

AN INVESTIGATION OF SELECTED TRADITIONAL  
ASSUMPTIONS ABOUT SEXUAL AROUSAL,  
ORGASM AND PLEASURE

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## **ABSTRACT**

Relatively few studies have been conducted on orgasm, and several traditional assumptions about its relationship to sexual arousal and pleasure have not been empirically confirmed. The majority of orgasm research has focused on orgasmic difficulties in women. Following a review of our current understanding of orgasm and female orgasmic disorder (presented in Manuscript One), this research aimed to test the following assumptions: (a) clitoral stimulation is very important to women's ability to reach orgasm, (b) sexual arousal (and possibly orgasm) decreases genital pain sensitivity and increases pleasurable sensitivity, (c) men's sexual arousal decreases more consistently after orgasm than women's, and (d) orgasms are more pleasurable following a greater build-up of sexual arousal. In Manuscript Two, the literature on female genital mutilation/cutting and surgical restoration of the external clitoris was reviewed, and found to indirectly support the first assumption. Two experimental studies were conducted to investigate changes in sensitivity and sexual arousal/desire, respectively, with masturbation to orgasm in the laboratory. As described in Manuscript Three, the results of the first study contradicted the second assumption: women's genital pain sensitivity increased rather than decreased following masturbation (on the vulvar vestibule, especially with masturbation to orgasm), and pleasurable sensitivity did not change from baseline. As described in Manuscript Four, the results of the second study confirmed the third and fourth assumptions: men and women exhibited a similar pattern of increased sexual arousal and desire during masturbation, but men's sexual arousal decreased immediately after orgasm whereas women's remained elevated. Orgasmic pleasure was related to the build-up of sexual

arousal and desire prior to orgasm in both genders, and in women to a greater post-orgasmic decrease in genital temperature but the maintenance of subjective sexual arousal and desire. In both studies, masturbation enjoyment in the laboratory was similar to that experienced at home, thus supporting the feasibility and ecological validity of conducting orgasm research in the laboratory. The clinical implications of these findings are discussed, as well as areas for future research, which should continue to integrate physiological and subjective measures of sexual experience to increase our understanding of their interaction.

*Keywords:* orgasm, sexual arousal, pleasure, sensitivity, sexual desire

## RÉSUMÉ

Relativement peu d'études ont été menées sur l'orgasme, et plusieurs hypothèses traditionnelles concernant la relation entre l'orgasme et l'excitation et le plaisir sexuel n'ont pas été confirmées de manière empirique. La plupart des recherches ont porté sur l'étude de difficultés orgasmiques chez les femmes. Après une analyse de l'état actuel des connaissances sur l'orgasme et les troubles orgasmiques chez les femmes (présentée dans le premier manuscrit 'One'), cette thèse présente les résultats d'une recherche ayant pour but de tester les hypothèses suivantes: (a) la stimulation du clitoris détermine en grande partie la capacité des femmes à atteindre l'orgasme, (b) l'excitation sexuelle (et peut-être l'orgasme) diminue la sensibilité à la douleur génitale et augmente la sensibilité au plaisir, (c) l'excitation sexuelle diminue après l'orgasme de manière plus cohérente chez les hommes que chez les femmes, et (d) les orgasmes sont plus agréables à la suite d'une plus grande accumulation d'excitation sexuelle. Dans le deuxième manuscrit ('Two'), la littérature sur les mutilations et les restaurations génitales, y compris les chirurgies du clitoris externe, a été examinée, et celle-ci soutient indirectement la première hypothèse. Deux études expérimentales en laboratoire ont été menées pour étudier les changements de sensibilité et d'excitation sexuelle et du désir, respectivement, avec la masturbation jusqu'à l'orgasme. Le troisième manuscrit ('Three') démontre en quoi les résultats de la première étude contredisent la deuxième hypothèse: la sensibilité à la douleur génitale chez les femmes est augmentée plutôt que diminuée suivant la masturbation (sur le vestibule vulvaire, en particulier avec la masturbation jusqu'à l'orgasme) et la sensibilité au plaisir reste inchangée. Le quatrième manuscrit

('Four') décrit comment les résultats de la deuxième étude ont confirmé les hypothèses trois et quatre: les hommes et les femmes présentent une tendance similaire quant à l'augmentation de l'excitation sexuelle et du désir pendant la masturbation, mais l'excitation sexuelle des hommes diminue immédiatement après l'orgasme alors que l'excitation sexuelle des femmes reste élevée. Le plaisir orgasmique est lié à l'accumulation d'excitation sexuelle et du désir avant l'orgasme chez les deux sexes. Chez les femmes, le plaisir orgasmique est lié à une diminution post-orgasmique de la température génitale, mais l'entretien de l'excitation sexuelle et du désir subjectifs. Dans les deux études, le plaisir masturbatoire analysé en laboratoire était semblable à celui évalué au domicile des participants, renforçant ainsi la faisabilité et la validité scientifique de mener des recherches sur l'orgasme en laboratoire. Les implications cliniques de ces résultats sont discutées, ainsi que les domaines de recherche futurs visant à continuer à intégrer des mesures physiologiques et subjectives sur l'expérience sexuelle.

*Mots-clés:* l'orgasme, l'excitation sexuelle, le plaisir, la sensibilité, le désir sexuel

## **GENERAL INTRODUCTION**

Orgasm is considered the peak of sexual pleasure and is a highly valued event for many men and women (Graham, 2010). Despite its importance, it remains the least well-understood sexual response (Bancroft, 2009). Relatively little empirical research has been conducted on orgasm, and current knowledge continues to rely heavily on Masters and Johnson's (1966) observations of men and women's patterns of sexual response, and on other research using retrospective reports of subjective orgasm experience. The majority of empirical and theoretical publications on orgasm have focused on orgasmic difficulties in women.

Female orgasmic disorder (FOD) is the second most common sexual difficulty in women after low sexual desire, and considerable efforts have been undertaken to understand and treat this disorder. It will likely be defined in the upcoming fifth version of the Diagnostic and Statistical Manual of the American Psychiatric Association (DSM-5) as delayed or absent orgasm and/or orgasms that are reduced in intensity, occurring on the majority (75% or more) of occasions of sexual activity, for 6 months or longer, with significant associated personal distress or impairment (Graham, 2010). As presented in Manuscript One, few factors have been identified that differentiate women with difficulty reaching orgasm from their more easily-orgasmic counterparts. There is some evidence, however, that orgasmic functioning in women is heritable and positively related to sexual autonomy, genital self-image, greater emotional intelligence, and relationship satisfaction, and negatively related to cognitive distraction during sexual activity. The treatments that have been developed for FOD (e.g.,

psychotherapy including directed masturbation), often improve other aspects of sexual functioning and satisfaction more than orgasmic functioning itself. It is possible that treatment efficacy would be improved by increasing our knowledge of orgasm in healthy populations.

To this end, I identified several gaps in the literature on orgasmic functioning, where traditional assumptions about sexual arousal, orgasm and sexual pleasure have not been confirmed experimentally. The goal of the present research was to test the following assumptions:

1. Stimulation of the external clitoris is very important to women's ability to reach orgasm.
2. Sexual arousal decreases genital pain sensitivity and increases pleasurable sensitivity.
3. Orgasm decreases peripheral pain sensitivity but may make genital stimulation aversive.
4. Men's sexual arousal consistently decreases after orgasm, whereas women's can remain elevated, thus allowing for additional orgasms.
5. Orgasms are more pleasurable and satisfying following a greater build-up of sexual arousal prior to orgasm.
6. Studying orgasm under controlled laboratory conditions is not ecologically valid.

My colleagues and I explored the first assumption listed above in Manuscript Two, a review of the literature on the effect of female genital mutilation/cutting (FGM/C) on orgasm. This is an unfortunate phenomenon but

provides an indirect test of the importance of direct and/or indirect stimulation of the clitoris in facilitating women's orgasm, since it typically involves excision of the external clitoris. It was not feasible to study this topic in the laboratory since Montreal does not have a large population of affected women or a FGM/C clinic from which to recruit participants.

An alternative way to increase our understanding of orgasm is to study it in the laboratory. I therefore designed an experimental paradigm involving private masturbation in the laboratory to investigate the other assumptions, in two studies (presented in Manuscripts Three and Four).

The laboratory setting allows for standardized measurement and prospective self-reports from participants. It may be particularly important to study orgasm prospectively, since it involves a degree of impaired consciousness (Bancroft, 2009) that could decrease the reliability of long-term memory of orgasm quality and related processes. Despite the numerous advantages of studying orgasm in the laboratory, it has not been established to what extent it is possible to simulate orgasm at home. In addition, the laboratory environment may affect men and women differently, thereby minimizing or maximizing authentic gender differences. The ecological validity of the paradigm used in these studies was therefore tested by comparing the masturbation enjoyment and orgasm quality that participants experienced in the laboratory to that experienced during masturbation at home.

The first of these studies is presented in Manuscript Three. In this study, my colleagues and I investigated the effect of masturbation to high levels of sexual arousal and orgasm on healthy women's genital and non-genital sensitivity.

The second of these studies is presented in Manuscript Four. In this study, my colleagues and I investigated men and women's patterns of sexual arousal, desire and orgasm during masturbation to orgasm in an attempt to replicate Masters and Johnson's (1966) observation that men's sexual arousal decreases more consistently after orgasm than women's. We also explored the predictors and correlates of orgasmic pleasure.

In both of these studies, participants were instructed to masturbate in their typical fashion in order to maximize their chances of reaching orgasm and to recreate as closely as possible masturbation at home. Standardized measurement of sensitivity (Manuscript Three) and physiological sexual arousal (Manuscript Four) were conducted at baseline, before orgasm (at "almost-orgasm"), and after orgasm. Participants were instructed to masturbate until almost reaching orgasm in an attempt to elicit a high level of sexual arousal, as well as to differentiate the effects of orgasm from those of masturbatory stimulation. Since the relationship between sexual arousal and orgasm is not fully understood, and extremely high levels of sexual arousal are not always required for orgasm to occur (Bancroft, 2009), we instructed participants to masturbate until very near to orgasm rather than to a certain level of sexual arousal.

The following manuscript presents our current knowledge on orgasm and FOD.



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## MANUSCRIPT ONE

### DISORDERS OF FEMALE ORGASM

Paterson, L. Q. P., Sarin, S., & Binik, Y. M. (accepted). Disorders of female orgasm. In K. Anunta (Ed.) *Female Reproductive and Sexual Medicine*. New York: Humana Press, Inc.

## Abstract

Orgasm is a complex experience involving both subjective and physiological changes, typically including feelings of intense pleasure and rhythmic pelvic floor muscle contractions. Women reporting orgasmic difficulties vary considerably with respect to their orgasmic impairment, and a thorough assessment can uncover the causal and maintaining factors contributing to the problem (e.g., cognitive distraction during sexual activity, inadequate sexual technique, medication side effects). The diagnosis of female orgasmic disorder (FOD) is appropriate for women who have experienced a lack of orgasm, or orgasms that are infrequent, markedly delayed or diminished in intensity, for 6 months or longer on the majority (75% or more) of occasions of sexual activity, with significant associated personal distress or impairment. The best treatment for FOD appears to be psychotherapy, including directed masturbation, which has been shown to be most effective in women with lifelong, as opposed to acquired, FOD. No pharmacological treatment for FOD has been shown to be more effective than placebo. There is a need for more methodologically consistent research on this problem and, until we know more about how orgasm is inhibited, our patients would best be served by validating their desire to experience this pleasurable event, but working with them and their partners to make sexual activity more pleasurable and satisfying for them whether or not they reach it.

*Keywords:* orgasm, orgasmic difficulties, female orgasmic disorder, sexual dysfunction, sexual distress, sex therapy, cognitive-behavioural therapy

## Disorders of Female Orgasm

*Orgasm is no proof of love... Orgasm is no proof of anything. Orgasm is proof of orgasm. Someday every woman will have orgasms... like every family has color TV... and we can all get on with the real business of life.*

– Erica Jong (1977)

Unlike sexual desire and arousal, orgasm is a discrete event that is not necessary for sexual activity to be enjoyable. Nevertheless, the experience of orgasm is highly valued for many women, and many of those who have difficulty reaching it present clinically in the hopes of improving their orgasmic functioning. Their dissatisfaction may be due to an absence of orgasm, difficulty or delay in reaching orgasm, or diminished/absent orgasmic intensity or pleasure (i.e., anhedonic orgasm). These difficulties may be lifelong (primary) or acquired (secondary, having developed after a period of satisfactory orgasmic functioning). In addition, they may be present during all situations or sexual activities (generalized), or during some but not others (e.g., partnered sex, but not masturbation; situational).

While clinicians and researchers depend on women to accurately report whether or not they are experiencing orgasm, many women are unable to do so with certainty (Bancroft, 2009). Even experts in the field disagree about what characterizes an orgasm, and a multitude of definitions have been proposed that have typically emphasized either its physiological or psychological components (Mah & Binik, 2001). One of the challenges in establishing an integrated, biopsychosocial definition is that the changes ascribed to orgasm differ depending on whether one defines orgasm as beginning when the woman first perceives it or

when the first physical signs of orgasm occur (Meston, Levin, Sipski, Hull, & Heiman, 2004). A group of sexuality researchers' synthesis of the current knowledge on female orgasm culminated in the following definition: "An orgasm in the human female is a variable, transient peak sensation of intense pleasure, creating an altered state of consciousness, usually with an initiation accompanied by involuntary, rhythmic contractions of the pelvic striated circumvaginal musculature, often with concomitant uterine and anal contractions, and myotonia that resolves the sexually induced vasocongestion (sometimes only partially), usually with an induction of well-being and contentment" (Meston et al., 2004). Their cautious wording acknowledges the considerable variability that exists in women's orgasmic response. This chapter will present our current understanding of female orgasm and orgasmic difficulties, followed by guidelines for their assessment and treatment.

### **Female Orgasm and Orgasmic Difficulties**

#### **Triggers and Mechanisms of Orgasm**

Orgasm is typically elicited by stimulation of the clitoris or vagina (especially its anterior wall), but it has also been reported to occur following stimulation of the periurethral glans, breast/nipple, or mons, and through mental imagery, fantasy, hypnosis, and an extremely variable group of tactile, visual and auditory stimuli ("hyperesthesia sexualis"), as well as spontaneously and during sleep (for a review, see Meston et al., 2004). Although models of sexual response since Masters and Johnson's seminal publication in 1966 have reflected the more common pattern of a high level of genital arousal preceding orgasm, the varied levels of arousal associated with the situations listed above illustrates that this is

not always required. High levels of arousal are, of course, also no guarantee of orgasm.

The likelihood of orgasm differs by type of genital stimulation and context (i.e., alone or with a partner). More women consistently (i.e., usually to always) reach orgasm during masturbation, which typically involves external stimulation of the clitoris (Lloyd, 2005), than during sexual activity with a partner, especially if this does not include oral or manual clitoral stimulation. Despite the fact that the clitoris may be indirectly or directly stimulated during vaginal intercourse (Mah & Binik, 2001), one-third of women rarely or never reach orgasm during intercourse (for a review, see Lloyd, 2005). A recent study found that orgasmic consistency rates for masturbation were approximately 63%, while those for vaginal intercourse were only approximately 37%, with a slightly higher rate of approximately 41% for other partnered sexual activities (e.g., oral or manual stimulation; Zietsch, Miller, Bailey, & Martin, 2011). In an Australian survey, women were most likely to have experienced orgasm at their last heterosexual encounter if it included oral and/or manual stimulation either alone (84%) or in addition to vaginal intercourse (76%), as compared to vaginal intercourse only (50%; Richters, Visser, Rissel, & Smith, 2006). Recent American and Swedish surveys also found higher orgasm rates when women engaged in a greater number of sexual behaviours (Fugl-Meyer, Oberg, Lundberg, Lewin, & Fugl-Meyer, 2006; Herbenick et al., 2010). There is some evidence that women who have undergone female genital mutilation/cutting, which typically involves excision of the external clitoris, have lower rates of orgasm, thus providing additional indirect

evidence of the importance of clitoral stimulation to orgasm (Paterson, Davis, & Binik, 2012).

Several mechanisms of orgasm have been proposed, generally involving a reflex triggered by a build-up of sexual excitement, but what exactly initiates orgasm remains unknown (Meston et al., 2004). Laboratory research on women with spinal cord injuries, approximately 50% of whom can reach orgasm, suggests that orgasm is an autonomic nervous system reflex that depends on an intact sacral reflex arc (in women who used clitoral, vaginal and/or breast self-stimulation to reach orgasm; Sipski, Alexander, & Rosen, 2001); however, there is also some evidence that the vagus nerves provide a sensory pathway directly from the cervix to the brain in women with partial or complete spinal cord injuries who experience orgasm through vaginal-cervical stimulation (e.g., Komisaruk et al., 2004). A willingness to lose control has often been cited as necessary for orgasm to occur (e.g., Bancroft, 2009), and recent brain imaging studies support this theory: in both men and women, deactivation occurs in the left ventromedial and orbitofrontal cortex at orgasm, areas that are associated with behavioural control (Georgiadis et al., 2006; Georgiadis, Reinders, Paans, Renken, & Kortekaas, 2009).

### **Correlates of Orgasmic Functioning**

Increasing age is correlated with having ever had an orgasm: Kinsey and colleagues found that 23% of women had experienced orgasm by the age of 15, 53% by the age of 20, 77% by the age of 25 and about 90% by the age of 35 (Kinsey et al., 1953). They estimated that 9% of women “would probably not reach orgasm in the course of their lives” (p. 513). Although, now 60 years later,

women are likely experiencing their first orgasms earlier, the number of women with lifetime anorgasmia does not appear to have decreased (Bancroft, 2009).

Few psychological factors have been associated with orgasmic functioning in particular. A recent large twin study found that partnered and masturbatory orgasm rates were significantly heritable but not related to demographic or personality traits (Zietsch et al., 2011). However, there is some evidence that a more positive genital self-image (Herbenick & Reece, 2010) and greater emotional intelligence (the ability to identify and manage one's own and others' emotions; Burri, Cherkas, & Spector, 2009) are associated with higher orgasm rates. Cognitive distraction during sexual activity, which can be due to body image as well as performance concerns, has been linked to lower orgasmic consistency (Dove & Wiederman, 2000), as have introversion, emotional instability, and low openness to new experiences (to orgasm rates during vaginal intercourse specifically; Harris, Cherkas, Kato, Heiman, & Spector, 2008).

Although Freud's notion that women who are able to have "clitoral" but not "vaginal" orgasms have not yet reached psychosexual maturity (Freud, 1905) has been largely abandoned (Graham, 2010), one research group has found that those who reported reaching orgasm through vaginal intercourse without concurrent manual clitoral stimulation endorsed fewer immature psychological defenses, such as excessive fantasy or dissociation, than those who did not (Brody & Costa, 2008; Costa & Brody, 2010). It has been argued, however, that it is instead increased sexual autonomy (having a sense of control over sexual behaviours, which is related to greater sexual pleasure and arousal; Sanchez, Crocker, & Boike, 2005; Sanchez, Kiefer, & Ybarra, 2006), that permits women



to obtain adequate stimulation during partnered sex and increase their probability of orgasm (Laan & Rellini, 2011). In support of this perspective, partnered orgasmic consistency has been found to be higher in young women who are more willing to communicate their preferred sexual activities and engage in direct clitoral (self-) stimulation with a partner (McIntyre-Smith, 2010). These behavioural skills appear to depend on having the knowledge that clitoral stimulation facilitates orgasm and positive attitudes towards this type of stimulation (i.e., as would be predicted from an information-motivation-behavioural skills model; McIntyre-Smith, 2010; Fisher, Fisher, & Harman, 2003). Similarly, women who are happier and more satisfied with their relationships report more consistent partnered orgasms, likely also because of increased communication of desired stimulation (Mah & Binik, 2001).

Anatomical differences may also explain why some women find it easier than others to reach orgasm during vaginal intercourse alone (i.e., without concurrent manual clitoral stimulation). In 20 healthy women reporting high orgasmic functioning, having ever experienced such an orgasm was associated with having a thicker urethrovaginal space as measured by introital ultrasonography, which may reflect the presence of more extensive clitoral bulbar or anterior vaginal tissue (Gravina et al., 2008). In addition, greater frequencies of orgasm during intercourse have been reported by women with a smaller distance between the clitoris and the urethra, likely due to increased external and/or internal clitoral stimulation during thrusting (Wallen & Lloyd, 2011).

### **Prevalence and Correlates of Orgasmic Difficulties and Distress**

As with orgasm itself, orgasmic difficulties have been operationalized in a wide variety of ways, and the inconsistent inclusion criteria (e.g., required duration, frequency of orgasmic difficulty, level of associated distress) employed by different studies limits the usefulness of aggregating their findings. Community prevalence rates of women's orgasmic difficulties using nationally representative samples have ranged from 4 to 34% (Graham, 2010), and are typically second only to those for low sexual desire (West, Vinikoor, & Zolnoun, 2004). Sexual desire and arousal complaints are highly comorbid with orgasmic difficulties (e.g., Nobre, Pinto-Gouveia, & Gomes, 2006) and one would not expect women experiencing impaired sexual desire or arousal to easily reach orgasm; however, these epidemiological studies have typically neglected to identify the primary sexual problem in women who reported more than one concern (Graham, 2010). Our knowledge of the psychosocial and physical factors that negatively affect sexual functioning in general (e.g., poor physical and mental health, relationship difficulties; Graham, 2010) therefore still far exceeds that for orgasm in particular.

Some physical factors can be associated with an impairment of only orgasm [such as the use of selective-serotonin reuptake inhibitor (SSRI) medication; Rosen, Lane, & Menza, 1999]; however, as of yet, there is little consistent evidence that psychosocial factors (e.g., age) alone differentiate women with and without orgasmic difficulties (Graham, 2010). Recent research has found a link between child sexual abuse and lower orgasmic function, but only in women who also avoid interpersonal closeness (Staples, Rellini, & Roberts, 2012). Although anxiety, cognitive distraction, and sexual inhibition are

negatively associated with all aspects of sexual functioning, a fear of “letting go” or “losing control” is thought to particularly contribute to orgasmic problems (Bancroft, 2009).

