaxation or clarity of thought. The light grey and hatched bars together (lighter in both cases) represent deep orgasms and the black/dotted and dark grey ones together (darker in both cases) surface orgasms. For example, deep orgasms had a 70.2 % chance of being reported as originating inside the body and a subjective anxiety (during sexual activity) rating of 1.84. By contrast, surface orgasms had a 28.3 % chance of being reported as having originated inside the body and a subjective anxiety rating of 2.28.

Validation of Typology

In a preliminary effort to validate the typology, three external correlates were examined: partner presence, penetrative sexual behaviors, and rapidity of orgasm. Recall that deep orgasms were predicted to be significantly associated with the first two of these, but not the third (i.e., discriminative validity). Results provided support for all three validational predictions. Deep orgasms (Type I), relative to surface orgasms (Type II), were—as typed by latent class analysis—significantly more likely to occur with partners (with both the first orgasm reported, 70.7 % vs. 48.8 %; $\chi^2(1, n = 135 \text{ orgasms}) = 6.03$, $p < .05$; and the second 72.8 % vs. 34.1 %; $\chi^2(1, n = 135 \text{ orgasms}) = 17.82$, $p < .001$). Also, deep orgasms were significantly more likely to occur with penetrative sexual activities (with both the first orgasm reported, 76.4 % vs. 49.2 %; $\chi^2(1, n = 135 \text{ orgasms}) = 10.74$, $p < .001$, and the second orgasm, 82.1 % vs. 44.2 %; $\chi^2(1, n = 135 \text{ orgasms}) = 19.52$, $p < .001$. Note that for these validations were based on responses from only those women reporting two orgasm types (i.e., not the full complement of

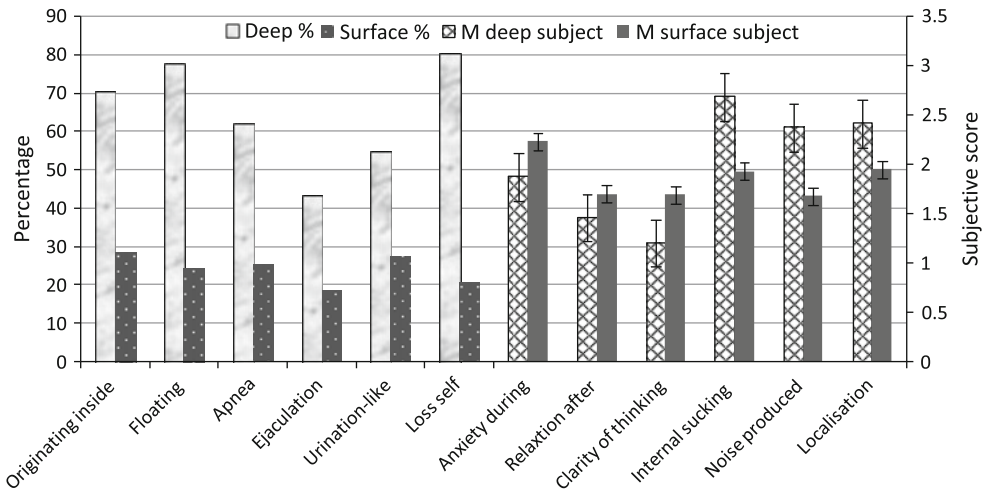

Fig. 1 Comparison of Profiles of Orgasm Typologies, Deep and Surface. The *bars* (either *light grey* or *black* with *white dots*) on the *left*, represent percentage chances of particular sensations (such as floating) or behaviors (such as apnea) being reported. The *bars* (either *hatched* or *dark grey*) on the *right*, display the subjective assessments of the degree of particular sensations, such as degree of relaxation or clarity of thought. The *light grey* and *hatched bars* together (lighter in both cases) represent deep orgasms, the *black/dotted* and *dark grey* ones together (darker in both cases), surface orgasms. *Error bars* on the right—for the subjective measures—show the SEM