On average, half of women who report orgasmic difficulties experience significant associated distress (Graham, 2010). It is noteworthy that, in general, women’s levels of sexual distress have been found to be predicted by the presence of a lack of emotional well-being and negative emotional feelings during partnered sexual activity, but not by the physical aspects of sexual response, including orgasmic frequency (Bancroft, Loftus, & Long, 2003). Although orgasmic functioning is, on average, related to sexual satisfaction (Fugl-Meyer et al., 2006), the degree of importance women and men attach to female orgasm varies considerably (Bancroft, 2009). Women who highly value personally reaching orgasm, or who have partners who do, are likely particularly vulnerable to becoming distressed should they experience orgasmic difficulties (Graham, 2010). In a representative British survey, 28.6% of women and 37.4% of men agreed or strongly agreed that “sex without orgasm cannot be really satisfying for a woman” (Wellings, Field, Johnson, & Wadsworth, 1994). A recent American survey asked women how important each of four factors was to their sexual happiness: only 29% rated “[having] an orgasm” as very or extremely important, in comparison to “[feeling] emotionally close to your partner” (83%), “[having] your partner be sexually satisfied” (78%), and “[feeling] comfortable talking to your partner about sex” (61%; Bancroft, Long, & McCabe, 2011).

Distress about orgasmic difficulties may also be related to the extent to which a woman has internalized cultural messages about female orgasm. A recent

study on the social representations of female orgasm compared the thematic content of interviews with 50 British women about orgasm to that of the writing about female orgasm in two women's magazines over the last 30 years (Lavie-Ajayi & Joffe, 2009). In both the interviews and the magazines, orgasm was deemed a central indicator of sexual pleasure and the goal of sex. The women who were experiencing orgasmic difficulties reported associated feelings of shame, but not personal sadness. This suggests that, among these women, it was their perception of external pressure to have an orgasm rather than their own unmet expectations that led to distress.

### **Assessment of Orgasmic Difficulties**

It is likely that a woman's distress must reach a certain threshold before she consults for orgasmic difficulties. When assessing such a woman, the clinician's role is to first determine whether the problem is indeed primarily one of orgasm, rather than due to insufficient stimulation, sexual desire and/or arousal, and if so, whether it warrants a diagnosis of Female Orgasmic Disorder (FOD). With a thorough assessment, the clinician can develop hypotheses about the causal and maintaining factors contributing to the problem (e.g., cognitive distraction during sexual activity, poor sexual technique, medication side effects), and tailor treatment to address these issues or refer the woman to the appropriate specialist. Given that she may not know whether she is experiencing orgasm, the clinician must have an understanding of the physiological and subjective signs of orgasm, presented in the following section, to be able to ask her whether or not they are occurring.

### **Signs of Orgasm**

**Physiological changes at orgasm.** Masters and Johnson (1966) were the first to document the physiological changes that accompany orgasm in women, and their original observations have been largely confirmed over the last 40 years. Genital changes at orgasm typically include rhythmic contractions of the outer third of the vagina and rectal sphincter due to pelvic striated muscle contractions, expulsive contractions of uterine smooth muscle, dilation of the cervical os immediately after orgasm lasting 20 to 30 minutes, and no specific change in the clitoris or labia (Meston et al., 2004). Masters and Johnson (1966) found that the physiological changes associated with clitorally- and vaginally-stimulated orgasms were identical, and their speculation that the clitoris is stimulated vaginally has been supported by the recent discovery of the extent to which the clitoral bulbar tissue extends internally (O'Connell, Sanjeevan, & Hutson, 2005). There is also no consistent evidence that there is a distinct anatomical structure in the vagina (i.e., the “G-spot”) responsible for “vaginal” orgasms (Meston et al., 2004). Some women emit urethral fluid (“ejaculate”) at orgasm, generally following stimulation of the anterior vaginal wall, and research on whether the fluid originates from the bladder or the paraurethral glands has yielded inconsistent results (Mah & Binik, 2001).

Extragenital changes at orgasm include a peak of respiration rate, blood pressure, heart rate, and “sex flush” (vasocongestion of the skin), rapid detumescence of areolar congestion leading to transient corrugation, contractions in the neck, face, arms, hands or legs possibly becoming spastic, and no specific change in the breasts or nipples (Meston et al., 2004). Preliminary research on the effect of orgasm on sensitivity have found that it increases peripheral pain

thresholds (Whipple & Komisaruk, 1985) and genital vibratory detection thresholds (Gruenwald, Lowenstein, Gartman, & Vardi, 2007), i.e., decreases sensitivity. The hormonal changes accompanying orgasm include an increased secretion of prolactin, oxytocin, vasopressin, and plasma vasoactive intestinal polypeptide (Meston et al., 2004). The increase in prolactin during sexual activity is specific to orgasm for both women and men, and appears to lead to feelings of sexual satiety by offsetting the central dopamine increases that accompany sexual arousal (Krüger, Haake, Hartmann, Schedlowski, & Exton, 2002). In one study, women and men's prolactin release following orgasm during intercourse was five times greater than that following orgasm during masturbation (Brody & Kruger, 2006). Although not evaluated in this study, it is possible that orgasms experienced during partnered sex typically follow a longer period of sexual stimulation and an increased level of sexual arousal, as compared to those experienced during masturbation, and this increased arousal might result in a greater dopamine-offsetting prolactin release.

Masters and Johnson (1966) noted that after orgasm, genital vasocongestion is less quick to dissipate in women than in men, and that women do not exhibit the refractory period characteristic of men, meaning that they remain receptive to further stimulation and can experience multiple orgasms in quick succession. Some women do, however, describe a refractory period, while some men do not, and there is a need for further research to understand individual variation in post-orgasmic sexual responsiveness (Bancroft, 2009; Levin, 2009).

Unlike men, who generally ejaculate with orgasm, there is no visible indication that a woman has had an orgasm, which explains why women are more

likely to be unsure of whether or not it has occurred (Bancroft, 2009). A recent study investigated whether the frequency of the involuntary pelvic floor muscle contractions associated with orgasm are specific to and could be considered a marker of orgasm in women (van Netten, Georgiadis, Nieuwenburg, & Kortekaas, 2008). Women were clitorally stimulated by their partners while changes in their rectal pressure, an index of pelvic floor muscle activity, were measured with a rectal probe. They experienced the fastest (alpha) fluctuations in rectal pressure only during orgasm, but not during voluntary imitation of orgasm or failed orgasm attempts, and these fluctuations were interpreted as reflecting the involuntary contractions accompanying orgasm.

Since female orgasm is not essential for reproduction, numerous, hotly-debated theories have been proposed to explain its existence, including that these involuntary muscle contractions cause an “upsuck” or semen into the uterus at orgasm. Upon reviewing the evidence in support of these theories, however, Lloyd (2005) concluded that female orgasm has no evolutionary purpose and is simply an artifact of the parallel initial stage of embryonic development between males and females, during which the nerve and tissue pathways are established for orgasm (akin to male nipples, which serve a purpose only in the female). This interpretation of the literature is, however, not universally accepted (e.g., Puts & Dawood, 2006). On the other hand, regardless of whether or not female orgasm is an adaptation, the pleasurable feelings associated with orgasm may motivate both women and men to engage in sexual activity with their partners.

**Subjective experience of orgasm.** Available evidence indicates that women and men’s subjective experience of orgasm, involving feelings such

pleasure and release of tension, is more similar than different. An early study found that female and male obstetrician-gynecologists, psychologists, and medical students were equally unable to differentiate between the descriptions of orgasm written by female and male college students (Vance & Wagner, 1976). More recently, a two-dimensional model of orgasm was found to describe both male and female college students' orgasms during masturbation and sex with a partner (Mah & Binik, 2002). Participants rated the degree to which a list of adjectives related to the sensory dimension (i.e., building, flooding, flushing, shooting, and throbbing sensations, and general spasms) and to the cognitive-affective dimension of orgasm (i.e., pleasurable satisfaction, relaxation, emotional intimacy, and ecstasy) described their most recent orgasm experiences; the only meaningful difference was in men's greater "shooting" ratings, likely due to concurrent ejaculation. Women and men both provided similar sensory ratings for orgasms experienced during masturbation and sex with a partner, and greater emotional intimacy ratings for sex with a partner.

Orgasmic pleasure, satisfaction and intensity are highly related aspects of the orgasm experience (Mah & Binik, 2005), and have been found to be positively correlated in women with the extent to which heart rate increases during sexual activity (Alzate, Useche, & Villegas, 1989; Levin & Wagner, 1985), testosterone levels (van Anders & Dunn, 2009), as well as the cognitive-affective aspects of orgasm (but not the sensory aspects or the anatomical location of orgasmic sensations) and relationship satisfaction (Mah & Binik, 2005). Relationship happiness may enhance the subjective and emotional qualities of orgasm directly and/or indirectly via increased disinhibition and relaxation during partnered



sexual activity (Mah & Binik, 2001). Retrospectively, orgasms elicited by direct external clitoral stimulation have been described as more localized and intense, sharper, and more satisfying physically, while orgasms experienced during vaginal intercourse have been described as more diffuse and “whole-body” or “deeper”, throbbing, stronger, longer-lasting, and more satisfying psychologically, although reported sensations can be highly variable (Mah & Binik, 2001).

### **Clinical Assessment Recommendations**

Although some women will spontaneously report difficulties with sexual functioning, many will not, either because they are too uncomfortable or embarrassed to bring such personal matters up with their clinician, or because they believe that no treatment exists. It has been shown that patients visiting their gynecologists for routine care feel that it is important that health care providers ask specific, detailed questions about their sexual function (Leonard & Rogers, 2002). Even if there is time for a thorough assessment, gynecologists often lack education about where to refer patients with sexual dysfunction (Leonard & Rogers, 2002); thus, it is important for clinicians to familiarize themselves with local treatment resources to be able to provide specific referral information to women reporting sexual difficulties.

A general question about sexual functioning and satisfaction should be integrated naturally into every clinical assessment (i.e., “How satisfied are you with your sexual functioning?”). Women reporting dissatisfaction should be queried about whether it is related to how much sexual desire they feel, their ability to become sexually aroused, and/or their ability to reach orgasm, as well as to their level of psychological and physical comfort experienced during sexual

activity. Recommended assessment questions for women reporting orgasmic difficulties are listed in Table 1.

In order to put the woman at ease, the clinician should ask questions in a direct manner and sensitively validate her concerns. A detailed interview will not only determine the characteristics of the problem, but also the etiological and maintaining factors that, if unaddressed, may act as barriers to its treatment. Whenever possible, it is helpful to also assess the woman's partner to gain better insight into their relationship dynamics and whether he or she also has any sexual problems. Three cases illustrating the range of possible clinical presentations for women with orgasmic complaints are presented in Appendix 1: the first (Alison) describes a lifelong lack of orgasm, while the second and third (Sara and Brooke) report acquired orgasmic difficulties.

Determining whether a woman fulfills diagnostic criteria for an orgasmic disorder (described in the following section) is often a necessary but not sufficient step in her assessment. While self-report measures, such as the Female Sexual Function Index (Rosen et al., 2000), yield insufficient information on their own, they are useful to establish baseline functioning and later monitor treatment-induced changes. Other potentially relevant assessment instruments are listed throughout Appendix 1.

### **Diagnostic Criteria for Female Orgasmic Disorder (FOD)**

The traditional model of sexual dysfunction in both women and men is largely based on the assumption that sexual desire, arousal and orgasm occur in a linear progression and that problems in these domains are discrete and can be separated for diagnostic and treatment purposes (Kaplan, 1974; Masters &

Johnson, 1966, 1970). The two most widely-used classification systems for the diagnosis of sexual dysfunction are the *International Classification of Diseases* (ICD-10; World Health Organization, 1992) and the *Diagnostic and Statistical Manual of Psychiatric Disorders*, for which a fifth edition is soon to be published (DSM-5; Graham, 2010). The DSM-5 proposed diagnostic categories acknowledge the circularity of women's sexual response and combine sexual desire and arousal disorders ("Sexual Interest/Arousal Disorder"; Brotto, 2010); however, Female Orgasmic Disorder remains a separate diagnosis.

In the ICD-10, a diagnosis of Orgasmic Dysfunction in a man or a woman is indicated simply when "orgasm either does not occur or is markedly delayed" (World Health Organization, 1992). The proposed DSM-5 diagnostic criteria is more detailed, and all three of the following must be fulfilled for a diagnosis of FOD:

*Criterion A:* Presence of at least one of the two following symptoms for a minimum duration of approximately 6 months, and experienced on all or almost all (approximately 75%) occasions of sexual activity:

- 1) Marked delay in, marked infrequency, or absence of orgasm.
- 2) Markedly reduced intensity of orgasmic sensation.

*Criterion B:* The problem causes clinically significant distress or impairment.

*Criterion C:* The sexual dysfunction is not attributable to a non-sexual psychiatric disorder, by the effects of a substance/medication, by another medical condition, by severe relationship distress (e.g., partner violence), or other significant stressors (Graham, 2010).

Duration and frequency requirements not present in the DSM-IV-TR (American Psychiatric Association, 2000) have been added in Criterion A to ensure that the difficulty is stable rather than a recent and potentially transient development (Graham, 2010). Criterion B now requires “distress or impairment” rather than “distress or interpersonal difficulty”, so as not to pathologize a woman who is not personally bothered or affected by her orgasmic functioning. (When it only dissatisfies her partner, there is still a clinically significant issue, but it is relational and due to discordant sexual values and expectations.) New severity specifiers (*Mild*, *Moderate*, and *Severe*) are used to specify the woman’s amount of distress over her symptoms in Criterion A. The etiological specifier (i.e., whether the disorder is due to psychological or combined psychological and medical factors) in the DSM-IV-TR has been deleted, as the cause and the relative contributions of physiological and psychological factors can rarely be determined with certainty (Graham, 2010). The Lifelong vs. Acquired subtypes and Situational vs. Generalized specifier have been retained to differentiate between women who have always experienced FOD and those who developed it after a period of satisfactory orgasmic functioning, and women who have difficulties reaching orgasm in all sexual situations and those who are able to experience orgasm in some situations but not others, respectively. Finally, the following new dimensional specifiers have been added to highlight factors relevant to etiology and treatment: *Partner factors*, *Relationship factors*, *Individual vulnerability factors*, *Cultural/religious factors*, and *With medical factors relevant to prognosis, course or treatment*.

The Lifelong *vs.* Acquired subtypes and Generalized *vs.* Situational specifier have historically been conflated. For example, the diagnosis of lifelong/primary FOD has often been given only to “preorgasmic” women, i.e., who have never experienced an orgasm in any situation. As compared to the recommended diagnostic criteria listed above, which include women who experience marked orgasmic delays, infrequency, or mildness, this is a very limited definition of this FOD subtype. In contrast, the term acquired/secondary FOD has been applied to a wide range of women, not only to those who have previously been satisfactorily orgasmic but are currently experiencing orgasmic difficulties, but also to those who are orgasmic by themselves but not with a partner (Situational FOD), and those who are orgasmic only through restricted methods of stimulation (e.g., direct clitoral stimulation). The latter case is a normal variation in orgasmic functioning and does not by itself qualify a woman for a diagnosis (Graham, 2010). As will be discussed in the Treatment section, this issue makes it very difficult to interpret and compare across previous studies of acquired FOD.

Although the above DSM-5 recommendations improve upon the DSM-IV-TR criteria, the clinician must still rely on his or her judgement to decide whether a woman is experiencing a “marked delay in orgasm,” “marked infrequency of orgasm,” or “markedly reduced intensity of orgasmic sensation,” as there are few available data on normative orgasmic functioning (Graham, 2010). In addition, it can be difficult to determine if she is experiencing adequate stimulation and whether low levels of sexual desire or arousal are responsible for the orgasmic difficulties (Graham, 2010; Laan & Rellini, 2011); in the latter case, a primary

diagnosis would be SIAD can be made, with secondary Female Orgasmic Disorder. Regardless of whether she meets diagnostic criteria, a woman who presents with distress about her orgasmic functioning should receive treatment targeted at the root of this distress (which may be unrealistic expectations, difficulty becoming aroused, etc.).

## **Treatment of Female Orgasmic Disorder**

### **Pharmacological Treatment**

Although some pharmacological treatments have been shown in randomized, placebo-controlled trials to improve orgasmic functioning in women with no sexual complaints (sildenafil; Caruso, Intelisano, Farina, Di Mari, & Agnello, 2003) or postmenopausal sexual desire disorders e.g., testosterone patches; Basson, Wierman, van Lankveld, & Brotto, 2010), their efficacy has not been tested in women with FOD. There is no evidence that nutritional supplements (e.g., ArginMax, ginkgo biloba) affect orgasmic functioning more than placebo in any population (Ito, Polan, Whipple, & Trant, 2006; Meston, Rellini, & Telch, 2008).

SSRI-induced orgasmic dysfunction may be remediated by switching to or adding an antidepressant that also inhibits the reuptake of dopamine and norepinephrine (e.g., bupropion, moclobemide, or nefazodone; Demyttenaere & Jaspers, 2008; Meston et al., 2004). The use of sildenafil prior to sexual activity may also allow women whose depression has remitted to continue taking their SSRI; in a randomized, placebo-controlled trial, it improved orgasmic functioning in women with SSRI-related sexual side effects, almost all of whom had anorgasmia or delayed orgasm (Nurnberg et al., 2008).

## **Psychological Treatment**

**Overview of therapeutic approaches.** There are three main theoretical approaches to the treatment of orgasmic difficulties: psychoanalytic, systems, and cognitive-behavioural. Traditional psychoanalytic approaches have conceptualized low orgasmic ability as a reflection of a woman's limited capacity to relate intimately to another person as a result of unclear boundaries between self and other. Treatment therefore focuses not on treating the sexual difficulties, but on working through conflicts that are believed to have led to them. In contrast, systems theory provides more of a framework for examining sexual difficulties than a theoretical account of their development. Specifically, this approach highlights the principles of a system (e.g., homeostasis) that influence the types of interactions (e.g., affect expression) that occur between members of that system (e.g., the couple), and which may be relevant to understanding the nature of the sexual dysfunction (for a review, see Heiman, 2007). Lastly, while psychoanalytic and systems approaches aim to treat sexual difficulties through indirect means, cognitive-behavioural approaches manage them directly. This brief treatment approach, commonly known as sex therapy, aims to foster changes in sexual attitudes and sexually relevant thoughts, decrease sexual anxiety, increase orgasmic ability and frequency, and promote more positive feelings (e.g., satisfaction) about sexual behaviour. The behavioural component of this approach for treating orgasmic difficulties typically involves prescribing exercises to induce these cognitive changes, and primarily includes directed masturbation and anxiety-reduction techniques (e.g., systematic desensitization and sensate focus). In addition, sex education, communication and sexual skills training (e.g.,

the coital alignment technique), and Kegel exercises are often prescribed as adjuncts to treatment (Meston & Levin, 2005).

To date, there have been almost no controlled or comparison outcome studies on the effectiveness of psychoanalytic- or systems-based approaches in treating orgasmic difficulties. While there have been some recent attempts to incorporate modifications of psychoanalysis into sex therapy with individuals and couples, the efficacy of doing so remains to be established. Thus, these approaches currently provide, at best, useful frameworks in which to conceptualize orgasmic difficulties that may be integrated into other more empirically supported treatment programs (Heiman, 2007). In contrast, substantial empirical evidence is currently available for the cognitive-behavioural treatment of orgasmic difficulties, and as such, this approach will be the focus of the remaining discussion.

*Cognitive-behavioural approaches (CBT; a.k.a. “Sex Therapy”).* The majority of CBT outcome studies have employed a “mixed bag” of the aforementioned techniques, and systematic evaluation of the utility of each of these components, particularly in women with explicitly specified types of orgasmic difficulties, has not occurred. The relative efficacy and importance of each of these treatment techniques therefore remains unclear. At present, it is commonly accepted that the most effective method for the treatment of lifelong, generalized FOD in women with no other major complaints is a program of directed masturbation (DM). This program is based on a sexual skills learning model (LoPiccolo & Lobitz, 1972), and to date, it has been used effectively in



individual, group, couple and bibliotherapy (self-help) formats (for a review, see Meston & Levin, 2005).

***Directed masturbation (DM) for lifelong FOD.*** DM consists of a combination of several key treatment components: sex education, visual and tactile self-exploration, body awareness, and effective genital self-stimulation training (LoPiccolo & Lobitz, 1972). The first step is educational and involves having the woman visually examine her nude body with the help of a mirror and diagrams of female genital anatomy. An exploration of sexual attitudes, body image and sexual history influences is also incorporated at this step. Second, kinesthetic exploration of the body is encouraged, with the aim of identifying sensitive “pleasure-centers.” Direct instruction in masturbation techniques is provided, and the woman is encouraged to explore varieties of pressures and speeds in manual stimulation of her “pleasure-centers.” Next, the woman is encouraged to make the process more erotic by increasing the intensity and duration of stimulation, developing sexual fantasies and imagery, using topical lubricants and vibrators, and incorporating erotic literature and videotapes. For women who are able to become highly aroused but unable to reach orgasm, other sex therapy techniques, such as “role-playing an orgasm” and using “orgasm triggers” (behaviours that typically occur involuntarily during orgasm, such as holding the breath, thrusting, and tensing the leg and/or pubococcygeal muscles) may be recommended during high sexual arousal as a way of imitating or triggering orgasm (Heiman & LoPiccolo, 1988). Once the woman is able to achieve orgasm on her own, her partner is included in the process whenever possible. During this phase, the woman educates her partner on how to provide

her with effective stimulation, and demonstrates the techniques she has found to be effective (and her partner is encouraged to do the same). These techniques are ultimately incorporated into partnered sexual activities, such as intercourse.

Given that many women and their partners have little knowledge of the female sexual response cycle, bibliotherapy is often used as an adjunct to treatment, with the majority of researchers and clinicians recommending the use of *Becoming Orgasmic: A Sexual Growth Program for Women* (Heiman & LoPiccolo, 1988), a book based on the LoPiccolo and Lobitz sex therapy program, and *For Yourself: The Fulfillment of Female Sexuality* (Barbach, 2000). The addition of educational self-help books has been shown to increase the effectiveness of sex therapy in the treatment of uncomplicated cases of lifelong, generalized anorgasmia (Morokoff & LoPiccolo, 1986).

To date, masturbation has been found to be the most reliable method of producing an orgasm, as it is thought to enable a woman to experience accurate proprioceptive feedback about the type of touch she finds most stimulating, while giving her direct control over the amount and intensity of stimulation (LoPiccolo & Stock, 1986). In addition, given that masturbation can be performed alone, any anxiety that may be associated with partner factors is eliminated. The woman is also able to direct her attention to sexually pleasurable sensations without being reliant on her partner's sexual knowledge, skills, or her own ability to communicate her needs to her partner.

Indeed, research from a number of controlled outcome studies consistently indicates a relationship between masturbation and orgasmic ability, and has established DM as an empirically supported treatment for 80 to 90% of women

with lifelong, generalized anorgasmia and no other major complaints (for a review, see LoPiccolo & Stock, 1986; Meston et al., 2004). DM has been found to be effective in both therapist-directed (100% efficacy) and self-directed (47% efficacy) formats, as compared to a wait-list control group where women had not yet received any treatment (21% efficacy; Heinrich, 1976). Similar results have also been found for the use of DM in group treatment contexts, particularly for those without relationship distress or other major psychological problems (e.g., Wallace & Barbach, 1974); however, given the minimal existing research on the impact of various group treatment dimensions on treatment outcome (e.g., number of sessions, choice of treatment technique, whether to include the partner), it is not clear why this technique works, which treatment components are necessary, or for whom it is best suited (for a review, see LoPiccolo & Stock, 1986).

Despite its effectiveness, there have been several criticisms of DM, including its neglect of relationship dynamics, intimacy needs, morals, and social values (Christensen, 1995). It has been noted that this particular treatment program may not be well accepted by certain clients, particularly those who are older, or who have more conservative sexual attitudes and sexual guilt (Stock, 1993). In contrast, a higher probability of success has generally been indicated for those women who are younger, emotionally healthy and in stable relationships (for a review, see Meston & Levin, 2005). Given that such women may not be representative of women with orgasmic difficulties in general, it remains to be determined how many women are actually able to benefit from this “first-line treatment”.

*DM for acquired FOD.* In contrast to lifelong FOD, fewer controlled studies have examined the effects of DM alone on acquired FOD, and existing research has yielded less impressive results than for lifelong FOD, with success rates varying between 10% and 75% (for a review, see Heiman, 2007; Meston & Levin, 2005). This efficacy disparity may be attributed in part to the aforementioned extensive heterogeneity in how acquired FOD has been operationalized across studies, as well as to their varied treatment outcome measures. With respect to the latter, while the most common outcome measure used to gauge treatment success has been a women's self-report of orgasmic responsivity (Kilman, 1978), other criteria may be equally valuable (e.g., changes in sexual thoughts/feelings, or in sexual behaviours). For example, sex therapy programs for acquired FOD have been found to result in reported improvement in sexual satisfaction without producing significant changes in orgasmic response (Fichten, Libman, & Brender, 1986), and conversely, changes in orgasm ability have not necessarily translated into greater sexual satisfaction, thus highlighting the importance of the outcome criterion in measuring the success of a treatment. Moreover, research has indicated that one of the strongest predictors of treatment success for acquired FOD is marital happiness prior to therapy (McGovern, Stewart, & LoPiccolo, 1975). Hence, in evaluating the success of a treatment, it is important to consider and compare multiple outcome criteria (at several different time points) in addition to orgasmic response, such as the adequacy of sexual stimulation received, relationship satisfaction, and other affective measures (e.g., enjoyment; LoPiccolo & Stock, 1986). In addition, treatment goals vary dramatically for women with FOD (e.g., with respect to

whether orgasm is desired through coitus, cunnilingus, and/or self- or partner masturbation), and these chosen goals should be evaluated when determining whether DM is in fact successful. Given that the category of “acquired FOD” represents a more heterogeneous group than “lifelong FOD”, different treatment strategies will likely be necessary that specifically target the individual woman’s presenting difficulties. On the basis of the literature so far, it has been suggested that DM may specifically be beneficial for those women with acquired FOD who are anxious about touching their genitals (Meston et al., 2004).

***Anxiety-reduction techniques.*** It is commonly believed that anxiety during sexual activity impairs women’s orgasmic function by distracting from their processing of erotic cues. In such cases, rather than focusing on sexual pleasure and sexually relevant stimuli, attention is concentrated on non-sexual and anxiety-provoking cues (e.g., guilt/shame, body image, performance anxiety, etc.). By engaging in self-monitoring during sexual activity, anxious women are likely to both dampen their levels of sexual arousal and impede orgasm (Meston & Levin, 2005).

The most common anxiety-reduction techniques for treating orgasmic difficulties are systematic desensitization (SD) and sensate focus (SF). SD involves training a woman to relax her muscles through a series of deep relaxation exercises. A hierarchy of increasingly anxiety-provoking sexual situations is created by the woman and her therapist, and the woman is instructed to imagine each of the situations while remaining relaxed (thus replacing fear responses with relaxation responses). Once she has mastered this, she is then instructed to engage in the actual activities with the goal of maintaining her increased

relaxation (Wolpe, 1958). In comparison, SF, as initially conceptualized by Masters and Johnson (1970), involves a step-by-step sequence of body exploration exercises that the woman performs with her partner, moving hierarchically from nonsexual to increasingly sexual touching of one another's bodies in relaxed situations, with the goal of increasing awareness and communication between partners of sexually sensitive areas and pleasurable sensations. Partners are instructed not to move to the next stages of sexual touching until they feel completely relaxed in the previous ones. SF components specific to treating orgasmic difficulties include non-demand genital touching by the partner, non-goal-focused sex, and female guidance of sexual stimulation and positioning in order to maximize pleasurable stimulation. SF has been recommended as a couple's skills learning approach (Meston & Levin, 2005).

As with DM, the efficacy of anxiety-reduction techniques in treating FOD is difficult to measure, as the majority of studies testing SD and SF have also employed a combination of other treatment techniques, and the independent contribution of each of these components has not been systematically assessed (e.g., Munjack et al., 1976). The few controlled studies of SD that exist indicate that it leads to decreased sexual anxiety, increased sexual satisfaction, and occasionally also increased sexual communication and intercourse frequency; however, significant changes in orgasmic functioning have not typically been found (for a review, see Meston et al., 2004). In addition, while the few controlled studies that have tested SF have found positive gains in sexual satisfaction, they have not found substantial improvement in orgasmic ability, and treatment effects are typically small (e.g., Everaerd & Dekker, 1982; for a review,

see Meston et al., 2004). Hence, these findings suggest that anxiety-reduction techniques such as SF and SD may be best suited for cases in which there is significant comorbid sexual anxiety that interferes with sexual functioning. These results also speak to the importance of the chosen outcome measure in determining treatment success.

***Other behavioural techniques.*** In addition to DM and anxiety-reduction techniques, other techniques that have been incorporated in treatment packages include sexual education and sexual skill training, communication and assertiveness skill training, and Kegel exercises. Ignorance about genital anatomy, the female sexual response cycle, or sexual techniques for maximizing pleasure [e.g., coital alignment technique (CAT)] undoubtedly contributes to FOD (Meston & Levin, 2005). Thus, sex education and sexual skill training has been a component of most sex therapy treatment programs; however, results from combination treatment outcome studies containing an education component have been mixed with respect to changes in orgasmic response (e.g., Fichten, Libman, & Brender, 1983; McGovern et al., 1975; Munjack et al., 1976; Sotile, Kilmann, & Follingstad, 1977; for a review, see Meston et al., 2004). The few controlled studies that exist on the specific impact of sex education have found small improvements in orgasmic ability for lifelong FOD (e.g., Jankovich & Miller, 1978) and acquired FOD (e.g., Kilmann et al., 1983) with brief sexual education presentations. In addition, a few controlled studies have examined the impact of sexual skill training specifically in CAT, and have found substantial improvement in orgasmic ability, frequency, strength and satisfaction (Eichel, Eichel, & Kule, 1988; Hurlbert & Apt, 1995). In CAT, the woman lies supine, the partner is up

and forward in the missionary position (“riding high”), and both partners are trained to apply synchronized, genitally-focused, pressure-counterpressure rocking movements during intercourse, which is thought to maximize direct external clitoral contact (Eichel et al., 1988). Indeed, in one of the only randomized controlled studies of DM and CAT with a non-clinical (non-FOD) sample of married women and their partners, who were enrolled in a sexual enrichment workshop, CAT was found to outperform DM in increasing orgasmic consistency during sexual intercourse. Based on these results, the authors have recommended the use of a combined treatment program for situational orgasmic difficulties (e.g., inability to have an orgasm through intercourse) that incorporates both DM and CAT (Hurlbert & Apt, 1995). Although CAT has received extensive media attention, limitations of this study should be considered. In particular, the study sample did not include women with FOD, the workshops included education on multiple other sexual techniques in addition to either DM or CAT (e.g., sensate focus, and sexual communication training), and the superior performance of CAT to DM was specific to orgasms experienced *during intercourse*, which is the target outcome of CAT, not DM, hence such differences in orgasmic consistency are to be expected. To date, these findings have not been replicated by other research groups.

In addition to examining the utility of sexual education, the majority of the above studies have also included a communication skills training component as part of the larger treatment package (e.g., Fichten et al., 1983; McGovern et al., 1975; Munjack et al., 1976; Sotile et al., 1977; for a review, see Meston et al., 2004). In two of the only studies to evaluate the impact of this treatment



component, Kilmann and colleagues (1987, 1986) found that while both couple and group formats of sexual education and communication training improved orgasmic ability post-treatment in women with acquired, situational FOD (as compared to wait-list control), discrepant results were obtained between studies at follow-up, and so it remains unclear whether the effects of these particular treatments result in long-term gains.

Finally, with respect to Kegel exercises, after discovering a correlation between restoration of the pubococcygeus muscle and orgasmic potential, Kegel (1952) recommended a series of contraction-based exercises as treatment for orgasmic difficulties. Such exercises are argued to strengthen this band of muscle between the pubic bone and coccyx, thereby increasing genital vascularity, and in turn facilitating orgasm. Although some association has been reported between physiological weakness and atrophy of the pubococcygeus (PC) muscle and FOD (Kline-Graber & Graber, 1978), the results of the few treatment outcome studies that exist indicate that while the inclusion of Kegel exercises in treatment packages may increase PC muscle tone, they do not lead to improved orgasmic ability or frequency (e.g., Chambless et al., 1984; for a review, see Meston et al., 2004). It has been instead suggested that Kegel exercises serve to indirectly increase arousal by enhancing a woman's awareness of and comfort with her genitals (Heiman, 2007). These research findings are incorporated into the Treatment section of Appendix 1.

**Summary and recommendations.** To date, DM is the only treatment for FOD that has consistently been found to be efficacious, and is currently considered to be a first-line empirically supported treatment for lifelong,

generalized anorgasmia. In contrast, the efficacy of DM in treating acquired FOD is less clear. There are currently no empirically validated treatments for acquired FOD, although it has been recommended that some combination of couple therapy (fostering communication skills, trust, intimacy) and sexual skills training (e.g., in CAT or effective self- and partner-stimulation techniques) be employed, as determined by the exact nature of the orgasmic difficulties, and the specific goals of treatment (e.g., increased orgasmic frequency *vs.* relationship satisfaction). Anxiety reduction techniques such as sensate focus and systematic desensitization are also recommended as treatment adjuncts in those cases of lifelong or acquired FOD where comorbid sexual anxiety is of particular concern. While there is insufficient empirical evidence to suggest that sex education, communication or assertiveness skills or Kegel exercises are effective in and of themselves in treating FOD, preliminary research suggests that they may be helpful adjuncts to treatment.

At the same time, in light of the limitations of the empirical literature, caution should be exercised in drawing generalizations about the treatment of FOD. In particular, the majority of studies have failed to report on or evaluate the independent effects of demographic (e.g., religiosity, cultural values, education level, social class), personality (e.g., neuroticism, openness, sensation seeking), psychosexual (e.g., sexual abuse, sexual guilt, sexual attitudes), and relationship variables (e.g., marital satisfaction, stability, intimacy, partner sexual functioning), all of which have frequently been found to affect symptom presentation (e.g., levels of arousal and orgasmic response) and may ultimately affect treatment response (for a review, see Meston et al., 2004; Nairne &

Hemsley, 1983). In addition, few studies have attempted to clearly differentiate lifelong and acquired FOD sufferers, and researchers often neglect to specify the extent of comorbid sexual, medical or psychological difficulties (e.g., anxiety, depression, body dissatisfaction) that may influence orgasmic response. In light of these issues, it would be advantageous for researchers not only to clearly specify and control for such factors in future treatment studies, but also to target many of these associated vulnerabilities specifically in their treatment approaches. Finally, the majority of treatments for FOD, with their focus on penile-vaginal intercourse (e.g., CAT), are arguably heterosexist and traditional in nature, and may not sufficiently speak to the complexity and variance of many women's sexual experiences. Unfortunately, due to the dearth of systematic research over the past two decades on the impact of psychosocial factors on treatment outcome, we currently find ourselves at a standstill, accepting potentially limited treatments, without a clear understanding of why they work, or for whom they are best suited. Future research must systematically address these issues within a framework that is capable of simultaneously handling the vast individual differences between women and the flexibility that is inherent within every woman's sexual life.

### **Conclusions**

Orgasm is a complex experience involving both subjective and physiological changes, including feelings of intense pleasure and rhythmic pelvic floor muscle contractions. Women reporting orgasmic difficulties vary considerably with respect to their orgasmic impairment, the adequacy of their sexual arousal, and their psychological and relationship functioning. Since

Masters and Johnson (1966), research on orgasm has focused on the associated physiological changes; in contrast, treatment studies of FOD, including those of Masters and Johnson (1970), have almost exclusively involved psychotherapy. Although there have been some recent attempts to test the effects of pharmacological treatments, none has proven more effective than placebo (Meston et al., 2004), and this remains an area for future research. In healthy women, the factors that contribute to FOD appear to be more psychosocial than physiological, suggesting that this disorder should not be over-medicalized.

Methodological limitations make the existing psychological and physiological research difficult to interpret. FOD treatment study samples have been both too heterogeneous (including women with lifelong and acquired types, situational and generalized types, and/or with and without impaired arousal) and too homogeneous (mostly including only young, heterosexual, white women in stable relationships). In order to better inform clinical practice, future research on FOD should be consistent in its operationalization of the problem, integrate the measurement of its physiological and psychological dimensions, and include a wider variety of affected women (e.g., those who are older, homosexual, non-white, and unmarried).

Perhaps because of the current lack of clarity as to the causes of FOD, the best psychotherapeutic strategies often improve sexual arousal, pleasure, intimacy, and satisfaction more than orgasmic functioning itself, especially for women with acquired FOD. Although directed masturbation (DM) is the first-line psychotherapeutic treatment, its effectiveness has only been demonstrated in women with lifelong FOD. Until we know more about how orgasm is inhibited,

our patients would therefore best be served by validating their desire to experience this pleasurable event, but working with them and their partners to make sexual activity more pleasurable and satisfying for them whether or not they reach it.

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Table 1. Assessment questions for women reporting orgasmic difficulties.

| <u>Desired Information</u>                  | <u>Assessment Questions</u>   |
|---|---|
| <i>Current Orgasmic Functioning</i>         |   |
| <i>(“In the past month...”):</i>            |   |
| Frequency of Orgasm                         | During sexual activity, how often have you reached high levels of sexual arousal?<br><br>How often have you reached orgasm?   |
| Quality/Intensity of Orgasm                 | (If she is orgasmic) Overall, how satisfying were your orgasms?   |
| Type of Sexual Stimulation                  | What sexual activities have you engaged in? (e.g., masturbation, manual stimulation, oral stimulation, vaginal intercourse)<br><br>(If she is orgasmic) During which of these activities have you experienced orgasm? |
| Level of Associated Distress                | How upset or distressed are you about your orgasmic difficulty?   |
| Perceived Cause of Difficulty               | Why do you think you are experiencing this orgasmic difficulty?   |
| <i>Orgasm and Treatment History:</i>        |   |
| Orgasm History                              | (If she does not report any recent orgasms) Have you ever experienced orgasm?   |
| Onset of Difficulty (Lifelong vs. Acquired) | When did your orgasmic difficulty begin?<br><br>(If acquired) At that time, had you experienced any physical or psychological changes or events? (e.g., medical illnesses or their treatment, major life events or    |

|  |   |
|--|---|
|  | traumas)  |
| Course of Difficulty   | When has your orgasmic functioning been better than it is now?<br><br>When has it been worse? (e.g., with other sexual partners, when experiencing less stress) |
| Treatment History  | Have you ever received treatment for your orgasmic difficulty?<br><br>(If yes) Did it help?   |
| Treatment Goals and Expectations   | In what situations would you like to be able to reach orgasm?   |
| <i>Relevant Relationship Factors</i><br><br><i>(if she is in a sexual relationship):</i> |   |
| Level of Associated Interpersonal Difficulty   | How has your partner reacted to your orgasmic difficulty?   |
| Quality of Communication   | How well do you communicate with your partner about your sexual difficulties and other relationship issues?   |
| Partner's Sexual Functioning   | Does your partner have any sexual difficulties?   |

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## Appendix 1. Case illustrations of FOD

### Case 1

#### Initial Presentation

Alison, a 22-year old college student, shyly reported to her gynecologist during a routine examination that she was “pretty sure” she was not having orgasms with her boyfriend of the last two years. Her boyfriend had expressed disappointment with her lack of orgasms, and she was also wondering what she is missing. Her gynecologist referred her to a sex therapy clinic for further assessment.

#### Assessment

Alison reported engaging in sexual activity with her boyfriend twice a week, during which they exclusively had vaginal intercourse, and never having masturbated because of not “[seeing] a need”. She denied having ever experienced any of the subjective or physiological indicators of orgasm. She described a generally positive relationship with her boyfriend, to whom she was physically attracted, and finding intercourse with him pleasurable. With further questioning, however, it became apparent that she did not become highly sexually aroused. Although she particularly enjoyed the oral sex she received from a former partner, she stated not being comfortable suggesting this activity to her boyfriend.

Alison reported conservative sexual attitudes, as well as high idealism about sex and low instrumentality (i.e., utilitarian views about experiencing pleasure during sex) on the Brief Sexual Attitudes Scale (which also assesses permissiveness about casual sex and birth control; Hendrick, Hendrick, & Reich,

2006). Meeting with Alison and her boyfriend together revealed a pattern of poor sexual and general communication, which is more common in couples in which the woman is anorgasmic during the majority of partnered sexual interactions (Kelly, Strassberg, & Turner, 2004, 2006). In particular, they were uncomfortable discussing sexual activities associated with direct clitoral stimulation, and perhaps as a result, her boyfriend had an inaccurate understanding of her sexual preferences. When discussing intercourse, they appeared to blame each other for her lack of orgasm. [When meeting with the couple is not possible, the Dyadic Adjustment Scale can be used to assess relationship quality in cohabiting couples, including their communication (Spanier, 1976).] When interviewed on her own, Alison described aversive feelings associated with intercourse, including anxiety, guilt, and alienation, which are common in women experiencing orgasmic difficulties with a partner (Birnbaum, 2003).

Alison's orgasmic difficulties appeared to result from a combination of poor sexual knowledge, inadequate sexual stimulation, poor communication and sexual skills, sexual anxiety and negative sexual attitudes (e.g., about masturbation). There is no available normative information on the amount of stimulation normally required for women to reach orgasm; however, many women require that it be clitorally-focused, intense, and prolonged. Not surprisingly, lack of sexual knowledge and conservative sexual attitudes, which tend to preclude this type of stimulation, are related to sexual difficulties (Shokrollahi, Mirmohamadi, Mehrabi, & Babaei, 1999). The impact of poor sexual skills in the partner, particularly with clitoral stimulation, have not been

studied, but undoubtedly play a role in some cases of FOD in women like Alison who only engage in sexual activity with their partner.

### **Diagnosis**

Like many women seeking treatment for lifelong anorgasmia (Basson, 2002), Alison also describes impaired sexual arousal, and a diagnosis of Sexual Interest/Arousal Disorder (SIAD; Graham, 2010) should also be considered. She does not, however, appear to be receiving what for her would be adequate stimulation, nor does she report significant personal distress about her sexual functioning, factors which preclude any diagnosis. Since she and her boyfriend report wishing to improve their sexual interactions, therapy can nevertheless be provided.

### **Treatment Recommendations**

A couple-based program of DM is recommended, consisting of sexual education (e.g., on female genital anatomy, normal variations in orgasmic functioning and sexual response), self- and partner-exploration and sensate focus (to increase bodily awareness and arousal, enhance sexual image and reduce anxiety), and training in communication skills and sexual stimulation techniques (to expand their sexual repertoire and maximize pleasure; e.g., through CAT) in addition to DM. These components should be introduced as non-goal-oriented methods of enhancing their sexual life, rather than as techniques to “solve Alison’s orgasmic problem”. Barring any cultural proscription of masturbation, which should be respected, Alison’s resistance to masturbating should be challenged with education about its effectiveness and an exploration of the origins of her negative sexual attitudes (e.g., conservative religious beliefs or parental



communication of negative sexual messages). Providing that Alison and her partner participate actively in therapy (and especially that Alison completes DM), the prognosis is good that she will achieve orgasm at least on her own and likely with her partner through some means of direct clitoral stimulation.

## **Case 2**

### **Initial Presentation**

Sara, a 42-year old high school teacher, was seeing a psychologist for help coping with her recent divorce. She described wanting to “finally deal with” a lifelong inability to reach orgasm with a partner before beginning to date again.

### **Assessment**

Sara reported having reliably reached orgasm on her own since beginning to masturbate as an adolescent. She described occasionally becoming very sexually aroused with her previous sexual partners but never reaching the “tipping point”, and eventually becoming distracted and frustrated by her inability to reach orgasm. She revealed some ambivalence about engaging in therapy by wondering “whether it will even be worth it”.