Table 8 Comparison of means and SDs of external correlates of orgasm descriptions by orgasm type

External correlate	Orgasm type (heterosexual sex with a partner context)				ANOVA results $F(1, 236)$	Partial η^2
	Type I. Deep orgasms ($n = 165$ orgasms)		Type II. Surface orgasms ($n = 72$ orgasms)			
	M	*SD*	*M*	*SD*		
Vigor of penetration[a]	2.93	0.84	2.67	0.96	4.42*	.018
Attractiveness of partner smell[b]	2.67	0.49	2.42	0.58	11.8**	.048
Partner dominance[c]	3.34	0.92	3.07	0.95	4.22*	.018
Partner considerateness[a]	3.88	0.84	3.51	1.09	8.07*	.033
Partner muscularity[a]	2.58	0.66	2.58	0.65	<1	0.0
Partner masculinity[a]	3.34	0.74	3.28	0.68	<1	.002
Partner aggressiveness[a]	2.25	0.87	2.18	0.074	<1	.001

* $p < .05$, ** $p < .01$

[a] Absolute range, 1–4

[b] Absolute range, 1–3

[c] Absolute range, 1–5

360 orgasms ($n = 135$ orgasms), thereby avoiding the problem of multiple representation of participants. The final validational finding indicated, as predicted, that deep orgasms ($M = 2.65$, $SD = 0.92$) were not significantly harder to generate in terms of time taken to bring them about than surface orgasms ($M = 2.42$, $SD = 0.80$). In this latter case, $n = 251$ because only partnered orgasms were considered.

Hypothesis Testing

The second goal was to determine whether different types of orgasms would be differentially related to putatively evolutionarily salient partner characteristics. If deep orgasms (Type I) are sperm-selecting, as theorized, then these should track key fitness indicators in male partners. Recall that it was predicted that more aggressive, more dominant, more masculine, and more muscular partners and those engaging in more vigorous sex would be associated with deep orgasms. It was also predicted that attractiveness of partner smell and partner considerateness would also be associated with deep orgasms. To test these predictions, MANOVA analyses, with follow-up ANOVAs, were carried out on the 237 orgasms resulting from sex with a partner. The within subjects independent variable (fixed factor) was orgasm type (I/deep or II/surface).

The MANOVA revealed that the effect of orgasm type was significant, $F(7, 236) = 3.23$, $p = .003$, $\eta^2 = .090$, using Wilks' lambda as a statistic. Results of univariate tests, along with mean scores, *SD*, and effect sizes are shown in Table 8. Of the seven dependent variables, four were significantly associated with orgasm type in the manner predicted. Partners who generated deep (Type I) orgasms, relative to those who generated surface (Type II) ones, were described as having a more attractive smell, behaving in a more dominant yet more considerate manner, and as participating in more vigorous penetration. Other dependent variables were found not to be significantly associated with orgasm type, namely, aggressiveness of partner behavior, muscularity, and masculinity.

Discussion

The research presented herein was based on the view that female orgasm, or at least elements of it, may reflect an adaptation sculpted by natural selection in the service of sperm selection and, thereby, fitness enhancement. It had two primary aims. The first was to determine whether different types of female orgasms could be distinguished empirically and, more specifically, whether at least one type discerned might reflect sperm selection; included as part of this effort were tests to validate the typology which emerged. The second primary goal was to test the hypothesis that a sperm-selection type orgasm would be related to evolutionary salient partner characteristics.

Identifying and Characterizing a Typology of Orgasms

When surveyed about their experience of orgasm, women frequently, but not always, reported experiencing more than one type of orgasm. Important to appreciate in this regard is that nothing leading up to the request, within the survey, for a description of a second type of orgasm led the participants to have any idea that the survey was about different types of orgasm. This means that participants did not pre-select to participate in the survey because they knew this was its focus, though it may have led some to fail to complete the survey once this focus became evident. Nevertheless, there seems

little reason to believe that participation was biased as a function of experiencing one or more kinds of orgasms.

Most participants reported two different kinds of orgasms and latent class analysis supported this division. Importantly, this study revealed a typology that was broadly in agreement with that reported by King et al. (2011). In both investigations, two broad kinds of orgasms emerged, those that were experienced deep inside and those that were experienced on the surface. The deep orgasms had a phenomenology that *could* be associated with oxytocin action—something that is known to be associated with female sexual response (Anderson & Dennerstein, 1994, 1995; Blaicher et al., 1999). These phenomenological characteristics included detectable internal spasming, which *could* be a plausible indicator of uterine peristalsis (Fox & Fox, 1971; Fox et al., 1970; Wildt et al., 1998; Zervomanolakis et al., 2007). Further characteristics of deep orgasms included the shuddering of the whole body and feelings of great pleasure, loss of self, and loss of clarity of thought which are *plausible* extensions of the known feelings of pleasure, trust, and merging with another that are correlates of oxytocin production or *plausible* extensions of mammalian behavior under the influence of oxytocin (for a review see Insel, 2010). We emphasize in our use of italics that we are drawing inferences here, as no measurements of oxytocin or any other hormones, such as prolactin (Krüger, Haake, Hartmann, Schedlowski, & Exton, 2002) or any objective physiological measurements were used.

It would be a mistake to argue that some orgasms (i.e., deep ones) were regarded as generally better than others (i.e., surface ones) on all measures. Recall, for example, that surface orgasms were rated as being both more relaxing, as well as more intense and localized, than deep ones; such observations challenge the use of the labels of "good sex" and "not-as-good sex" used in our previous study to describe the two kinds of orgasms identified (King et al., 2011). This would fit with such orgasms being often associated with solitary and (localized) masturbatory sexual experience that focus on the external, and more sensitive, clitoral glans (Schober et al., 2004). There is no implication, here, however, that one type of orgasm is better than the other or more associated with psychological well-being as some have contended (e.g., Brody, 2007; Costa & Brody, 2007), perhaps including ourselves (King et al., 2011). Features like being intense in pleasure and more relaxing, as the surface orgasms appear to be, could be seen as contributing to psychological well-being at least as much as internal spasming and apnea.

Validating the Orgasm Typology

The results of the latent-class analysis identifying two types of female orgasm met face validity criteria given that one type appeared to reflect possible sperm-selecting, oxytocin-influenced deep orgasms. However—even given this—we sought to validate the typology before testing the evolutionary-informed primary hypotheses pertaining to partner characteristics and sexual behavior. Recall that, as predicted, Type I orgasms, which we labelled as "deep" ones, were significantly more likely to occur through penetrative sexual activities involving a partner. Although they took a little longer to bring about than those labelled "surface" ones, the difference was not significant, as predicted. This was the case even when brought about in sexual positions where direct contact with the external part (glans) of the clitoris was not indicated, such as rear-entry (e.g., "doggy-style") sex without additional external stimulation applied.[3] This finding contradicts those versions of female sexual anatomy which deny the importance of internal stimulation (e.g., Masters & Johnson, 1965, 1966). This result is also problematic for those who rely on such anatomical claims, such as the by-product account of female orgasm (Gould, 1987; Lloyd, 2005; Symons, 1979) or for those who do not distinguish masturbatory from copulatory orgasms (e.g., Baker & Bellis, 1993b). Deep orgasms did not occur on every occasion of sexual intercourse with a partner and this is something that attention to evolutionary theory and female choice would predict. Recall that an orgasm-intercourse discrepancy is expected if deep orgasms are part of a facultative adaptation that only performs its function in response to certain partner characteristics in the service of sperm harvesting and fitness enhancement (Puts, 2006, 2007; Puts & Dawood, 2006).