With further questioning, Sara revealed a preoccupation with her weight and discomfort with being naked, particularly with a partner. Sara was therefore asked to complete the Sexual Modes Questionnaire to assess her automatic thoughts, emotions, and sexual response during partnered sexual activity (Nobre & Pinto-Gouveia, 2008). Like some other women with FOD, Sara endorsed dysfunctional body image beliefs (e.g., “an ugly woman is not capable of sexually satisfying her partner”). She also reported feelings of incompetence, disengagement, and a lack of erotic thoughts during past partnered sexual activity.

For Sara and many women with FOD, the transition from high arousal to orgasm appears to be interrupted by distraction from erotic cues (Meston & Levin, 2005), in this case primarily by body image concerns.

### **Diagnosis**

Sara meets diagnostic criteria for situational FOD, lifelong type, as she endorsed being significantly distressed about the problem verbally and on the Female Sexual Distress Scale (Derogatis, Rosen, Leiblum, Burnett, & Heiman, 2002).

### **Treatment Recommendations**

Sara's body image concerns should be challenged through psychotherapy, which would include SF-type body exploration exercises. Like Alison, she would also benefit from a program of directed masturbation. Since she is already experiencing orgasms during masturbation, this would focus on imagining being with a sexual partner while masturbating in order to work through any inhibitions she might have about "letting go" or "losing control" in front of someone else. In addition, she should vary her masturbation technique and attempt to simulate partnered sexual activity (e.g., vaginal penetration as well as clitoral stimulation) to increase her chances of being orgasmic with a partner. Sara will likely be able to achieve orgasm during simulated partnered sex; however, this will be more challenging with a partner present and she may wish to continue/resume therapy when she begins a new relationship to tackle any residual barriers to orgasm.

## **Case 3**

### **Initial Presentation**

Brooke, a 36-year old mother of two, reported to her psychiatrist that she has been unable to reach orgasm since beginning SSRI medication to treat her depression one year ago. She expressed frustration about this change, but also concern about whether her depressive symptoms will return should she discontinue the medication.

### **Assessment**

Brooke reported initially feeling sexual desire and becoming highly aroused during sexual activity with her husband; however, with prolonged stimulation, she becomes preoccupied by her inability to reach orgasm and her desire and arousal decrease. She and her husband have discussed the problem and have both noticed that it has dampened her interest in being sexually intimate with him. She described now reaching orgasm only occasionally (25% of the time) during masturbation, when she masturbates for “a really long time”, but reports that they are not as pleasurable as her orgasms were before.

Orgasmic difficulties are particularly common in women patients taking SSRIs (Rosen et al., 1999), and clinical impression suggests that they often experience a pattern of high arousal that reaches a plateau then dissipates either because of “going numb” or negative cognitions (Basson, 2002). Given Brooke’s history of satisfactory orgasmic functioning, her good relationship with her husband, and the timing of the onset of her orgasmic difficulty, it seems clearly linked to the medication. However, her resultant frustration and distraction from her sexual arousal may currently be contributing to the problem.

### **Diagnosis**

Because her orgasmic difficulty and secondary decrease in sexual desire are due to a medication, Brooke meets diagnostic criteria not for FOD, but for Substance/Medication-Induced Sexual Dysfunction (specifically, Antidepressant-Induced Sexual Dysfunction).

### **Treatment Recommendations**

Brooke may benefit from switching to or adding alternative antidepressant medications that also affect dopamine and norepinephrine levels (e.g., bupropion), which can improve SSRI-related sexual side effects (Demyttenaere & Jaspers, 2008; Meston et al., 2004). However, careful and frequent monitoring for signs of depressive relapse and for any drug-associated side effects will be required during this transition. Should more research demonstrate the effectiveness of sildenafil for SSRI-related sexual dysfunction (Nurnberg et al., 2008), her psychiatrist may also choose to prescribe it to be taken prior to sexual activity. Another approach would be to discontinue antidepressant medication and begin a course of cognitive-behavioural therapy, which is as effective as pharmacotherapy for depression (Roshanaei-Moghaddam et al., 2011). In the meantime, Brooke and her husband should be encouraged to adopt a less goal-oriented and more pleasure-focused approach towards their sexual interactions, with Brooke increasing her focus on pleasurable sensations and erotic cues to enhance her levels of sexual arousal and desire, and to prevent self-monitoring. Provided that Brooke's depression can be stabilized on a new treatment regimen, the prognosis is fair that her orgasmic difficulties will remit.

## **TRANSITION**

As discussed in the preceding review of FOD, women's orgasm rates have consistently been found to be higher when they experience direct and/or indirect stimulation of the external clitoris. Female genital mutilation/cutting typically involves excision of the external clitoris, and I wondered to what extent this would impair their experience of sexual pleasure and capacity to reach orgasm. My colleagues and I therefore conducted a literature review to test this hypothesis. Ideally, studies on this topic would compare women who have undergone FGM/C to women who have not, but are of the same culture, religiosity, and socioeconomic status. It is, however, very difficult to find appropriate comparison groups because FGM/C is practiced nearly uniformly in certain cultural subgroups (Abdulcadir, Margairaz, Boulvain, & Irion, 2011). The following manuscript presents the current state of our knowledge on the effect of FGM/C and clitoral restoration surgery on orgasm.

## References

Abdulcadir, J., Margairaz, C., Boulvain, M., & Irion, O. (2011). Care of women with female genital mutilation/cutting. *Swiss Medical Weekly*, 140, w13137. doi: 10.4414/smw.2010.13137

## **MANUSCRIPT TWO**

### **FEMALE GENITAL MUTILATION/CUTTING AND ORGASM BEFORE AND AFTER SURGICAL REPAIR**

Paterson, L. Q. P., Davis, S. N. P., & Binik, Y. M. (2011). Female genital mutilation/cutting and orgasm before and after surgical repair. *Sexologies*, 21, 3-8. doi: 10.1016/j.sexol.2011.09.005.

## Abstract

Female genital mutilation/cutting (FGM/C) is often performed to decrease women's sexual pleasure. Removal of the external clitoris may particularly impair sexual pleasure and orgasmic functioning. This review evaluates the literature on (a) the orgasmic functioning of women with FGM/C whose clitorises have and have not been excised and (b) the effect of surgical repair on orgasm. A PubMed search was performed to identify all published studies of FGM/C that included an assessment of orgasm. While three of the seven FGM/C studies that included a control group found decreased orgasmic functioning in affected women, no study fully controlled for demographic differences between groups or separated the FGM/C group by clitoral integrity. The impact of FGM/C on orgasm therefore remains unknown; however, indirect evidence suggests that orgasm rates would be reduced in women who cannot engage in direct stimulation of the external clitoris. Surgical defibulation releases the infibulation scar and appears to improve global sexual functioning but not orgasm. Clitoral reconstructive surgery, which creates a new external clitoris, restores a more normal genital appearance, resolves pain at the excision site, and increases clitoral pleasure. One large study found that it enabled clitoral orgasm in approximately 40% of patients. Since rates of orgasm from all forms of stimulation (e.g., vaginal) were not assessed, it is unclear for how many women an external clitoris is necessary for orgasm. Future studies on FGM/C and orgasm should address the methodological limitations of previous research. Although clitoral reconstruction allows many women with FGM/C to become clitorally orgasmic, it does not



guarantee orgasm. Women should be offered psychotherapy to improve their sexual or orgasmic functioning regardless of their genital integrity.

*Keywords:* female genital mutilation, female genital cutting, orgasm, sexual functioning, genital surgery, clitoral reconstruction

## Female Genital Mutilation/Cutting and Orgasm Before and After Surgical Repair

Female genital mutilation/cutting (FGM/C), the partial or total removal of the external genitalia or any other intentional injury to the female genital organs for non-medical reasons (WHO, 2008), is a tradition performed in some patriarchal societies to control female sexuality and chastity, reduce women's sexual pleasure, increase men's sexual pleasure and/or increase the sexual attractiveness of the genitalia (Abdulcadir, Margairaz, Boulvain, & Irion, 2011). Between 100 and 140 million girls and women have undergone these procedures, mostly in Africa and Asia, and an estimated 3 million girls are at risk every year (WHO, 2008). The World Health Organization (2008) has classified FGM/C into four types: *Type I*: partial or total removal of the clitoris and/or the prepuce (*Type Ia*, removal of the clitoral hood/prepuce only, appears to be rare and is generally performed in medical rather than traditional settings; *Type Ib*, removal of the clitoris with the prepuce). *Type II*: Partial or total removal of the clitoris and the labia minora, with or without excision of the labia majora (*Type IIa*, removal of the labia minora only; *Type IIb*, partial or total removal of the clitoris and the labia minora, *Type IIc*, partial or total removal of the clitoris, the labia minora and the labia majora). *Type III (infibulation)*: Narrowing of the vaginal orifice with creation of a covering seal by cutting and appositioning the labia minora (*Type IIIa*) or the labia majora (*Type IIIb*), or both, with or without excision of the clitoris (infibulation). *Type IV*: Unclassified, all other harmful procedures of the female genitalia for non-medical purposes.

FGM/C violates human, children and women's rights and leads to numerous immediate and long-term health complications, such as severe pain,

infection, birth complications, and decreased quality of sexual life (WHO, 2008). Although Type III generally indicates the greatest severity and risk, the clitoris is left intact under the infibulation scar approximately 50% of the time (Krause, Brandner, Mueller, & Kuhn, 2011; Nour, Michels, & Bryant, 2006); in these cases, Types Ib, IIb and IIc could cause more impairment in sensitivity (WHO, 2008). Clitoral excision may decrease not only the experience of sexual pleasure and orgasm, but also indirectly dampen sexual desire, arousal, and satisfaction. However, since FGM/C is almost always preformed before girls reach sexual maturity, affected women lack a personal frame of reference for normal sexual functioning (Foldes & Louis-Sylvestre, 2006) and may not experience as much of a subjective deficit until their perception of their genitalia and functioning changes when they move to urban centers or Western countries (Abdulcadir et al., 2011). They may then seek surgical repair to improve their sexual functioning, regain a normal genital appearance, and/or resolve genital pain. The following review evaluates the literature on (a) the orgasmic functioning of women with FGM/C with and without intact clitorises and (b) the effect of surgical repair (defibulation and clitoral reconstruction) on orgasmic functioning. In addition to addressing the medical and sexual needs of women with FGM/C, surgical repair has the potential to clarify the relative importance of the external clitoris for orgasm.

### **Orgasm in Women with FGM/C**

#### **Methodological Considerations**

While clinicians and researchers depend on women to accurately report whether or not they are experiencing orgasm, many women are unable to do so

with certainty (Bancroft, 2009). It is therefore important for studies to clearly define orgasm using culturally-appropriate language (Obermeyer, 2005) and ask about the specific signs included in the following definition of orgasm: “a variable, transient peak sensation of intense pleasure, creating an altered state of consciousness, usually with an initiation accompanied by involuntary, rhythmic contractions of the pelvic striated circumvaginal musculature, often with concomitant uterine and anal contractions, and myotonia that resolves the sexually induced vasocongestion (sometimes only partially), usually with an induction of well-being and contentment” (Meston, Levin, Sipski, Hull, & Heiman, 2004). Women with FGM/C sometimes report rates of orgasm exceeding those of Western women (e.g., on average, 90% of three samples of Somali immigrants with mixed FGM/C types reported orgasm with penetrative vaginal sex in Catania et al., 2007); therefore, for the impact of FGM/C on orgasm to be determined, studies must include an appropriate comparison group. In addition, since women who have undergone FGM/C are likely to differ from those who have not more than anatomically, studies should statistically control for any demographic differences (e.g., age, education, religion) between groups (Obermeyer, 2005). In women without FGM/C, lower age and education level and higher religiosity have been associated with decreased rates of orgasm, at least during masturbation (Laumann, 1994).

### **Comparisons to Women without FGM/C**

Table 2 lists the seven studies that have compared the orgasmic functioning of women with FGM/C to that of a control group. While some have found that women with FGM/C have lower rates of orgasm (el-Defrawi, Lotfy,

Dandash, Refaat, & Eyada, 2001; Elnashar & Abdelhady, 2007) or reduced orgasmic functioning (Alsibiani & Rouzi, 2010), none of these controlled for demographic factors. The one study to report (but not control for) demographic differences found that the FGM/C group was less educated, younger, and more often housewives and living in rural areas than controls (Elnashar & Abdelhady, 2007). The only study to control for most demographic factors found similar frequencies of usually or always experiencing orgasm during sexual intercourse in women who had undergone FGM/C (66%) and those who had not (59%; Okonofua, Larsen, Oronsaye, Snow, & Slinger, 2002). In this study, the FGM/C group was significantly less likely to report that the clitoris was the most sensitive part of their body (11%) than controls (27%), the majority (63%) choosing their breasts instead (vs. 44% of controls), and the authors suggest that their sexual functioning was maintained by shifting focus from the (absent) clitoris to the breasts (Okonofua et al., 2002). However, since the majority of both groups were pregnant, women with FGM/C who have difficulty completing intercourse were less likely to be included, and the FGM/C group may have therefore been unusually sexually healthy.

In summary, due to significant methodological limitations, the impact of FGM/C on orgasm remains unclear. Importantly, no study has separated the FGM/C group by clitoral integrity in order to directly examine the effect of clitoral excision on orgasmic functioning. There is, however, evidence that some women without external clitorises experience orgasm. Some clitoral tissue remains under the site of the excision, and while its stimulation is often painful due to scarring, 2% of patients in a clitoral reconstruction study reported clitoral

orgasm prior to surgery (Foldes & Louis-Sylvestre, 2006). This is certainly an underestimate of the overall orgasm rate for women with excised clitorises, since more women could have been experiencing orgasm from vaginal stimulation, and women seeking clitoral repair may have below-average sexual functioning. The following section discusses how orgasm would be possible but likely more difficult to reach for women with excised clitorises.

### **Orgasm without an External Clitoris**

Approximately 90% of women without FGM/C are able to reach orgasm (Bancroft, 2009), and it is typically elicited by stimulation of the clitoris or vagina (especially its anterior wall/“G-spot”), but it has also been reported to occur following stimulation of the periurethral glans, cervix, breast/nipple, or mons, and through mental imagery, fantasy, hypnosis, and an extremely variable group of tactile, visual and auditory stimuli, as well as spontaneously and during sleep (for a review, see Meston et al., 2004). Several mechanisms of orgasm have been proposed, generally involving an autonomic nervous system reflex triggered by a build-up of sexual excitement (Meston et al., 2004). What exactly initiates orgasm remains unknown, but laboratory research on women with spinal cord injuries suggests that it depends on an intact sacral reflex arc (Sipski, Alexander, & Rosen, 2001). As evidenced by the variety of sexual behaviours that elicit orgasm, it does not, however, always depend on the external clitoris.

Masters and Johnson (1966) found that the physiological changes associated with clitorally- and vaginally-stimulated orgasms were identical, and they may in fact both be largely elicited by stimulation of clitoral tissue (Foldes & Buisson, 2009). Recent studies using ultrasound and magnetic resonance imaging

have found that the majority of clitoral tissue is internal, including two clitoral bodies and bulbs that partially surround the vagina and unite above its anterior wall (for a review, see Wallen & Lloyd, 2011). However, direct clitoral stimulation appears to be more effective than vaginal stimulation at eliciting orgasm. The vast majority of women use this method of masturbation (Kinsey, Pomeroy, Martin, & Gebhard, 1953), and even though some degree of direct and indirect clitoral stimulation occurs during vaginal intercourse (Mah & Binik, 2001), only approximately 25% of women always reach orgasm during intercourse, with 33% doing so rarely or never (for a review, see Lloyd, 2005). More women experience orgasm with a partner when they engage in a greater number of sexual behaviours (Herbenick et al., 2010; Richters, Visser, Rissel, & Smith, 2006), generally increasing direct clitoral stimulation. Women's rates of orgasm at their last sexual encounter were found in a Western survey to be highest when they received oral and/or manual clitoral stimulation either alone (84%) or in addition to vaginal intercourse (76%), as compared to vaginal intercourse alone (50%; Richters et al., 2006). Another such survey found that more women reported orgasm when oral stimulation had occurred; however, this was also true for vaginal and anal intercourse, and there was no association between manual clitoral stimulation and orgasm rates (Herbenick et al., 2010). These studies suggest that women with excised clitorises are likely to experience lower rates of orgasm than women who can engage in external clitoral stimulation.

In women without FGM/C, the size of the clitoris, averaging  $18.5 \pm 9.5$  mm<sup>2</sup> for the surface area of the glans and  $16.0 \pm 4.3$  mm for the length of the entire external clitoris (glans and shaft; Verkauf, Von Thron, & O'Brien, 1992), is

not related to the ability to reach orgasm (Masters & Johnson, 1966). On the other hand, having ever reached orgasm through vaginal intercourse without concurrent clitoral stimulation has been associated with having a thicker urethrovaginal space as measured by introital ultrasonography, which may reflect more extensive clitoral bulbar/anterior vaginal tissue (Gravina et al., 2008). Similarly, a smaller distance between the clitoris and the urethra (as a proxy of the vagina) has been related to a greater frequency of orgasm during intercourse (Wallen & Lloyd, 2011). Although this could simply reflect greater external clitoral stimulation during penile thrusting, it could also indicate more compact internal clitoral tissue that is closer to and more easily stimulated through the vagina, thus eliciting orgasm irrespective of the former (Wallen & Lloyd, 2011). Increased internal clitoral tissue could be protective of orgasmic functioning when the external clitoris is removed in FGM/C. In one Egyptian study, the overall “sex score” (comprising genital anatomy, genital and sexual knowledge, and sexual functioning questions) of 100 women with partially or fully excised clitorises did not differ from that of 50 controls despite their certain lower scores on the genital anatomy subscale, possibly because they had increased internal clitoral tissue and therefore higher rates of orgasm through vaginal stimulation (though the latter were not reported; Thabet, 2009). Significantly more women with FGM/C could identify the “G-spot”, reported ejaculation from its stimulation, and had palpable anatomical landmarks and histological findings consistent with its presence (Thabet, 2009).

In summary, while it is possible for women with excised clitorises to reach orgasm, it is likely more difficult because they cannot experience direct or indirect



stimulation of the external clitoris. Those with increased or more compact internal clitoral tissue may have a greater chance of reaching orgasm through vaginal stimulation and therefore higher overall rates of orgasm; however, this hypothesis has yet to be adequately investigated.

### **The Effect of Surgical Repair of FGM/C on Orgasm**

#### **Defibulation**

Infibulation affects sexual functioning by causing pain during intercourse, at least initially, and covering the clitoris when this has not been excised (WHO, 2008). Surgical defibulation (also called deinfibulation) involves releasing the vulvar scar tissue, exposing the introitus, and creating new labia majora (Johnson & Nour, 2007). It is typically performed to allow for (less painful) vaginal intercourse or childbirth (e.g., Nour et al., 2006). One outcome study has evaluated its potential effect on sexual functioning. Defibulation was performed at the request of 18 Swiss patients, aged 18 to 41 years, with carbon dioxide laser (Krause et al., 2011). The majority were from Egypt, married, and had undergone Type III FGM/C. FGM/C had been performed at a median age of 8 years (range of 0 to 12 years). Patients completed the Female Sexual Function Index (FSFI; Rosen et al., 2000) before defibulation and 6 months afterwards, at which point they reported significant improvements in sexual desire, arousal, satisfaction, and pain with sexual intercourse. Lubrication and orgasm scores had increased slightly but non-significantly: the average score on the orgasm subscale remained at approximately 1 out of 6. It was noted that clitoris remnants were identified in 56% of the patients. Although the effect of defibulation on orgasm likely depends

on whether it uncovers an intact or partially intact clitoris, the sexual functioning scores of the women with and without external clitoral tissue were not compared.

### **Clitoral Reconstruction**

Clitoral reconstructive surgery is a relatively new procedure wherein a new clitoral glans is created by freeing and advancing the deep clitoral tissue that remains beneath the surface after clitoral excision (Foldes & Louis-Sylvestre, 2006; Thabet & Thabet, 2003). Like in penile lengthening surgeries (e.g., Mokhless, Abdeldaeim, Rahman, Zahran, & Safwat, 2010), greater clitoral length is obtained by cutting the clitoris's suspensory ligament, which connects the clitoris to the pubic bone. This surgery aims to restore both clitoral anatomy and function, allowing women without external clitorises to “regain the feminine identity associated with the clitoris” (the reason endorsed by 100% of one sample seeking the surgery) and to resolve sexual dysfunction (endorsed by 90%) and pain experienced at the excision site during sexual activity (endorsed by ~50%; Foldes & Louis-Sylvestre, 2006). Two studies have demonstrated the feasibility of clitoral reconstructive surgery. Thabet and Thabet (2003) found that it significantly increased the lower overall “sex scores” (comprising genital anatomy, genital and sexual knowledge, and sexual functioning questions) of their Egyptian patients with Type Ib, II or III FGM/C, which became indistinguishable from those of the control group. For the complicated Type III group, where clitoral cysts appeared to sometimes increase orgasmic functioning, excision of the clitoral cyst resulted in a significant decrease in sexual functioning scores unless clitoral reconstruction was performed as well, in which case their scores were maintained. Changes in subscale scores were not reported, so it is unclear

whether any change occurred in orgasm or other aspects of sexual functioning, as opposed to only in genital appearance. The authors noted that those women for whom surgery restored their clitoral stumps to more than 10 mm, and/or both their glans clitoris and labia minora, developed normal and satisfactory sexual functioning; however, the analyses underlying this statement were not reported.

Foldes and Louis-Sylvestre (2006) performed clitoral reconstructive surgery on 453 women, aged 18 to 63 years (average of 30), who had undergone Type II or III FGM/C. Patients had undergone FGM/C in a variety of geographic locations and at an average of 5.4 years of age (range of 3 months to 20 years of age). Before surgery, 50% of patients reported some clitoral pain; this was moderate to severe during sexual intercourse for 25%. In the authors' assessment of clitoral pleasure prior to surgery, 0.4% reported experiencing unrestricted orgasm, 2% reported orgasm restricted by the mutilation, 38% reported clitoral pleasure without orgasm, 21% reported slight clitoral pleasure, and 38% reported never experiencing clitoral pleasure. The surgery resulted in a visible clitoris in 88% of cases, ranging from a visible but covered clitoral volume (30%), an exposed glans without hood (37%), to a close-to-normal appearance (21%). The vast majority of these patients (93%) were satisfied with their new appearance, while a small number were disappointed that the result was too discreet. Pain at the site of the incision, present in 4 patients at 4 months post-surgery, resolved within one year in all cases. The authors reported that the surgery improved the sexual functioning of the clitoris in 75% of cases: at the 6-month follow-up, 3% reported "normal clitoral sexuality" (possibly, regular clitoral orgasm), 29% reported sometimes experiencing clitoral orgasm, 32% reported significant

improvement without orgasm, 19% reported a small improvement without pain, 3% reported minor clitoral pain, and 0.2% reported clitoral pain without pleasure. The rates of clitoral orgasm therefore increased from 2% to 43%. Overall orgasm rates (i.e., obtained through all forms of stimulation) were not reported. Based on this one study, this procedure appears to create the capacity for clitoral orgasm in just under 40% of cases, with minimal short-term and no long-term complications.