Primary Evolutionary-Based Predictions

A number of potentially evolutionarily salient partner characteristics and behaviors proved to be reliably associated with the putatively sperm-selecting (deep) orgasms. These characteristics were attractive partner smell, perhaps indicating possession of suitable MHC elements (Thornhill et al., 2003; Wedekind & Penn, 2000; Wedekind, Seebeck, Bettens, & Paepke, 1995) or, alternatively, the possession of genes that currently produce fit genotypes regardless of compatibility with the females own genes (Gangestad & Thornhill, 1998; Thornhill & Gangestad, 1999); considerate, yet dominant partner sexual behaviors, perhaps indicating a high quality/status partner willing to invest in potential offspring as well as confidence and self-assurance (Buss, 1989; Fieder et al., 2005; Jozifkova & Flegr, 2006; Jozifkova & Konvicka, 2009); and, finally, vigorous, passionate, penetrative sexual intercourse, perhaps indicative of strength and health (e.g., Dawkins, 2006; Eberhard, 1985).

A number of potentially evolutionarily relevant partner characteristics were not found to be significantly associated

[3] Data are available from the corresponding author.

with deep orgasms, however, thus failing to support hypotheses. These were partner muscularity, masculinity, and aggression. On a final note, each of these factors, bar one (partner muscularity), while not significantly associated with deep orgasms, were rated higher in deep orgasms than surface ones. Perhaps more sensitive measures of partner characteristics and behaviors might reveal further relationships in subsequent research; for example, masculinity could be regarded as ambiguous between morphology and behavior. Other possibilities include the fact that there are other markers of health—such as skin tone—which may be more reliably associated with female preference (Scott, Pound, Stephen, Clark, & Penton-Voak, 2010). Additionally, it should be noted that the aggression of men in their dealings with other men might be found attractive—but that this might not translate into an attractive quality during a sexual encounter.

To be clear, results reported herein do not offer any support for the idea that specifically masculine characteristics, as revealed by noticeable, testosterone-related behaviors or body morphologies, were predictive of sperm-selecting orgasms. Perhaps, as some have argued (e.g., Puts, 2010), conspicuous masculine characteristics, such as large musculature, are more important in intra-sexual aggression than inter-sexual selection (Darwin, 1871). That which intimidates other males may not necessarily be central in stimulating choice in females. This would fit with other findings that female preferences about male body morphology are not as extreme as some males might assume (Frederick, Fessler, & Haselton, 2005; Frederick & Haselton, 2007).

One implication of the findings of the present study might be that anecdotal accounts of male anxiety over sexual performance are explicable responses, given the fitness-related implications of such performances. This phenomenon has been sometimes linked to the "male ego" but this is merely question-begging. Why should the male ego be keyed to female sexual response unless this has fitness implications? After all, in other areas, the male ego—as revealed, for example, by what they lie about in lonely hearts columns—is keyed to characteristics which have fitness implications. Examples include money/status (Borgerhoff Mulder, 1992; Buss, 1989; Fieder et al., 2005; Hopcroft, 2006; Nettle & Pollet, 2008; Pollet & Nettle, 2009) and height (Mueller & Mazur, 2001; Nettle, 2001; Pawlowski, Dunbar, & Lipowic, 2000; Sear, 2006; Shepperd & Strathman, 1989; Sunder, 2006).

Limitations of the Internet Survey

The Internet survey was based on self report. However, the possibility for introspection to bias results was avoided by asking participants to ground reports in distinctive physical sensations and emotional experiences. It was assumed in the present study that females would be capable of acting as a relevant self-measuring instrument, given the idea that female choice in evolution may involve at least some conscious, subjective elements in humans, which can to some extent strategize their choices (Buss, 1998; Buss & Schmitt, 1993; Buss & Shackleford, 2008; Gangestad & Simpson, 2000; Greiling & Buss, 2006).

Perhaps most notably, reported feelings of internal spasming were not the same as demonstrating actual preferential sperm selection via insuck (Fox & Fox, 1971; Fox et al., 1970; Wildt et al., 1998; Zervomanolakis et al., 2007). However, others have demonstrated sperm transport that accompanies such internal spasming, via oxytocin administration, (e.g., Wildt et al., 1998; Zervomanolakis et al., 2007). This is a matter to be ultimately settled by anatomists. Nevertheless, the fact remains that detectable internal spasming sensations accompanied some, but not all, female orgasms. There was within-subject variation in this phenomenon—namely, this sensation tended to occur in the presence of partners demonstrating evolutionarily relevant characteristics but not as often at other times. That these sensations, which are known to be stimulated by oxytocin (Russell et al., 2003; Wildt et al., 1998), were also accompanied by other oxytocin-linked sensations, such as trust and the sense of floating (e.g., Kosfeld, Heinrichs, Zak, Fischbach, & Fehr, 2005), and can, therefore, be taken to be suggestive of some female orgasms being functional.

Future Directions

Masters and Johnson (1965, 1966) believed that they had captured all the relevant phenomena relating to female orgasm, by investigating the effects of limited masturbation in the laboratory. Their research was the underpinning for much subsequent investigation (Levin, 2001) and has informed social and political commentaries on female sexuality ever since (e.g., Hite, 1976; Lloyd, 2005). However, with the neurological (e.g., Komisaruk et al., 2004), anatomical (e.g., O'Connell et al., 1998, 2005; Zaviačičet al., 1988), and behavioral (e.g., Lightfoot-Klein, 1984; McCaughey & French, 2001) data subsequently available to us, their findings stand in need of revision. Indeed, there now seem grounds for arguing that not all female orgasms are the same. Furthermore, there is good reason to believe that the Masters and Johnson (1965, 1966) methodology systematically sidelined key features of evolved anatomy and behavior and thus missed important features of female orgasms. Subsequent research will need to attend to features of ecological and experimental validity and in ways informed by evolutionary thinking to capture these missing elements. Returning female choice to a central place in explanatory mechanisms of human sexual behavior must form a key part of this (Cronin, 1991, 1992; Darwin, 1871; Gowaty, 1997; Hrdy, 1981, 1986; Judson, 2003; Zuk, 2002).

One element in female choice that recent research has made increasingly evident is the role of estral timing on female

sexual preferences and responses (Buss, 2004, DeBruine, Jones, & Perrett, 2005; DeBruine et al., 2005; Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004; Gangestad, Thornhill, & Garver-Apgar, 2005; Haselton & Miller, 2006; Puts, 2005; Thornhill & Gangestad, 1999). Our study did not collect data on whether there were different types of orgasms at peak estrus and it is predicted that in further work the deep orgasms—the putatively sperm-selecting ones—would be more likely at this time given that these are hypothesized to be a response to high quality mates.

Future data collection needs to be handled in ways that are sensitive to the fact that human sexual encounters do not typically take place in dispassionate laboratories. Indeed—and connected to this observation—egregious components of human sexuality that have not been measured in the current study include the roles of imagination, fantasy, and mood. The importance of these can easily be seen by the fact that appropriate visualizations alone can generate orgasm in some females (Whipple, Ogden, & Komisaruk, 1992).

A number of women reported ejaculatory experiences attendant upon orgasm in the current study, consistent with earlier findings (Perry & Whipple, 1981). No fitness-related role is proposed here for this phenomenon and it may well have none. Female ejaculate is not simply urine (Zaviačič et al., 1988) and its production can be enhanced with study (Sundahl, 2003). Might its chemical constitution contribute to making the reproductive tract less hostile to sperm? It would be a pity if mere squeamishness forced researchers to ignore an experience that persistently occurs in a sizeable minority of females and is regarded as important by them (Achille & Wilkinson, 2001).