### **Conclusions**

Women with FGM/C experience a wide range of health problems, including decreased quality of sexual life (WHO, 2008). The published literature on the effect of FGM/C on orgasm is inconclusive due to significant methodological shortcomings. In addition to clearly defining orgasm and including an appropriate control group, future research should carefully categorize women based on clitoral integrity and control for demographic differences between groups. Some authors speculate that women may compensate for an absent external clitoris by focusing instead on either breast (Okonofua et al., 2002) or “G-spot” stimulation (Thabet, 2009); however, indirect evidence suggests that they would have more difficulty reaching orgasm because they are not able to engage in direct external clitoral stimulation.

Defibulation and clitoral reconstructive surgery should be offered to improve the sexual health of women with FGM/C. Defibulation appears to improve global sexual functioning but not orgasm. On the other hand, one large study found that clitoral reconstructive surgery improved clitoral sensitivity in 75% of patients and enabled clitoral orgasm in 40%, as well as resolved pain at the excision site and restored a more normal genital appearance, with minimal

complications. However, since orgasm rates from other forms of stimulation (e.g., vaginal) were not reported, the relative importance of the external clitoris for orgasm in general remains unclear; future research should assess all forms of orgasm before and after surgery.

Orgasm is possible for some women with excised clitorises, clitoral reconstruction does not guarantee orgasm, and orgasmic difficulties are experienced by 20 to 30% of women without FGM/C (West, Vinikoor, & Zolnoun, 2004). Orgasm clearly depends on more than anatomy, and all women wishing to improve their sexual/orgasmic functioning should be referred for psychotherapy to address any contributory psychosocial factors, whether or not they have experienced FGM/C.

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Table 2. Orgasmic functioning in women with FGM/C compared to control groups.

| Study                   | Participants   | Setting   | Orgasmic<br>Functioning  | Limitations   | Conclusion  |
|-------------------------|--|---|--|---|---|
| el-Defrawi et al., 2001 | 200 FGM/C (all with injury to/excision of the clitoris) vs. 50 controls. | Family planning centres in Egypt.                 | FGM/C group significantly more likely to report absent orgasm (43% vs. 18%).   | Demographic variables not reported.   | Unclear due to possible demographic differences between groups.           |
| Okonofua et al., 2002   | 827 women with FGM/C (71% Type I and 24% Type II) vs. 1009 controls.     | Antenatal and family planning clinics in Nigeria. | Controlling for demographic factors, FGM/C group equally likely to report always or usually experiencing orgasm during | Controlled for religion, but not religiosity. Over two-thirds of sample were 30-40 weeks pregnant; FGM/C group may have | Orgasmic frequency in coitally-active women may not be affected by FGM/C. |

|                                  |   |   |  |  |   |
|----------------------------------|---|---|--|--|---|
|                                  |   |   | sexual intercourse<br>(66% vs. 59%).   | therefore been<br>above FGM/C<br>average in sexual<br>functioning. |   |
| Thabet &<br>Thabet, 2003         | 30 Type Ia<br>FGM/C; 30 with<br>Type Ib, II or<br>III; 57 with<br>Type III and<br>clitoral cysts; vs.<br>30 controls. | Randomly<br>selected from<br>family planning<br>and<br>gynaecologic<br>clinics in<br>Egypt. | Second group<br>endorsed fewer<br>orgasmic signs<br>(e.g., pelvic<br>throbbing,<br>ejaculation) than<br>the three other<br>groups (2.0 vs. 3.6-<br>4.2/6). | Rates of orgasm<br>and demographic<br>variables not<br>reported.   | Unclear due to lack<br>of a meaningful<br>measure of orgasmic<br>functioning and<br>possible<br>demographic<br>differences between<br>groups. |
| Elnashar &<br>Abdelhady,<br>2007 | 200 FGM/C<br>(type not<br>reported) vs.<br>64 controls, all   | Randomly<br>selected from a<br>university<br>hospital,                                      | FGM/C group<br>significantly more<br>likely to be<br>“unsatisfied”/have  | Reported but did<br>not control for<br>demographic<br>differences  | Unclear due to<br>demographic<br>differences between<br>groups.   |

|                      |   |   |  |  |   |
|----------------------|---|---|--|--|---|
|                      | newly married.  | maternal and child health centres, and private OB/GYN clinics in Egypt. | failure of orgasm (43% vs. 11%).   | (FGM/C group less educated, younger, and more often housewives and living in rural areas than controls). |   |
| Catania et al., 2007 | 57 Somali immigrants with Type III FGM/C vs. 57 controls. | Research centre for women with FGM/C and “informal places” in Florence. | FGM/C group scored significantly higher on the FSFI <sup>a</sup> orgasm subscale (13.2 vs. 11.9/15). | Although of similar ages, control group was almost all Italian.  | Unclear due to cultural/demographic differences between groups. |
| Thabet, 2009         | 125 FGM/C (Types I and II) vs. 50 controls,               | Medical clinic in Egypt.  | FGM/C group more likely to report ejaculation (77%   | Rates of orgasm and demographic variables not  | Unclear due to lack of a meaningful measure of orgasmic         |

|                         |   |                                    |   |  |  |
|-------------------------|---|------------------------------------|---|--|--|
|                         | all with vaginal wall descent.  |                                    | vs. 23%). Overall “sex scores” not significantly different between groups.  | reported.  | functioning and possible demographic differences between groups.   |
| Alsibiani & Rouzi, 2010 | 130 FGM/C (41% Type I or II, 42% Type III, and 17% unknown), vs. 130 controls, all sexually active. | Gynecology clinic in Saudi Arabia. | FGM/C group scored significantly lower on the FSFI <sup>a</sup> orgasm subscale (3.7 vs. 4.2/6). Groups similar in age, level of education, and parity. | Religiosity and relationship status not reported; a 0.5-point difference in orgasmic functioning may not be clinically meaningful. | Unclear due to possible demographic differences between groups. Groups reported similarly impaired sexual functioning (overall FSFI scores of 21.4 and 23.5/36). |

a. The Female Sexual Function Index (FSFI) asks 3 questions about orgasm (frequency and ease of reaching orgasm, and satisfaction with ability to reach orgasm; Rosen et al., 2000).

## **TRANSITION**

As discussed in the preceding review on orgasmic functioning in women with FGM/C, a high number of affected women experience ongoing discomfort and/or pain at the site of their former external clitoris, as well as at the vaginal introitus. This pain is unfortunately easily explained given the typical extent of the mutilation/cutting and the conditions under which it is performed. Despite my interest in investigating the genital sensitivity and sexual functioning of women with FGM/C in the laboratory, this was not feasible due to anticipated difficulty with recruitment and appropriate matching of affected women to healthy controls. Many women who have not undergone FGM/C also experience recurrent vulvar pain leading to dyspareunia, or pain during sexual activity, but without a clear explanation. The most common form of vulvodynia is provoked vestibulodynia, characterized by burning pain with stimulation of the vulvar vestibule, which affects 12 to 21% of premenopausal women (Basson, 2012). One of the traditional sex therapy recommendations for women with dyspareunia is to achieve a high level of sexual arousal before attempting to engage in sexual activity and especially vaginal intercourse. It may also be recommended to avoid having an orgasm before attempting intercourse, since orgasm is followed by the (at least partial) resolution of physiological sexual arousal. A high level of sexual arousal involves increased vaginal lubrication, and is thought to not only decrease uncomfortable friction, but also to decrease genital pain sensitivity and increase pleasurable sensitivity (Bancroft, 2009). The one study on genital pain sensitivity, however, had found that it actually increased with sexual arousal (Payne et al., 2007). The effect of orgasm on genital pain or pleasurable sensitivity had never

been tested, and it therefore remained possible that the positive mood elicited by orgasm would also positively affect sensitivity, potentially overriding the subsequent decreases in arousal/lubrication.

A clearer understanding of sensitivity changes with sexual arousal and orgasm in healthy women would inform treatment recommendations for those with sexual complaints and dyspareunia. In an effort to document normative patterns of sensitivity, my colleagues and I designed a study to test the traditional assumptions that sexual arousal (and possibly orgasm) result in decreased genital pain sensitivity and increased pleasurable sensitivity. In Payne and colleagues' (2007) study, participants were only asked to rate sensation painfulness rather than also sensation pleasurableness, and it is possible that this caused hypervigilance to pain and/or biased them to appraise any intense sensation as painful. We therefore obtained ratings of the pleasurableness as well as the painfulness of each sensation, on separate scales. In this way, we were able to test the relationship between pleasure and pain without presupposing that they are opposite poles of the same continuum, i.e., that a sensation cannot be simultaneously experienced as both pleasurable and painful.

In this study, we used pressure to test touch and pain thresholds, like Payne and colleagues (2007), since this mirrors an important and universal component of the stimulation received during sexual activity and allows for standardization. We replicated Payne and colleagues' (2007) sensory testing of the vulvar vestibule and volar forearm, and importantly added testing on the clitoris. The clitoris is not only the most richly innervated female genital tissue (Baskin et al., 1999; Moszkowicz et al., 2011), but its stimulation appears to be the most effective



means of reaching orgasm for the majority of women during both solo and partnered sexual activity (Lloyd, 2005). As in Gruenwald and colleagues' (2007) study of sensory detection thresholds, we examined to what extent any sensation changes were maintained over time by conducting sensory testing both immediately and 15 minutes after masturbation cessation. The following manuscript presents the results of this laboratory study on sexual arousal, orgasm and sensitivity.

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## **MANUSCRIPT THREE**

### **PLEASURE AND PAIN: THE EFFECT OF (ALMOST) HAVING AN ORGASM ON GENITAL AND NON-GENITAL SENSITIVITY**

Paterson, L. Q. P., Amsel, R., & Binik, Y. M. (in press). Pleasure and Pain: The effect of (almost) having an orgasm on genital and non-genital sensitivity. *Journal of Sexual Medicine*.

## Abstract

The effect of sexual arousal and orgasm on genital sensitivity has received little research attention, and no study has assessed sensation pleasurable-ness as well as painfulness. This study aimed to clarify the relationship between sexual arousal, orgasm and sensitivity in a healthy female sample. Twenty-six women privately masturbated to orgasm and almost to orgasm at two separate sessions, during which standardized pressure stimulation was applied to the glans clitoris, vulvar vestibule, and volar forearm at three testing times: (a) baseline, (b) immediately following masturbation, and (c) following a subsequent 15-minute rest period. Participants indicated their touch thresholds (a measure of tactile detection sensitivity) and pain thresholds (pain sensitivity), and provided sensation pleasurable-ness ratings (pleasurable sensitivity). Results indicated that pleasurable-ness ratings were higher on the glans clitoris than the vulvar vestibule, and at most testing times on the vulvar vestibule than the volar forearm; and at baseline and immediately after masturbation than 15 minutes later, mainly on the genital locations only. Pain thresholds were lower on the genital locations than the volar forearm, and immediately and 15 minutes after masturbation than at baseline. After orgasm, genital pleasurable-ness ratings and vulvar vestibular pain thresholds were lower than after masturbation almost to orgasm. Post-masturbation pleasurable-ness ratings were positively correlated with pain thresholds but only on the glans clitoris. Hormonal contraception users had lower pleasurable-ness ratings and pain thresholds on all locations than non-users. There were no significant effects for touch thresholds. Masturbation therefore appears to maintain pleasurable genital sensitivity but increase pain sensitivity, with lower

genital pleasurable sensitivity and higher vulvar vestibular pain sensitivity when orgasm occurs. Findings suggest that enhancing stimulation pleasurableness, psychological sexual arousal and lubrication mitigate normative increases in pain sensitivity during sexual activity, and underscore the importance of measuring both pleasure and pain in sensation research.

*Keywords:* sensitivity, pain, pleasure, sexual arousal, orgasm,  
masturbation

## Pleasure and Pain: The Effect of (Almost) Having an Orgasm on Genital and Non-Genital Sensitivity

Little is known about the optimal level of genital sensitivity, or responsiveness to external stimulation, which allows for sexual activity to be experienced as highly pleasurable but not painful. No matter whether sensitivity is blunted or heightened, chronic alterations appear to negatively impact sexual functioning by decreasing the pleasurableness of genital stimulation and/or causing it to be painful [e.g., in provoked vestibulodynia (Basson, 2012) or genital anesthesia following SSRI treatment (Csoka, Bahrnick, & Mehtonen, 2008)]. Few studies, however, have investigated how sexual arousal and orgasm affect genital sensation, or subjective sensory experience, in either clinical or healthy populations. Physicians and sex therapists have traditionally credited sexual arousal for preventing pain and facilitating pleasure during sexual activity, with putative mechanisms including decreased friction during vaginal penetration (due to vaginal lubrication), increased pain thresholds, and enhancement of “pleasurable sensitivity to touch” in erotic regions of the body (Bancroft, 2009, p. 308). While intuitive, the recommendation to therefore become highly sexually aroused prior to engaging in genital stimulation is not empirically supported by the one previous study on genital pain sensitivity, which found that it actually increased with sexual arousal (Payne et al., 2007). The effect of orgasm on genital pain sensitivity has not been tested, and may differ from that of sexual arousal. In addition, although the valence of genital sensations likely determines an individual’s response to stimulation (i.e., to continue it when it is positive/pleasurable and discontinue it when it is negative/painful), the

pleasurableness of stimulation has never been measured along with its painfulness. Before we can understand and address dysfunctional genital sensitivity, it is necessary to first document normative changes in sensation quality and intensity occurring over the course of sexual arousal and orgasm.

The limited laboratory research on the effect of sexual arousal and orgasm on sensitivity has found that, outside of the genital area, touch thresholds (the minimum amount of pressure that is detectable/produces a sensation) do not change (Martinez-Gomez, Whipple, Oliva-Zarate, Pacheco, & Komisaruk, 1988; Payne et al., 2007; Whipple & Komisaruk, 1985), but has yielded contradictory findings for pain thresholds (King & Alexander, 2000; Martinez-Gomez et al., 1988; Payne et al., 2007; Whipple & Komisaruk, 1985). Only two studies have examined the effects of sexual arousal or orgasm on genital sensitivity, and these have measured sensory detection and pain thresholds using mechanical, vibratory and thermal stimuli, with greater sensitivity indicated by lower thresholds and vice versa. Payne and colleagues (2007) assessed touch and pressure-pain thresholds in 20 women with provoked vestibulodynia and 20 healthy controls before and after they viewed an erotic film clip and found that, for both groups, touch and pain thresholds decreased on the vulvar vestibule but did not change on the inner labium following exposure to an erotic film clip. Gruenwald and colleagues (2007) measured vibratory and thermal detection thresholds in 11 healthy women before and after they viewed an erotic film clip then masturbated to orgasm with a vibrator. Vibratory detection was assessed on the clitoris and anterior wall of the vagina, and thermal detection on the clitoris only, with one test performed at each of three sessions. After viewing the erotic film clip,

vibratory detection thresholds increased on the clitoris but remained stable on the anterior vaginal wall, while after masturbation to orgasm they increased further on the clitoris and increased on the vaginal wall, with all thresholds returning to baseline levels by 20 minutes post-orgasm. There were no changes in thermal detection thresholds on the clitoris.

Taken together, the results of these studies suggest inconsistent sensitivity changes across genital locations and sensory modalities (mechanical, vibratory, and thermal): that tactile detection and pressure-pain sensitivity increase with passive (i.e., elicited by viewing an erotic film clip) sexual arousal on the vulvar vestibule but not the inner labium; that vibratory detection sensitivity decreases with passive sexual arousal on the clitoris but not the anterior vaginal wall, then decreases on both locations with masturbation to orgasm; and that there is no effect of passive sexual arousal or masturbation to orgasm on thermal detection on the clitoris. It is not clear how to reconcile these findings and integrate them into treatment recommendations for women with sexual complaints.

The present study sought to clarify the relationship between sexual arousal, orgasm and sensitivity in a healthy female sample. Changes in sensitivity on both genital (glans clitoris and vulvar vestibule) and non-genital (volar forearm) locations were assessed using standardized sensory testing before and after private masturbation to orgasm and almost to orgasm, at two separate sessions. Punctate pressure was applied incrementally to determine touch thresholds (tactile detection sensitivity) and sensation valence (pleasurable and/or painful), with testing discontinued at the pain threshold (a measure of pressure-pain sensitivity). We extended previous research by obtaining intensity ratings of



sensation pleasurable (a measure of pleasurable sensitivity) as well as painfulness; pleasure is not only typically a more important sexual motivator than (avoidance of) pain, but, as noted by Payne and colleagues (2007), inquiring only about painfulness could prime participants to appraise any intense stimulation as painful rather than pleasurable. This allowed us to test two out of the three aforementioned assumed effects of sexual arousal (decreased pain sensitivity and increased pleasurable sensitivity); while lubrication decreases friction and the force required for movement across or into genital structures, it would not be likely to directly affect underlying tissue sensitivity.

Masturbation almost to orgasm was used to generate higher levels of sexual arousal than in previous studies and attempt to standardize the amount of genital friction/pressure applied at both sessions, thereby isolating the effect of orgasm at the Orgasm session. Our procedure allowed us to compare sensation on the glans clitoris and vulvar vestibule and explore the relationship between pleasure and pain, as there is evidence that they are mutually inhibitory in non-sexual contexts (for a review, see Leknes & Tracey, 2008). We also assessed the influence of hormonal contraception, as its use appears to decrease sexual desire in some women and increase the risk of developing provoked vestibulodynia by reducing levels of free testosterone and estradiol (for a review, see Burrows, Basha, & Goldstein, 2012). Two studies have compared the genital sensitivity of users to non-users, without first inducing sexual arousal: one found that users had decreased vulvar vestibular pain thresholds (Bohm-Starke, Johannesson, Hilliges, Rylander, & Torebjork, 2004), while the other found no group differences in

clitoral thermal or vibratory detection thresholds or vulvar vestibular pain thresholds (Lee, Morgan, & Rapkin, 2011).

A secondary goal was to collect descriptive information on masturbation in the laboratory and test how well our experimental paradigm simulated masturbation at home. In a recent study, healthy participants who viewed an erotic film clip exhibited smaller increases in subjective sexual arousal and clitoral but not vaginal sexual arousal when tested in the laboratory environment than when tested at home (Bloemers et al., 2010). We therefore attempted to minimize inhibition by creating a comfortable, bedroom-like setting in the laboratory and not monitoring or interrupting participants in any way during masturbation.

We hypothesized that:

1. Participants would successfully reach orgasm through masturbation in the laboratory. At their Orgasm session, they would masturbate for slightly longer, reach slightly higher levels of sexual arousal, and experience lower levels of desire to have an orgasm following masturbation than at their Almost-Orgasm session. They would indicate minimal negative effect of the laboratory environment on their masturbation experience, including relaxation, enjoyment, and orgasmic pleasure.
2. Sensitivity (tactile detection sensitivity, pleasurable sensitivity and pain sensitivity) would be higher on the glans clitoris than the vulvar vestibule, and on both genital locations than the volar forearm.
3. Masturbation would increase sensitivity, with greater changes occurring on the genital locations than on the volar forearm.

4. Sensitivity would be lower after orgasm (when sexual arousal will have likely somewhat decreased) than after almost reaching orgasm.
5. Following masturbation, at the presumed highest level of sexual arousal, there would be a negative correlation between pleasurable sensitivity and pain sensitivity (i.e., higher pleasurableness ratings would be accompanied by higher pain thresholds and vice versa).
6. Women using hormonal contraception would report finding genital stimulation less pleasurable and more painful than those not using it.

## **Methods**

### **Participants**

Participants were recruited via online McGill University classified advertisements and screened during a semi-structured telephone interview. All participants were required to be 18 -30 years of age, fluent in English, in good health with no regular medication use other than hormonal contraception, and report: no sexual difficulty, genital pain, or previous genital surgery; no difficulty becoming sexually aroused or reaching orgasm during masturbation by oneself; having reached orgasm through masturbation by oneself in the month prior to screening; and predicting being able to reach orgasm in the laboratory setting using their preferred masturbatory technique (incorporating any aids such as vibrators, erotic films, etc. typically used during masturbation at home). The study was approved by the McGill University Faculty of Medicine ethics review board.

Thirty-five women completed the pilot-tested protocol, 9 of whom were excluded following testing. Seven attended only one session (three

misunderstood instructions, two were lost to follow-up, one withdrew due to predicting discomfort during sensory testing, and one withdrew due to a scheduling conflict). Two participants were excluded after completing both sessions (one due to unusually low and non-quantifiable pain sensitivity and one due to measurement error). The final sample consisted of 26 healthy women ( $M$  age, 22.51 years;  $SD = 2.74$ ). The majority of participants were current students (89%), born in North America (85%), and reported a heterosexual sexual orientation (85%). Most participants were in a regular romantic relationship (65%), and just less than half were using hormonal contraception (oral contraceptive pills or contraceptive vaginal ring; 42%).

## **Measures**

**Sensory testing.** Sensory testing was performed by the (female) first author at three testing times per session: (a) before masturbation (“baseline”), (b) immediately after masturbation to orgasm or almost to orgasm (“post-masturbation”), and (c) after a subsequent 15-minute rest period (“post-rest”). Three locations were tested: first (a) on the glans clitoris and (b) at the 9 o'clock position on the vulvar vestibule (with order of genital locations counterbalanced between participants), then (c) on the middle of the volar surface of the forearm. The position tested on the vulvar vestibule was lateral to the middle of the vaginal orifice and midway between it and Hart’s line, which demarcates the vulvar vestibule from the inner labium. Participants were instructed to privately gently blot the vaginal opening with a tissue before each of the sensory testing times to minimize moisture, as vaginal lubrication would cause sliding of the sensory testing instruments; this was done at each testing time to standardize the dryness

of the vulvar vestibule and the stimulation participants applied to the area during blotting. During sensory testing, they were asked to gently retract the clitoral hood to allow for testing of the glans and to rest their arm on the bed with volar side up for testing of the forearm; the first author opened the labia in order to access the vulvar vestibule. Participants rated the pleasurableness and painfulness of each detected sensation on two 11-point scales (0 = “not at all” to 10 = “the most I’ve ever experienced”).

Touch thresholds were determined using graded disposable filaments, varying in length and diameter and calibrated using a digital balance (Eliav & Gracely, 1998). They were clamped at the appropriate length with hemostatic forceps and applied using a simplified incremental approach (Payne et al., 2007) to the three locations tested, at 5-second interstimulus intervals, until the participant reported detecting a sensation. Forces applied ranged from 0.0035 g to a maximum of 11.75 g, as required. In an effort to complete sensory testing before sexual arousal dissipated, we did not use the first two filaments used in previous studies as none of our pilot participants reported detecting them.

Vulvalgesiometers, manual spring-based devices with a cotton-swab tip that apply pre-calibrated pressures (Pukall, Binik, & Khalife, 2004), were then used to apply force using the same simplified incremental approach at 5-second interstimulus intervals until participants reached their pain threshold (rating > 0 out of 10 on painfulness). The surface of each cotton-swab tip was smoothed with a very light application of personal lubricant prior to each use. Forces applied ranged from 3 g to a maximum of 400 g on the genitals and from 60 g to a maximum of 950 g on the forearm, as required. Participants not reporting pain

with the greatest force were assigned the next hypothetical incremental value for their pain threshold (i.e., 450 g for the glans clitoris or vulvar vestibule and 1000 g for the forearm). Again in the interest of time, we did not use the lower vulvalgesiometer forces (< 60 g) on the volar forearm as none of our pilot participants reported that these were painful.

**Questionnaires and interview.** Two widely used, reliable and valid psychometric inventories, the Female Sexual Function Index (FSFI; Rosen et al., 2000) and State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), were used to measure sexual functioning over the preceding four weeks and in-session anxiety. The FSFI was scored according to Meyer-Bahlburg and Dolezal (2007) and Brotto's (2009) recommendations (i.e., responses indicating no sexual activity over the past 4 weeks were coded as missing rather than given a score of "0"). A modified version of the Orgasm Rating Scale (ORS; Mah & Binik, 2002) was incorporated into a questionnaire designed for this study on masturbation and orgasm characteristics. Finally, an interview designed for this study was used to collect demographic and sexual history information.

## **Procedure**

Eligible participants were scheduled for two two-hour testing sessions during the estimated follicular phase of their menstrual cycle after menstruation cessation, and at least one menstrual cycle apart ( $M = 7.64$  weeks,  $SD = 4.89$ ; range = 3 – 23). Session procedures were identical except for instructions to masturbate to orgasm at one session (Orgasm Session) and until very near to orgasm ("as close as possible without accidentally reaching orgasm/80-90% of the way there"; Almost-Orgasm session) at the other, with session order

counterbalanced between participants. Prior to each session, the participant masturbated at home and completed the masturbation and orgasm questionnaire and STAI-Trait inventory in order to familiarize herself with the type of questions she would complete in session, as well as completed the FSFI. She was instructed to refrain from experiencing orgasm during the twenty-four hours before each session (to prevent any possible impact of recent orgasm on sensitivity or her ability to reach orgasm in the laboratory) and to bring any masturbatory aids (e.g., vibrators, erotic films) that she typically used at home to her session. Sessions took place at our sexual psychophysiology laboratory, which was converted to resemble a bedroom and equipped with an intercom to allow communication between the participant and the first author and research assistant, who documented participants' ratings during sensory testing. Upon arrival, the first author showed the participant the testing facilities, explained the study in further detail (including whether she was being asked to masturbate to orgasm or almost to orgasm at this session), and answered any questions. After obtaining informed consent, she conducted the interview, asked the participant to complete the STAI-State, and left the room.

The participant was instructed to undress from the waist down and lay at the foot of the bed underneath a sheet, after which the researchers returned to the room and conducted the baseline sensory testing. The first author then reminded the participant to take her time getting relaxed and comfortable in the room before privately masturbating using her preferred technique until reaching orgasm or "almost-orgasm". She was instructed to immediately notify the researchers over intercom when she stopped masturbating. The first author timed the approximate

duration of the participant's masturbation (time until notification), then conducted the post-masturbation sensory testing immediately afterwards. This was followed by a fifteen-minute rest period during which the participant was asked not to masturbate more, and the final sensory testing. The participant dressed, completed the masturbation and orgasm questionnaire, and was then debriefed and compensated \$40 per session for any inconvenience due to study participation.

### **Data Analyses**

Following the hypotheses listed above:

1. Descriptive statistics were calculated on masturbation characteristics, and sessions were compared using one-way repeated-measures ANOVAs and correlations. Pearson product-moment correlations were used to test the relationship between all normally-distributed variables, and Spearman rank-order correlations for skewed variables (with a cut-off score of skewness/standard error =  $\pm 2.5$ ).
- 2 – 6. Four-way mixed-design ANOVAs were conducted on touch and pain threshold data and sensation pleasurable ratings (within-subjects variables = testing time, session, & location tested; between-subjects variable = hormonal contraception use). Since pain ratings at the pain threshold were almost always (99% of occasions) 1 out of 10, we did not analyze pain ratings. We found no precedent for testing sensation pleasurable ratings, and therefore extracted three variables: the percent of sensations rated as pleasurable [(# of sensations with pleasurable ratings > 0 out of 10)/(total # of sensations); “percent pleasurable”], as



well as peak and average pleasurableness ratings. There was no effect of masturbation method [manual-only *vs.* (also) with a vibrator] or area stimulated during masturbation (clitoris only *vs.* also the vagina/vaginal opening) on any sensitivity measure or interaction between these variables and location tested, testing time, or session, all  $p$ 's > .05, and these variables were therefore not included in reported analyses.

Significantly skewed and unbounded data (touch and pain thresholds) were log-transformed prior to analysis, with raw as well as log values reported to facilitate intuitive understanding. Greenhouse-Geisser conservative degrees of freedom were used for variables violating the sphericity assumption, with reported  $p$  values reflecting this adjustment. Post-hoc Tukey Honestly Significant Difference (HSD) tests (Tukey, 1953) were conducted on significant main effects, and effect sizes (Cohen's  $d$ , where small, medium and large effect sizes correspond to values of .20, .50, and .80) were calculated according to Morris and DeShon's formula for repeated-measures variables, which corrects for dependence between means (Morris & DeShon, 2002).

To assess the effect of orgasm, planned comparisons were performed on post-masturbation sensation between sessions; change scores (post-masturbation minus baseline) were not used due to the likely presence of different levels of anticipatory sexual arousal at baseline at the two sessions. Spearman rank-order correlations were calculated between post-masturbation sensation pleasurableness ratings and pain thresholds.

## **Results**

### **Sexual Functioning and Laboratory Masturbation Characteristics**

Participants' mean total scores on the FSFI were 29.89 ( $SD = 3.52$ ) out of 36, with mean orgasm subscale scores of 5.09 ( $SD = 0.74$ ) out of 6. Averaged across both sessions, they reported a mean frequency of solitary masturbation of 7.90 times over the past four weeks ( $SD = 6.2$ , range = 0 – 30). Their frequency of sexual stimulation with a partner over the past four weeks ( $M = 6.59$  times;  $SD = 7.4$ , range = 0 – 27) was marginally lower than their masturbation frequency,  $F(1, 25) = 3.46$ ,  $p = .075$ ; these frequencies were not correlated with each other,  $\rho(24) = .05$ ,  $p = .82$ .

All participants reported reaching orgasm at their Orgasm session and not having done so at their Almost-Orgasm session. In an open-ended question on masturbation technique [location(s) stimulated and method], all described stimulating their clitoris, with almost half (46%) also stimulating their vaginal opening/vagina. The majority (65%) reported using a manual-only masturbation technique, with the remainder (also) using their own vibrator (when the location of vibrator use was specified, it was mostly on the clitoris, though two participants described using it inside the vagina). Masturbation characteristics by session are presented in Table 3. One extreme outlier masturbated for significantly longer than the others at both sessions (49 and 55 minutes, respectively), and was removed from the reported duration statistics. On average, participants masturbated for marginally longer and provided significantly lower ratings of post-masturbation desire to have an orgasm and peak perceived genital sexual arousal at their Orgasm session than at their Almost-Orgasm session, and similar levels of peak psychological sexual arousal. There were no session differences in levels of state anxiety, relaxation or enjoyment of masturbation, and all

masturbation characteristics other than peak subjective sexual arousal were significantly positively correlated across sessions. There was no effect of order of session except for on state anxiety levels, which were slightly higher at participants' first sessions ( $M = 32.92$  vs.  $30.96$  out of  $80$ ),  $F(1, 24) = 4.35$ ,  $p = .048$ ; all other  $p$ 's  $> .10$ . Participants' ratings of orgasmic pleasure at their Orgasm session ( $M = 7.19$  out of  $10$ ,  $SD = 1.27$ , range =  $4 - 9$ ) did not significantly differ from those provided about their previous at-home masturbatory orgasm ( $M = 6.84$ ,  $SD = 1.27$ , range =  $4 - 9$ ;  $p > .10$ ).

### **Sensitivity**

#### **Glans clitoris vs. vulvar vestibule & forearm.**

***Touch thresholds.*** Touch thresholds did not significantly differ by location tested,  $F(2, 48) = 2.21$ ,  $p > .10$ .

***Pleasurableness ratings.*** There was a significant main effect of location tested on percent pleasurable,  $F(2, 48) = 14.23$ ,  $p < .001$ , peak pleasurableness ratings,  $F(2, 48) = 14.41$ ,  $p < .001$ , and average pleasurableness ratings,  $F(2, 48) = 16.39$ ,  $p < .001$ . Post-hoc Tukey HSD tests (presented in Figure 1) revealed that sensation pleasurableness was higher on the glans clitoris than on the vulvar vestibule,  $d$ 's =  $.61 - .70$ , and on both genital locations than on the volar forearm;  $d$ 's for glans clitoris vs. volar forearm =  $.58 - .93$  and  $d$ 's for vulvar vestibule vs. volar forearm =  $.34 - .54$ .

There was a significant interaction between testing time and location tested for peak pleasurableness ratings,  $F(4, 96) = 4.22$ ,  $p = .010$ , and average pleasurableness ratings,  $F(4, 96) = 3.80$ ,  $p = .012$ ; the interaction for percent pleasurable did not reach statistical significance,  $F(4, 96) = 2.23$ ,  $p = .098$ . For

both peak and average pleasurableness ratings, post-hoc Tukey HSD tests (presented in Figure 2 for peak pleasurableness ratings) revealed that location effects significantly differed by testing time. While values for the glans clitoris were significantly higher at all testing times than those for the vulvar vestibule, all  $p$ 's < .01,  $d$ 's = .42 – .82, and volar forearm at all testing times, all  $p$ 's < .01,  $d$ 's = .55 – .79, values for the vulvar vestibule were significantly higher than those for the volar forearm at baseline and post-masturbation only,  $p$ 's < .01,  $d$ 's = .33 – .63; there was no difference between vulvar vestibule and volar forearm values at post-rest,  $p$ 's > .10,  $d$ 's = .07 – .10.

**Pain thresholds.** There was also a significant main effect of location tested on pain thresholds,  $F(2, 23) = 119.96, p < .001$ . Post-hoc Tukey HSD tests (presented in Figure 1 with logged values) revealed that average pain thresholds on the glans clitoris (raw  $M = 68.88$  g) and vulvar vestibule (raw  $M = 57.98$  g) did not significantly differ from each other,  $d = .08$ , but that these were both significantly lower than those on the volar forearm (raw  $M = 173.87$ );  $d$  for glans clitoris vs. volar forearm = -2.36 and  $d$  for vulvar vestibule vs. volar forearm = -3.25.

**Summary.** Touch thresholds did not differ across locations. Pleasurableness ratings were significantly higher on the glans clitoris than on the vulvar vestibule and volar forearm; as well as significantly higher on the vulvar vestibule than the volar forearm, but for two out of three variables, only at baseline and immediately following masturbation. Effect sizes associated with significant differences ranged from .33 to .93. Pain thresholds were similar on the glans clitoris and vulvar vestibule, and significantly higher on both genital

locations than on the volar forearm; associated effect sizes ranged from 2.36 to 3.25.

**Baseline vs. post-masturbation & post-rest.**

*Touch thresholds.* Touch thresholds did not significantly differ by testing time,  $F(2, 48) = 1.10, p > .10$ , nor was there a significant interaction between testing time and location tested,  $p > .10$ .

*Pleasurableness ratings.* There was a significant main effect of testing time on percent pleasurable,  $F(2, 48) = 5.16, p = .009$ , peak pleasurableness ratings,  $F(2, 48) = 5.80, p = .006$ , and average pleasurableness ratings,  $F(2, 48) = 5.57, p = .007$ . All pleasurableness variables followed a significant linear trend, all  $p$ 's  $< .01$ , with post-hoc Tukey HSD tests (presented in Figure 3) revealing that baseline values did not significantly differ from those at post-masturbation,  $d$ 's = .03 – .14, but post-masturbation values exceeded those at post-rest,  $d$ 's = .39 – .49. For all variables, post-rest values were significantly lower than baseline values,  $p$ 's  $< .05$ ,  $d$ 's = .49 – .61.

Testing time effects on peak and average pleasurableness ratings significantly differed by location tested (as per the previously-mentioned interactions, presented in Figure 2 for peak ratings). While the lack of difference between baseline and post-masturbation values applied to all locations, all  $p$ 's  $> .10$ ,  $d$ 's = .02 – .26, they were significantly higher than post-rest values on the glans clitoris and vulvar vestibule only, all  $p$ 's  $< .10$ ,  $d$ 's = .48 – .84 (except for peak ratings on the glans clitoris at baseline vs. post-rest where  $p > .10$ ,  $d = .52$ ); values for the forearm did not differ across testing times, all  $p$ 's  $> .10$ ,  $d$ 's = .02 – .14.

**Pain thresholds.** There was a significant main effect of testing time on pain thresholds,  $F(2, 48) = 4.38, p = .018$ , which followed a significant linear trend,  $F(1, 24) = 4.64, p = .041$ . Post-hoc Tukey HSD tests (presented in Figure 3 with logged values) revealed that baseline pain thresholds (raw  $M = 170.98$  g) were significantly higher than those at post-masturbation ( $M = 162.18$  g),  $d = .52$ , and marginally higher than those at post-rest ( $M = 158.99$  g),  $p < .10, d = .43$ ; and that post-masturbation and post-rest pain thresholds did not significantly differ from each other,  $d = -.09$ . There was no significant interaction between testing time and location tested,  $p > .10$ .

**Summary.** Touch thresholds did not change following masturbation. Pleasurableness ratings did not change significantly from baseline to post-masturbation, but decreased from post-masturbation to post-rest (for two out of three variables, on the genital locations only); some differences between baseline/post-masturbation and post-rest did not reach statistical significance, but all associated effect sizes ranged from .39 to .84. Pain thresholds decreased significantly from baseline to post-masturbation and did not change significantly from post-masturbation to post-rest (where they remained marginally lower than at baseline); effect sizes associated with the difference between baseline and post-masturbation/post-rest were .52 and .43, respectively.

#### **Orgasm vs. Almost-Orgasm session.**

**Touch thresholds.** Touch thresholds did not significantly differ between sessions,  $F(1, 24) = 0.08, p > .10$ , nor was there a significant interaction between session and location tested or testing time,  $p$ 's  $> .10$ .

***Pleasurableness ratings.*** Neither percent pleasurable,  $F(1, 24) = .18, p > .10$ , peak pleasurableness ratings,  $F(1, 24) = .18, p > .10$ , nor average pleasurableness ratings,  $F(1, 24) = 2.27, p > .10$ , significantly differed between sessions. There was no significant interaction between session and testing time for any pleasurableness variable, all  $p$ 's  $> .10$ , indicating no overall effect of orgasm on sensation pleasurableness.

***Pain thresholds.*** There was a significant main effect of session on pain thresholds: those at the Orgasm session [ $M = 154.80$  g (1.80 log g)] were significantly lower than at the Almost-Orgasm session [ $M = 173.31$  g (1.86 log g)],  $F(1, 24) = 5.23, p = .031, d = -.42$ . There was no significant interaction between session and testing time,  $p > .10$ , indicating no overall effect of orgasm on pain thresholds.

***Planned comparisons.*** Planned comparisons were performed on post-masturbation sensation between sessions to assess the effect of orgasm separately for each location tested (presented in Table 4). Peak and average pleasurableness ratings were both significantly lower at the Orgasm than the Almost-Orgasm session on the glans clitoris and vulvar vestibule, but did not differ on the forearm; there were no differences at any location in percent pleasurable. Pain thresholds were significantly lower at the Orgasm than Almost-Orgasm session on the vulvar vestibule, but did not differ on the glans clitoris or forearm.

***Summary.*** Overall, touch thresholds and pleasurableness ratings did not differ between sessions, but pain thresholds were lower at the Orgasm than at the Almost-Orgasm session with an associated effect size of .42. After masturbation to orgasm, genital pleasurableness ratings (as measured by two out of three

variables) were significantly lower and vestibular pain thresholds were significantly lower than after masturbation almost to orgasm; associated effect sizes ranged from .27 to .42. There were no orgasm-related differences in touch thresholds, pleasurable ratings on the volar forearm, or pain thresholds on the glans clitoris or volar forearm.

**Relationship between sensation pleasurable and painfulness.** At post-masturbation, all pleasurable variables and pain thresholds (elicited during vulvalgesiometer testing) were significantly positively correlated on the glans clitoris,  $\rho(24) = .42 - .60$ , all  $p$ 's  $< .05$ , but there were no such associations on the vulvar vestibule or volar forearm, all  $p$ 's  $> .10$ .

**Hormonal contraception use vs. non-use.**

**Touch thresholds.** There was no effect of hormonal contraception use on touch thresholds,  $F(1, 24) = 2.11$ ,  $p > .10$ , or significant interactions between hormonal contraception use and testing time, session, or location tested for touch thresholds, all  $p$ 's  $> .10$ .

**Pleasurable ratings.** The percentage of sensations rated as pleasurable was significantly lower for users than non-users ( $M = 33\%$  vs.  $61\%$ ),  $F(1, 24) = 6.10$ ,  $p = .021$ ,  $d = -.97$ . There were also non-significant trends for users to have lower peak pleasurable ratings ( $M = 1.00$  vs.  $2.20$  out of 10),  $F(1, 24) = 3.13$ ,  $p = .090$ ,  $d = -.77$ , and lower average pleasurable ratings ( $M = 0.62$  vs.  $1.63$  out of 10),  $F(1, 24) = 2.94$ ,  $p = .099$ ,  $d = -.78$ , than non-users. There were no significant interactions between hormonal contraception use and testing time, session, or location tested for the pleasurable variables, all  $p$ 's  $> .10$ .



***Pain thresholds.*** There was a non-significant trend for users to have lower pain thresholds than non-users [135.06 g (1.70 log g) vs. 186.24 g (1.92 log g)],  $F(1, 23) = 3.02, p = .095, d = -.69$ . There were no significant interactions between hormonal contraception use and testing time, session, or location tested for pain thresholds, all  $p$ 's  $> .10$ .

***Summary.*** Hormonal contraception users and non-users had similar touch thresholds. Users had lower pleasurable ratings (significantly for one variable and marginally for the other two) and marginally lower pain thresholds than non-users; associated effect sizes ranged from .69 to .97.

## **Discussion**

In this study, healthy young women privately masturbated to orgasm and almost to orgasm during two separate laboratory sessions. They reported no sexual difficulties during screening or on the FSFI (scores were above the cut-off score for sexual dysfunction; Wiegel, Meston, & Rosen, 2005), and an average frequency of solitary masturbation and partnered sex of 1.98 and 1.65 times per week, respectively. Sensory testing was conducted on the glans clitoris, vulvar vestibule, and volar forearm before and immediately and 15 minutes after masturbation. All participants reported successfully complying with instructions to reach orgasm or avoid reaching orgasm at their two sessions, and relaxation, enjoyment and orgasmic pleasure ratings were similar to those experienced during masturbation at home; they also reported low levels of in-session anxiety and many provided positive feedback about feeling more comfortable and relaxed than they had expected. This outcome provides further support for the feasibility and participant acceptability of conducting studies of orgasm in the laboratory.

Despite the numerous advantages of laboratory studies of orgasm (e.g., allowing for a controlled setting and non-retrospective self-report), they are uncommon compared to those of sexual arousal (e.g., Courtois et al., 2008; Georgiadis et al., 2006; Georgiadis, Reinders, Paans, Renken, & Kortekaas, 2009; Gruenwald et al., 2007; Komisaruk et al., 2004; Kruger, Burri, & Schedlowski, 2011; Krüger, Haake, Hartmann, Schedlowski, & Exton, 2002; Kruger et al., 2006; van Netten, Georgiadis, Nieuwenburg, & Kortekaas, 2008).

As hypothesized, participants masturbated for marginally longer (almost 2 minutes) when masturbating to orgasm than almost to orgasm. They also reported significantly less (almost 4 points out of 10) desire to have an orgasm following masturbation to orgasm than almost to orgasm. Contrary to expectation, they provided similar ratings of peak psychological sexual arousal at both sessions and significantly lower ratings of peak genital sexual arousal (although by only 0.44 points out of 10) after masturbating to orgasm than almost to orgasm. Since ratings were provided following masturbation, it is possible that they were affected by participants' current levels of sexual arousal, which were likely lower following orgasm.