Finally, the functionality of insuck, linked to oxytocin-consistent phenomenology, has been inferred in these studies but, we emphasize, not shown directly. Baker and Bellis' (1993b) methodology appears unlikely to deliver this—without some modifications—given that it relied on surface masturbation and such orgasms do not appear to capture all of the relevant phenomena in question. Perhaps something closer to the Fox (1976; Fox & Fox, 1971) methodology (i.e., actual coition between partners who knew each other well) is required. However, considerable ingenuity will be needed to measure sperm flowback in a situation of actual coition—or something that closely captures its salient features. Another possibility is to measure oxytocin levels immediately following orgasm—rather than just arousal (Blaicher et al., 1999)—and to administer individually appropriate levels to participants and measure sperm flowback following intercourse. With other mammals (e.g., pigs), reduction of sperm flowback, due to oxytocin levels stimulated by male presence, has been shown to be as much as 18 % (Knox, 2010), although this particular phenomenon has yet to be directly linked to increased fertility; moreover, the best mode of oxytocin administration (e.g. via male presence, physical stimulation or introduction into sperm) is still open to debate (Levis, 2000). Any such research will have to take account of the extreme sensitivity of humans to such issues (Zucker, 2002).

Appendix

Survey Questions and Possible Responses

(1) Did you experience any internal sucking sensations? (1. None, 2. Weak, 3. Moderate, 4. Strong)
(2) How clear was your thinking after orgasm? (1. Total loss of clarity, 2. Clear thought as normally experienced, 3. Clearer-than-normal thinking)
(3) How relaxed did you feel following orgasm? (1.Very relaxed, 2. Somewhat relaxed, 3. Somewhat excited, 4.Very excited)
(4) How relaxed did you feel prior to orgasm? (1.Very relaxed, 2. Somewhat relaxed, 3. Somewhat anxious, 4.Very anxious)
(5) How localised was your orgasm? (1. Very localized, 2. Somewhat localized, 3. Whole body involved)
(6) How noisy were you during orgasm? (1. Not/silent, 2. Somewhat noisy, 3. Very noisy)
(7) Where was the orgasm centered? (On the surface of the genitals vs. Deep inside)
(8) Did you experience any floating sensations following orgasm? (Yes/No)
(9) Did you experience any apnoea (catching of breath) (Yes/No)
(10) Did you experience any sense of loss of self following orgasm? (Yes/No)
(11) Did you ejaculate during orgasm? (Yes/No)
(12) Did you experience a sensation akin to a desire to urinate prior to orgasm? (Yes/No)
(13) How long from the start of sexual intimacy did it take for orgasm to occur? (1. A few minutes, 2. More than a few minutes but less than 10, 3. More than 10 min but less than half an hour, 4. More than 30 but less than 60 min, 5. An hour or more)

Partner questions:

(1) How aggressive was your partner's behavior during sex? (1. Very tender, 2. Somewhat tender, 3. Somewhat aggressive, 4. Very aggressive)
(2) How considerate was your partner's behavior during sex? (1. Very selfish, 2. Somewhat selfish, 3. Somewhat considerate, 4. Very considerate)
(3) How muscular was your sexual partner? (1. Not at all, 2. Not very muscular, 3. Somewhat muscular, 4. Very muscular)
(4) How masculine would you describe your partner as being? (1. Very feminine, 2. Somewhat feminine, 3. Somewhat masculine, 4. Very masculine)

(5) 5) How attractive was your sexual partner's smell? (1. Unattractive, 2. Neither attractive nor unattractive, 3. Attractive)
(6) How dominant was your partner's behavior during sex? (1.Very submissive, 2.Somewhat submissive, 3. Neither dominant nor submissive, 4. Somewhat dominant, 5. Very dominant)
(7) How vigorous was penetration during intercourse—if any? (1.Very gentle, 2. Fairly gentle, 3.Fairly vigorous, 4.Very vigorous)

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