As expected, women reported significantly greater pleasurable sensitivity on the glans clitoris than the vulvar vestibule and especially the volar forearm; and, at most testing times, on the vulvar vestibule than the volar forearm. These results provide support for the ecological validity of the experimental procedure, in that they quantitatively confirm general reported experience, i.e., that clitoral stimulation is pleasurable, the easiest and most effective means of reaching orgasm for most women during both solitary and partnered sexual activity (Lloyd,

2005), and associated with the strongest orgasms (Schober, Meyer-Bahlburg, & Ransley, 2004). The glans clitoris's greater pleasurable sensitivity is also consistent with its extensive innervation relative to other genital areas (Baskin et al., 1999; Moszkowicz et al., 2011). As hypothesized, pain sensitivity was significantly higher on both genital locations than on the volar forearm, but it did not differ between the glans clitoris and vulvar vestibule. It therefore appears that the glans clitoris is more sensitive than the vulvar vestibule in terms of having more positive/pleasurable responses to stimulation (pleasurable sensitivity), but not more negative/painful ones (pain sensitivity).

Participants rated the sensations produced by stimulation of the genital locations as more pleasurable before and immediately after masturbation than 15 minutes later. Some differences did not reach statistical significance, but effect sizes in the small-to-medium to large range suggest that this was due to the small sample size. For most of the pleasurableness variables, there was no change over time on the volar forearm. Presuming that sexual arousal was at a low level at the baseline testing time (due to anticipation of masturbation) and at a high level (following masturbation), these results suggest that pleasurable sensitivity is highest in the presence of ascending sexual arousal as compared to after it has (partially) dissipated (during the rest period following masturbation cessation). While we expected an increase in pleasurableness ratings after masturbation, it is possible that (a) maximal pleasurable sensitivity is experienced once women surpass a relatively low, threshold level of sexual arousal that was already present at baseline, and/or (b) mood, which was not assessed in this study, influences pleasurable sensitivity and was positive before and immediately following

masturbation, but became more negative during the rest period. Future studies should investigate mood changes with sexual arousal and orgasm and their impact on sensitivity.

For all locations, pain thresholds were higher before masturbation than immediately or 15 minutes afterwards. Although the difference between baseline and post-rest pain thresholds did not reach statistical significance, both effect sizes were in the medium range. These results suggest that pain sensitivity is lowest while sexual arousal is at a low level (at baseline), as compared to at a high level (following masturbation) or after it has (partially) dissipated (during the rest period following masturbation cessation). This contradicts traditional advice to increase sexual arousal to decrease pain sensitivity, but replicates Payne and colleagues' (2007) findings of lowered pain thresholds on the vulvar vestibule with passive (i.e., watching an erotic film clip) sexual arousal; their results therefore appear not to be an artifact of inquiring about only sensation painfulness. Whether this effect is due to vasocongestion, as suggested by Payne and colleagues (2007), remains to be determined; our similar results for the genital locations and volar forearm suggest that other factors, such as a general increase in bodily awareness, may (also) decrease pain thresholds following masturbation.

Our finding of increased pain sensitivity following masturbation is counter-intuitive, since this would dissuade women from engaging in sexual activity when sexually aroused. There are two related possibilities that could explain this apparent contradiction: (a) lubrication – and, perhaps, avoiding direct stimulation of the uncovered glans clitoris – plays an even larger role than

previously thought in protecting against genital pain during sexual activity, since it must compensate for normative increases in tissue pain sensitivity, and (b) the pleasurableness of genital sensations (which may be increased with lubrication/indirect glans clitoris stimulation) suppresses pain awareness or unpleasantness through cognitive distraction or some other mechanism. In support of the first possibility, lubrication would reduce friction and thus facilitate the application of lighter pressure during sexual stimulation, as it would be easier for a hand/tongue/penis/sex toy to glide across or into genital structures. The effect of lubrication on pain and pleasure during genital stimulation is receiving increasing research attention. The application of an exogenous lubricant to the speculum has been found to reduce the painfulness of vaginal examinations (Hill & Lamvu, 2012). A recent, large American study prospectively tested the effect of exogenous lubricant use on women's sexual pleasure and satisfaction (Herbenick et al., 2011). At baseline, women reported preferring sex to feel more wet and feeling more easily orgasmic when sex was more wet (Jozkowski et al., 2012). In their daily diaries, they reported experiencing significantly more sexual pleasure and satisfaction during masturbation, vaginal intercourse, and anal intercourse when using an exogenous lubricant as compared to not using one (Herbenick et al., 2011).

In support of the second possibility, we found that, as hypothesized, post-masturbation pleasurableness ratings and pain thresholds were positively correlated, although only on the glans clitoris. Stimulation of the glans clitoris following masturbation was therefore the least painful when it was the most pleasurable. This is consistent with the theory that pleasure and pain suppress

each other (which thus far has only been tested in non-sexual contexts; Leknes & Tracey, 2008, 2010), and suggests that enhancing the pleasurableness of genital sensations (e.g., by using/communicating preferred stimulation techniques or first inducing positive mood) during sexual activity could decrease the likelihood of experiencing pain.

A comparison of sessions revealed no overarching effect of orgasm on sensitivity. However, as expected, pleasurable sensitivity was lower on both genital locations and pain sensitivity was higher on the vulvar vestibule after masturbation to orgasm than almost to orgasm. Decreased pleasurable sensitivity following orgasm may occur because of the subsequent (partial) resolution of sexual arousal, and is consistent with clinical experience that not all women enjoy and pursue additional stimulation after orgasm (Darling, Davidson, & Jennings, 1991; Masters & Johnson, 1966). Contrary to expectation, clitoral pain thresholds were similar whether or not orgasm had occurred. Orgasm therefore appears to decrease clitoral pleasurable sensitivity but not affect its pain sensitivity. This suggests that a woman's post-orgasmic decrease in desire for stimulation may be based more on the expectation of reduced pleasure than of pain/discomfort.

Contrary to hypothesis and Payne and colleagues' (2007) finding of decreased touch thresholds with sexual arousal, we found no significant differences in touch thresholds across locations, testing times, or sessions. During the touch threshold testing, several participants expressed uncertainty when asked whether they felt anything, and although we replicated Payne and colleagues' (2007) procedure, it is possible that a more careful staircase method (Pukall,

Binik, Khalife, Amsel, & Abbott, 2002) would have yielded more reliable results and/or different results.

As hypothesized, participants using hormonal contraception exhibited lower pleasurable sensitivity and higher pain sensitivity than those not using it; although most of these differences only neared statistical significance, all effect sizes were medium to large. Contrary to expectation, these findings were not specific to the genital locations, which suggests that the systemic effects of hormonal contraception (e.g., on levels of sexual desire) may also affect non-genital sensitivity to touch. Previous research has found an association between hormonal contraception use and both decreased sexual desire and the development of provoked vestibulodynia (for a review, see Burrows et al., 2012), but healthy women using hormonal contraception have not been consistently found to have higher genital pain sensitivity when tested with no induction of sexual arousal (Bohm-Starke et al., 2004; Lee et al., 2011). It is possible that greater differences emerge in a sexual context due to users' lower levels of sexual desire (in this case, for stimulation by the experimenter). Since we only included participants with no sexual difficulties, it was not possible to find differences in retrospective ratings of overall sexual desire (i.e., on the FSFI) between women using and not using hormonal contraception, and we did not assess sexual desire during study participation. Future studies should include measures of concurrent sexual desire and a more detailed assessment of contraceptive history (e.g., separating non-users into discontinued- and never-users), which could amplify the observed group differences.

This study had several limitations related to the sample, including its relatively small size and that only women open to masturbating in the laboratory volunteered to participate. They were likely more sexually active than non-volunteers, as they reported a high average frequency of solitary masturbation (almost 2 times per week) relative to North American population norms: a recent representative survey in the United States found that, of the women aged 18 to 24 who had masturbated in the past year (64%), only 16% masturbated more than once per week (Herbenick et al., 2010). Our sample's average frequency of partnered sexual activity (1.65 times/week) appears to have been more typical, with the same survey finding that 35% of women aged 18 to 24 engaged in vaginal intercourse more than once per week (frequency of all partnered sexual stimulation not provided; Herbenick et al., 2010). It may, however, be important for genital sensitivity research participants to be more sexually open than the general population, in that stimulation by an experimenter is inevitably less desired than that provided by a sexual partner or oneself outside of the laboratory environment and may engender self-consciousness. Our participants nonetheless reported experiencing varying levels of pleasure from stimulation, even at times of increased vulvar engorgement.

The study also had methodological limitations, including that the sensory tester was not blind to the participant's orgasm status and, since participants were not monitored during masturbation, it depended on their honest reporting of masturbation and orgasm occurrence and use of the same masturbatory technique at both sessions. Their descriptions of masturbatory technique were not always detailed and future studies should use separate checklist-style questions for



method and area(s) of stimulation. There was also no control condition not involving masturbation, and sexual arousal ratings were obtained only once (following masturbation). Future research including a non-sexual condition and multiple/continuous measures of sexual arousal would confirm the presence of anticipatory sexual arousal prior to masturbation, and the degree to which it increases with masturbation and decreases following masturbation cessation. Only one measure of pain sensitivity (thresholds) was obtained, and other measures, such as pain tolerance, may reveal different patterns. Finally, the punctate pressure used during sensory testing replicates the pressure but not the rubbing component of sexual stimulation. Although light stroking with a paintbrush has been used in recent studies of the “pleasantness” of non-genital touch (Loken, Evert, & Wessberg, 2011; Morrison et al., 2011), the greater pressure typically used during masturbation and partnered sex would be difficult to standardize in combination with stroking and administer safely on genital locations, which are not flat and vary in size between individuals and with sexual arousal. The “tampon test” has been used in vulvodynia treatment research as a proxy for vaginal intercourse (Foster et al., 2009), but stimulation is applied by participants, who may vary in the velocity of insertion and removal and natural levels of lubrication, and it is not applicable to the clitoris. Participants’ sexual partners have been used in other orgasm research to provide genital stimulation (Georgiadis et al., 2006), and partners could be instructed to conduct sensory testing (e.g., by applying their typical form of stimulation for a set amount of time); however, in addition to being impossible to standardize between participants, partners introduce a multitude of confounds related to their

stimulation skills and match with the participants' preferences, etc. Punctate pressure may therefore represent the best currently-available compromise between ecological validity and standardization.

This is the first study of the effect of sexual arousal or orgasm on sensitivity to include an assessment of the pleasurable of genital stimulation as well as its painfulness, test sensation intensity on the clitoris, and attempt to isolate the effect of orgasm. It provides normative data on changes in sensitivity elicited by pressure stimulation, and an experimental paradigm for use in future studies of women and men with abnormal genital sensitivity and sexual dysfunction.

Results indicate that genital sensations are pleasurable but also more painful after masturbation, and that orgasm decreases genital pleasurable sensitivity and further increases pain sensitivity on the vulvar vestibule only. The traditional sex therapy recommendation to increase levels of sexual arousal therefore appears to facilitate pleasurable sensitivity as intended, but may be overly simplistic as a strategy to decrease pain. Our results provide indirect support for the importance of lubrication in facilitating painless and pleasurable sexual activity, as it would reduce the pressure applied during genital stimulation. Lubrication and the beneficial effects of psychological sexual arousal, such as distraction from pain/discomfort, appear to be sufficient to override increases in pain sensitivity in the real world, where experimenters are not directing attention towards possible painfulness. A particularly intriguing finding was that, following masturbation, the experience of higher pleasurable sensitivity on the clitoris was associated with lower pain sensitivity. Future studies should test

whether the sensitivity changes found here in healthy women also occur in those with sexual dysfunction and chronic genital pain or anesthesia, and continue to incorporate measures of pleasurableness as well as painfulness to gain a fuller understanding of genital sensitivity.

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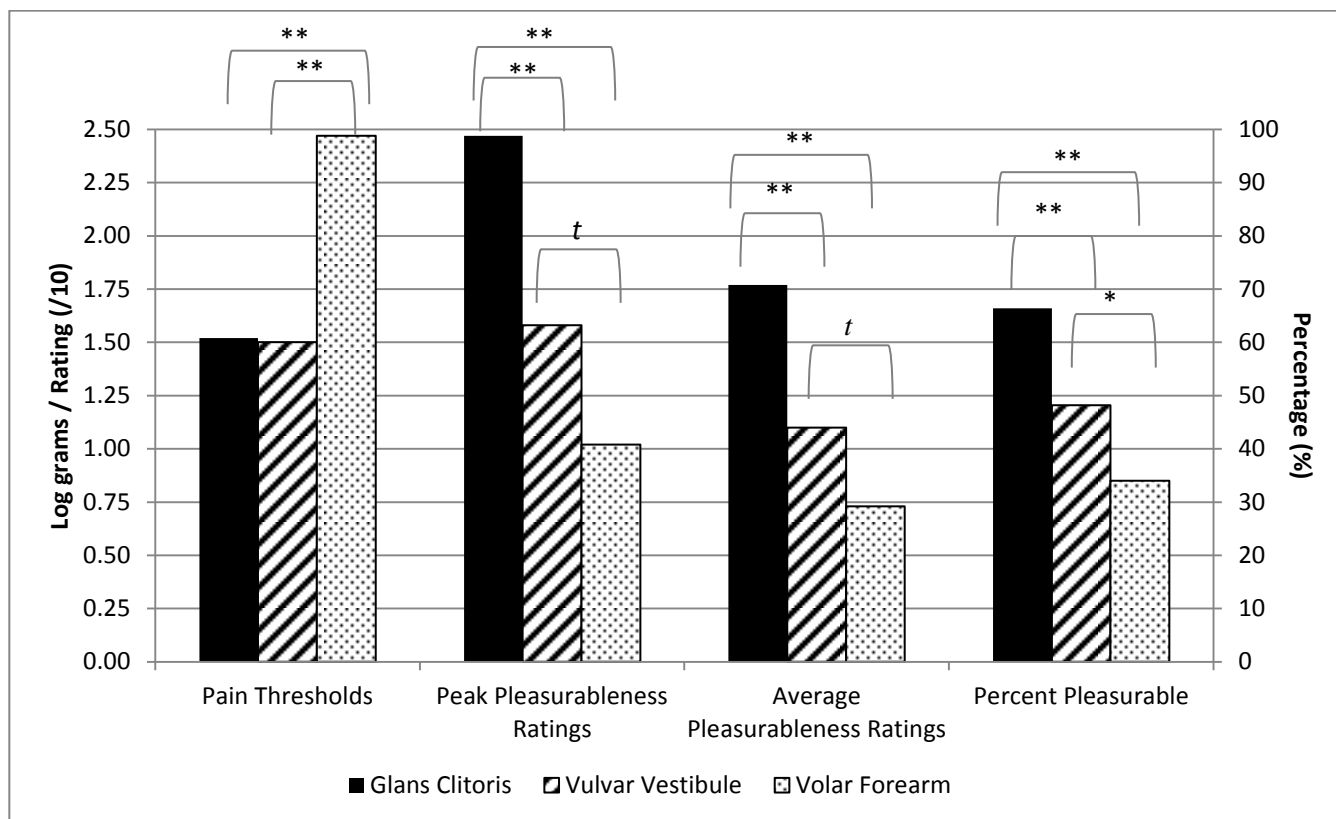
Table 3. Masturbation characteristics by session.

|  | Orgasm Session        | Almost-Orgasm Session | <i>F</i>                 | <i>r / rho</i> | <i>d</i> |
|--|-----------------------|-----------------------|--------------------------|----------------|----------|
|  | <i>M (SD, range)</i>  | <i>M (SD, range)</i>  |                          |                |          |
| Masturbation duration<br>(minutes)             | 11.92 (6.89, 1 – 26)  | 9.96 (5.98, 1 – 20)   | 2.97 <sup><i>t</i></sup> | .62 ***        | .35      |
| Peak perceived genital<br>sexual arousal (/10) | 7.23 (1.35, 4 – 9)    | 7.67 (1.01, 5 – 9)    | 3.25 *                   | .46 **         | -.36     |
| Peak psychological<br>sexual arousal (/10)     | 6.23 (1.45, 4 – 9)    | 6.61 (1.65, 4 – 9)    | .91                      | .12            | -.19     |
| Post-masturbation desire<br>for orgasm (/10)   | 4.04 (2.90, 0 – 9)    | 7.85 (1.78, 2 – 10)   | 51.21 **                 | .40 *          | -1.48    |
| State anxiety (/80)                            | 31.69 (7.01, 20 - 44) | 32.19 (7.44, 20 – 45) | 0.14                     | .76 ***        | -.10     |
| Relaxation (-3 to +3) <sup>a</sup>             | -0.73 (.78, -2 – 1)   | -0.73 (.67, -2 – 0)   | 0.00                     | .55 **         | .00      |
| Enjoyment (-3 to +3) <sup>a</sup>              | -0.54 (.90, -2 – 1)   | -0.46 (.90, -2 – 1)   | 0.24                     | .61 ***        | -.10     |

<sup>a</sup> Rated on a 7-point scale from -3 = “much less than at home” to +3 = “much more than at home”

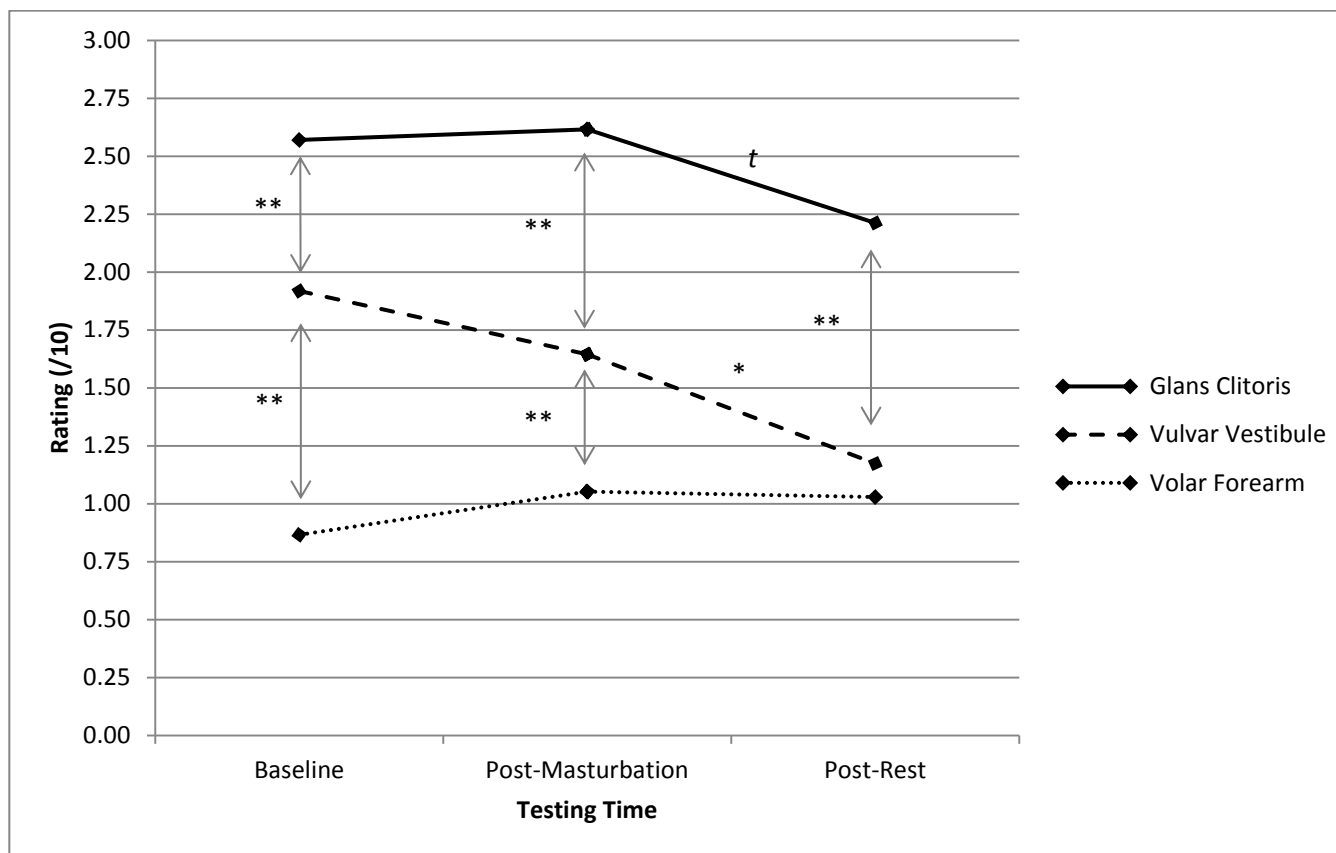
<sup>*t*</sup>  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Figure 1. Sensitivity by location tested.



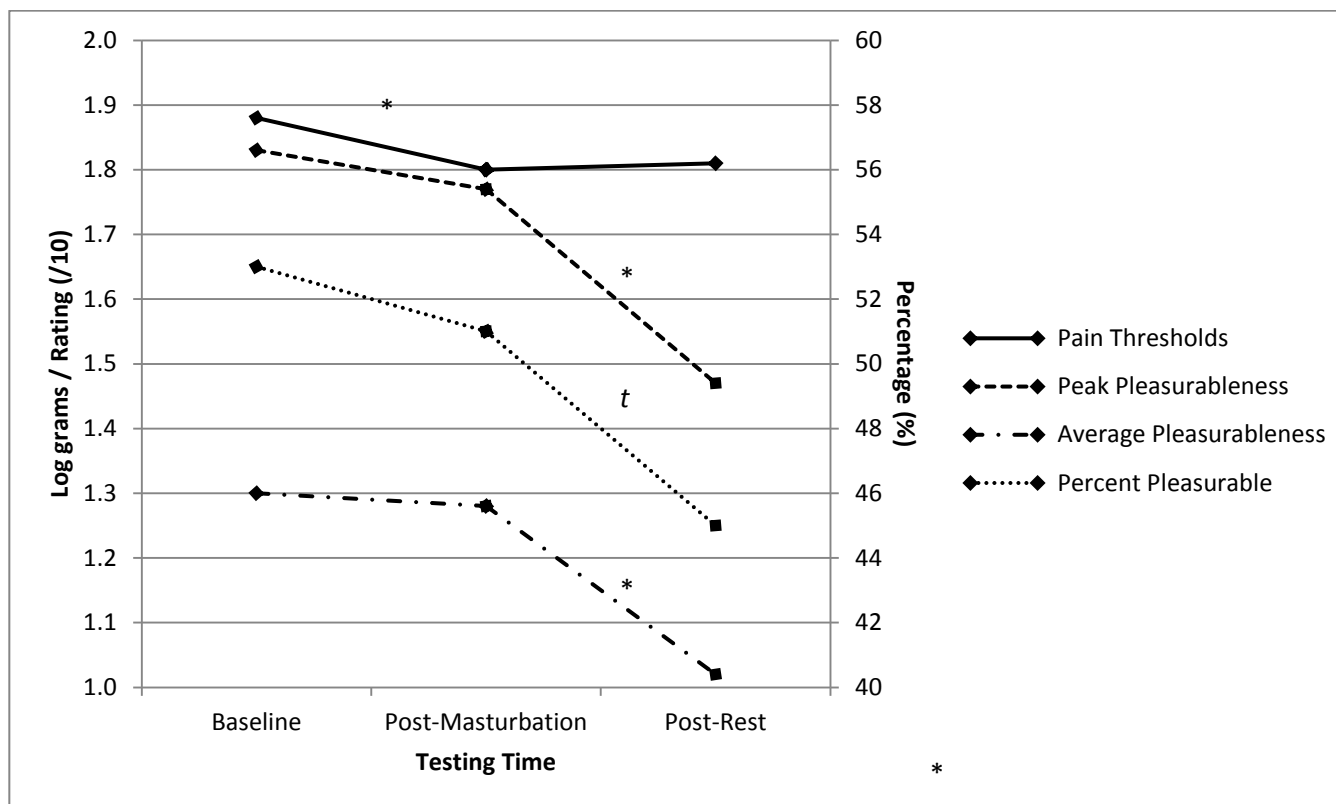
$t p < .10$ ,  $* p < .05$ ,  $** p < .01$

Figure 2. Peak pleasurableness ratings by testing time and location tested.



<sup>t</sup>  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$

Figure 3. Sensitivity by testing time.



<sup>t</sup>  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$

Table 4. Post-masturbation sensitivity by session.

|                               | Orgasm Session | Almost-Orgasm Session | <i>F</i> | <i>r</i> <sup>a</sup> / <i>rho</i> | <i>d</i> <sup>a</sup> |
|-------------------------------|----------------|-----------------------|----------|------------------------------------|-----------------------|
| <hr/>                         |                |                       |          |                                    |                       |
| Proportion Pleasurable (%)    |                |                       |          |                                    |                       |
| Clitoris                      | 66.80          | 68.87                 | 0.14     | .52 **                             | -.05                  |
| Vulvar Vestibule              | 47.57          | 51.51                 | 0.50     | .56 **                             | -.10                  |
| Forearm                       | 31.57          | 40.37                 | 2.50     | .44 *                              | -.19                  |
| Peak Pleasurableness (/10)    |                |                       |          |                                    |                       |
| Clitoris                      | 2.35           | 2.88                  | 7.75 **  | .85 ***                            | -.41                  |
| Vulvar Vestibule              | 1.23           | 2.06                  | 18.29 ** | .55 ***                            | -.42                  |
| Forearm                       | 1.03           | 1.08                  | 0.07     | .53 ***                            | -.03                  |
| Average Pleasurableness (/10) |                |                       |          |                                    |                       |
| Clitoris                      | 1.68           | 2.07                  | 7.10 **  | .71 ***                            | -.27                  |
| Vulvar Vestibule              | 0.90           | 1.51                  | 17.25 ** | .57 ***                            | -.41                  |
| Forearm                       | 0.70           | 0.80                  | 0.53     | .49 ***                            | -.12                  |
| Pain Thresholds [g (log)]     |                |                       |          |                                    |                       |
| Clitoris                      | 63.81 (1.47)   | 81.42 (1.52)          | 0.58     | .63 ***                            | -.10                  |



|                  |               |               |        |         |      |
|------------------|---------------|---------------|--------|---------|------|
| Vulvar Vestibule | 48.23 (1.38)  | 55.19 (1.54)  | 4.75 * | .47 *   | -.33 |
| Forearm          | 363.85 (2.44) | 360.58 (2.45) | 0.02   | .62 *** | -.04 |

<sup>a</sup> Calculated using logged values for pain thresholds.

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

## **TRANSITION**

In the preceding study, my colleagues and I inquired about orgasmic pleasure in order to establish that the laboratory setting had not degraded the orgasm experience as compared to during masturbation at home. For my next study, I set out to focus on orgasmic pleasure, as it is a relatively neglected topic in sex research. Most orgasm studies focus on occurrence rather than quality; however, a few have administered the Orgasm Rating Scale (ORS; Mah & Binik, 2002) to community samples of men and women. On the ORS, participants rate the extent to which a set of sensory and cognitive/affective adjectives describe their most recent solitary and/or partnered orgasm on a 6-point scale (0 = “does not describe it at all” to 5 = “describes it perfectly”). Orgasmic pleasure is measured with the Pleasurable Satisfaction subscale, which includes the adjectives “pleasurable”, “satisfying”, and “fulfilling”.

My colleagues and I designed a study that incorporated the ORS and other measures of orgasmic pleasure, intensity, and satisfaction in order to test the final two assumptions listed in the General Introduction: (a) that men’s sexual arousal consistently decreases after orgasm, whereas women’s can remain elevated, thus allowing for additional orgasms, and (b) that orgasms are more pleasurable and satisfying following a greater build-up of sexual arousal prior to orgasm. We additionally tested to what extent orgasmic pleasure predicted the decline in sexual arousal and desire following orgasm.

Physiological sexual arousal was measured with a thermal imaging camera. Until the recent validation of thermography as a measure of physiological sexual arousal (Kukkonen, Binik, Amsel, & Carrier, 2007, 2010), it was not possible to

study the interplay of sexual arousal and orgasm using an identical experimental procedure for men and women; all other measures require contact with the genitals and would not be compatible with masturbation. The following manuscript presents the results of this laboratory study on gender differences in sexual arousal and desire with masturbation to orgasm, and predictors of orgasmic pleasure.

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## **MANUSCRIPT FOUR**

### **GENDER DIFFERENCES IN SEXUAL AROUSAL, DESIRE AND ORGASMIC PLEASURE IN THE LABORATORY**

Paterson, L. Q. P., Jin, E. S., Amsel, R., & Binik, Y. M. (submitted manuscript).

Gender differences in sexual arousal, desire and orgasmic pleasure in the  
laboratory.

## Abstract

Relatively little is known about gender differences in the orgasm experience. The objectives of this study were to compare men and women's patterns of sexual arousal and desire before and after orgasm, and the predictors of their orgasmic pleasure. Thirty-eight men and 38 women masturbated to orgasm in the laboratory using their typical technique, and masturbation enjoyment was similar to that experienced at home. Physiological sexual arousal (genital temperature) and subjective sexual arousal and desire measurements were taken at baseline, after masturbation almost to orgasm, and immediately and 15 minutes after orgasm. Men and women both experienced significant increases in these measures during masturbation, with a greater build-up leading to more pleasurable orgasms. After orgasm, however, every measure decreased more quickly and consistently in men than in women, thereby replicating Masters and Johnson's (1966) observations. More men than women exhibited resolution of subjective sexual arousal and sexual satiation; their genital temperature also decreased more than women's but did not return to baseline. Women's orgasmic pleasure was related to a post-orgasmic decrease in genital temperature but, unexpectedly, the maintenance of subjective sexual arousal and desire. Future studies should explore whether this pattern explains gender differences in the pursuit of additional orgasms.

*Keywords:* orgasm, sexual arousal, sexual desire, masturbation, orgasmic pleasure

## Gender Differences in Sexual Arousal, Desire and Orgasmic Pleasure in the Laboratory

Relatively little empirical research has investigated how the orgasm experience differs between men and women. Existing studies have typically focused on either the physiological or psychological aspects of orgasm with few attempts at integration. Physical changes were first documented in the laboratory by Masters and Johnson (1966), who found that orgasm occurred at the peak of physiological sexual arousal and involved involuntary rhythmic contractions of the pelvic musculature in both genders. Despite the overall similarity, they noted two gender differences in orgasmic expression: (a) men experienced orgasm and ejaculation simultaneously, and (b) following orgasm, men exhibited a consistent resolution of genital sexual arousal and a “refractory period”, during which they could not experience further erection or orgasms. Women’s post-orgasmic genital arousal was more variable, and could decrease quickly like men’s or remain elevated, thus allowing for the experience of additional orgasms. The small number of subsequent laboratory studies on both men and women have confirmed the similarity of their peripheral and central changes during orgasm (e.g., Brody & Kruger, 2006; Georgiadis et al., 2006; Georgiadis, Reinders, Paans, Renken, & Kortekaas, 2009). While the gender difference in refractory period has not been experimentally verified in humans, it remains accepted (Levin, 2009), possibly because it is consistent with self-reported sexual behaviour. Women are more likely than men to pursue additional sexual stimulation following orgasm and experience more than one orgasm during a single session of sexual activity (e.g., 29% vs. 8% during optimal partnered sex; Haning et al., 2007), but it is not known

to what extent this is due to a greater post-orgasmic maintenance of sexual arousal, lesser sexual satiation (i.e., a smaller decrease in sexual desire), or both. The term sexual satiation or satiety is sometimes used interchangeably with sexual satisfaction (e.g., Leeners et al., 2013), but its defining feature, a lack of interest (i.e., desire) in further sexual activity, has never been prospectively studied in humans. It is not known whether it follows the same pattern after orgasm as the resolution of sexual arousal.

The psychological experience of orgasm also appears to be similar in men and women (Mah & Binik, 2001; Vance & Wagner, 1976), and includes feelings of intense pleasure and release of tension. Although many definitions of orgasm acknowledge variability in response, especially in women (e.g., Meston, Levin, Sipski, Hull, & Heiman, 2004), there is little data available on the factors associated with orgasmic pleasure. The first study to systematically assess orgasm quality found no gender differences in retrospective ratings of orgasmic pleasure for either solitary or partnered orgasms (Mah & Binik, 2002). Orgasmic pleasure does not appear to be related to testosterone or estradiol levels in either gender (van Anders & Dunn, 2009), but may be influenced by context: both men and women recall orgasms experienced with a partner present as having been significantly more pleasurable and satisfying than those occurring during solitary masturbation (Mah & Binik, 2002). It is not clear whether memory of orgasm is simply biased by a more positive general perception of partnered sexual activity than of masturbation, or whether there is another mechanism responsible for this discrepancy in pleasure ratings, such as higher levels of sexual arousal prior to orgasm during sex with a partner. Indeed, the assumption that high levels of



sexual arousal enhance orgasm is prevalent in popular media articles on sexuality, but has never been empirically tested. It is possible that sexual arousal and orgasmic pleasure continue to be related following orgasm, but in the opposite direction, with more pleasurable orgasms eliciting a greater decrease in sexual arousal and parallel feelings of sexual satiation. Given that men's sexual arousal appears to decrease more consistently than women's after orgasm, orgasmic pleasure may have a greater impact on post-orgasmic sexual arousal in women, for whom levels are more variable.

One way to clarify how physiological and subjective sexual arousal, desire and orgasm quality interact is to investigate these variables simultaneously in the laboratory. Solitary masturbation represents the ideal context in which to begin testing these potential relationships, as it eliminates many confounds associated with partnered sex (e.g., varying levels of emotional intimacy). Although there are many advantages of studying orgasm in the laboratory, it can be challenging to maintain ecological validity despite the presence of experimenters and standardized procedures, which may impair not only participants' ability to reach orgasm but also its enjoyment. In a previous study with women, we found no difference between ratings of orgasmic pleasure during masturbation in the laboratory and at home (Paterson, Amsel, & Binik, in press); however, women were not monitored in any way during laboratory masturbation, and it is not known whether pleasure would remain unaffected with concurrent measurement of physiological sexual arousal. In addition, no study has investigated potential differential effects of the laboratory setting in men and women (e.g., one group's sexual arousal may be enhanced by its novelty, and the other dampened due to

self-consciousness), and these would diminish the generalizability of laboratory findings of gender differences or similarities to the outside world.

The objectives of this study were as follows: (a) to investigate the ecological validity of studying orgasm in the laboratory; (b) to compare men and women's patterns of sexual arousal and desire before and after orgasm; and (c) to examine the psychological and physiological correlates of their orgasmic pleasure. Physiological and subjective sexual arousal and desire were measured at baseline, after masturbating almost to orgasm, immediately after orgasm, and 15 minutes after orgasm.

We hypothesized that:

1. Both genders would feel less relaxed during masturbation in the laboratory than at home, but there would be no other significant differences in their overall enjoyment of masturbation or orgasm.
2. For both genders, sexual arousal/desire would increase significantly during masturbation and decrease following orgasm. After orgasm, men would experience a more immediate and consistent decrease in sexual arousal and desire, with higher rates of sexual arousal resolution (consistent with a “refractory period”) and sexual satiation.
3. Orgasmic pleasure would be significantly positively correlated in both genders with the magnitude of the sexual arousal “build-up” during masturbation and, in women only, the decrease in sexual arousal/desire following orgasm. It would also be related in both genders to other orgasm characteristics (e.g., intensity), since these contribute to orgasm pleasure; post-orgasmic assessments of enjoyment of masturbation, since

these are influenced by orgasmic pleasure; and a lower frequency of sexual activity, due to the relative novelty of orgasm.

## **Methods**

### **Participants**

Potential participants were recruited via online McGill University classified advertisements and screened during a semi-structured telephone interview. All participants were required to be between 18 and 30 years of age, fluent in English, in good general health (for women, including having regular menstrual cycles), and report: no medication use, sexual dysfunction, genital pain, or previous genital surgery; no difficulty becoming sexually aroused or reaching orgasm during masturbation by oneself; having reached orgasm through masturbation by oneself at least once in the previous month; and anticipating being able to reach orgasm in the laboratory using one's preferred masturbatory technique (including any aids such as vibrators, erotic films, etc.) while in a sitting position (for men) or supine (for women). Participants agreed during screening to abstain from all drugs (including tobacco) or alcohol in the 24 hours prior to participation. Male and female participants were matched on age ( $\pm 2$  years) during recruitment. Women were scheduled to participate during the estimated follicular phase of their menstrual cycle (within 12 days following the onset of menstruation, after cessation of bleeding) to control for the possible menstrual cycle effects on sexual desire, arousal, and/or orgasm. The study was approved by the McGill University Faculty of Medicine ethics review board.

A total of 43 men and 44 women participated in the study. Five men and 6 women were excluded from analyses following testing due to not reaching orgasm

(2 women) or reaching orgasm early (during the almost-orgasm masturbation phase; 1 man and 1 woman); not following instructions [re: genital exposure (1 man) or avoiding drug use prior to testing (2 women)]; and computer malfunction (3 men and 1 woman). The final sample consisted of 38 men and 38 women; groups did not differ in age (grand *M*: 21.63 years, *SD* = 3.05 years; range = 18 – 30) and remained matched by  $\pm 2$  years.

The majority of participants (79%) were students. Most were born in Canada (53%), with the remaining from the United States (20%), Western Europe (9%), Latin America (7%), South Asia (5%), Eastern Europe (4%), Africa (1%), and the Middle East (1%). A large minority reported not being raised religious (42%), with the remaining reporting Christian (37%), Jewish (16%), Muslim (3%), and Hindu (1%) backgrounds; one-fifth of the sample reported being currently religious. The majority (68%) reported a heterosexual sexual orientation, with the remaining endorsing “bisexual” (4 men and 8 women), “homosexual” (6 men and 0 women), or “queer” (0 men and 6 women). At the time of testing, just over half of the participants (57%) were in a regular romantic/dating relationship. There were no gender differences in the proportion of participants who were students, born in North America, raised religious, currently religious, heterosexual, or in a regular relationship,  $p$ 's > .05.

Exactly half of the male participants were circumcised. Just over one-quarter of the female participants (29%) reported currently using hormonal contraception (oral contraceptive pills or contraceptive vaginal ring). Participants' sexual functioning scores corroborated the overall lack of sexual difficulties reported in their telephone screenings. Male participants scored highly

on the International Index of Erectile Function (IIEF; Rosen et al., 1997), with average scores of 66.56 ( $SD = 6.46$ ) out of 75. Female participants' average total scores on the Female Sexual Function Index (FSFI; Rosen et al., 2000) were 29.95 ( $SD = 3.77$ ) out of 36, above the cut-off score of 26.55 indicating sexual dysfunction (Wiegel, Meston, & Rosen, 2005).

Men reported masturbating significantly more often over the past 4 weeks (raw  $M = 13.05$  times,  $SD = 8.26$ , range = 1 – 28) than women (raw  $M = 7.71$ ,  $SD = 7.74$ , range = 1 – 35),  $F(1, 74) = 10.22$ ,  $p = .002$ , but there was no gender difference in the frequency of partnered sex (raw grand  $M = 7.97$ ,  $SD = 9.17$ , range = 0 – 40),  $p > .05$ . Masturbation and partnered sex frequencies were significantly negatively correlated with each other for men,  $r(36) = -.57$ ,  $p < .001$ , but not women,  $r(36) = -.15$ ,  $p > .30$ . Significantly more women (47%) than men (13%) reported at least once experiencing more than one orgasm over the past 4 weeks during a single session of solitary masturbation,  $\chi^2 = 10.54$ ,  $p = .001$ . There was no gender difference in the time between participants' last orgasm and their laboratory session (grand  $M = 48.27$  hours,  $SD = 40.70$ , range = 13 – 216),  $p > .30$ .

## **Measures and Equipment**

### **Interview and questionnaires.**

***Demographic and sexual background.*** Demographic and sexual background information was collected in a semi-structured interview developed for this study.

***Masturbation and orgasm experience.*** A questionnaire designed for this study assessed orgasm characteristics and masturbatory enjoyment and technique.

Ratings were provided relative to participants' prior sexual experiences, on 11-point scales ranging from 0 ("not at all") to 10 ("the most I've ever experienced"). This questionnaire integrated the Orgasm Rating Scale (ORS; Mah & Binik, 2002), which was simplified so that participants simply indicated "Yes" or "No" about whether each adjective described their most recent orgasm experience.

***Subjective sexual arousal and desire.*** An 8-item questionnaire designed for this study assessed levels of sexual arousal and desire at each testing time, on the same 11-point scales as above.

***Mood.*** The Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) was used to assess mood before and after masturbation. Due to a procedural error, only the first 40 of the 65 items were administered; scores for missing items were therefore interpolated from the means of the available items from each subscale. A total mood disturbance score was calculated by subtracting scores on the vigor-activity subscale from the sum of the remaining five subscales (tension-anxiety, depression-dejection, fatigue-inertia, anger-hostility and confusion-bewilderment).

***Sexual function.*** Two validated and gold standard measures of sexual functioning, the IIEF (Rosen et al., 1997) and FSFI (Rosen et al., 2000), were used to assess recent sexual functioning (over the past four weeks) in male and female participants, respectively. The IIEF includes 15 items assessing five domains (erectile function, orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction), and the FSFI includes 19 items assessing six domains (sexual desire, subjective sexual arousal, lubrication, orgasm, satisfaction, and pain during sexual activity).

**Genital thermography.** Genital temperature was used as a measure of physiological sexual arousal and assessed using a TSA ImagIR thermal imaging camera provided by Seahorse Bioscience (North Billerica, MA). Increased genital blood flow is a marker of physiological sexual arousal, and causes an increase in temperature that is significantly positively correlated with subjective ratings of sexual arousal in both men and women (Kukkonen, Binik, Amsel, & Carrier, 2007). The thermal imaging camera detects infrared radiation emitted by the body with non-tactile infrared sensors, and has several advantages in studies of gender differences during sexual activity: it can be used to assess temperature on any anatomical location, it requires no genital contact, and it uses a known scale (degrees Celsius) which allows for between-group comparisons (Kukkonen et al., 2007; Kukkonen, Binik, Amsel, & Carrier, 2010). As in previous studies, the sampling interval was set at eight frames per second and, in order to have a clear image of the genital region, the camera placement differed for male and female participants. For men, it was placed 1.0 m diagonally left of the participant, at a height of 1.09 m, and angled at approximately 30 degrees. For women, it was placed directly facing the participant at a distance of 0.5 m, at a height of 1.09 m, and angled at approximately 20 degrees.

At each testing time, participants were instructed to “expose” two genital locations (if male, the glans then the shaft of the penis; if female, the glans clitoris then the vulvar vestibule) for approximately 10 seconds each (a “count of 20”). Temperatures for the third genital location (the scrotum for men and the left outer labium for women) were measured during exposure of the shaft and vulvar vestibule, respectively. During exposures, male participants gently held the penis

up to reveal the ventral glans then the shaft of the penis, and female participants gently retracted the clitoral hood to reveal the clitoral glans then opened the labia to reveal the vulvar vestibule. For the purposes of this paper, we are focusing on penile and clitoral glans temperature (a complete analysis of genital temperature data, including its concordance with subjective sexual arousal, will be reported separately). Although different in many ways (e.g., size, proximity to the body, vascularity), the glans penis and clitoris share several important features: they are both typically stimulated during masturbation, areas of the greatest pleasurable sensitivity, and originate from the same embryological tissue.

## **Procedure**

**At-home masturbation.** Participants were e-mailed a set of questionnaires to complete immediately before (the POMS) and after (the masturbation and orgasm questionnaire, a second POMS, and the IIEF or FSFI) the next time they engaged in solitary masturbation at home, in order to familiarize themselves with study procedures and to gauge the effect of the laboratory setting on masturbatory enjoyment. They brought these questionnaires to their appointment, along with music to listen to during the genital temperature stabilization period and any sexually arousing stimuli or masturbatory aids (e.g., pornographic videos, sex toys) that they typically used during masturbation at home.

**Laboratory session.** Upon arrival, each participant met with a female research assistant who described the study procedures in detail, answered any questions, and obtained written informed consent. The research assistant then administered the interview and left the room. A standard intercom was used for



communication between the participant and the research assistant in the adjoining room.

Participants disrobed from the waist down and then sat (if male) or lay down (if female) on the reclining testing chair. They were instructed to listen to music and not masturbate or view any erotic materials for 12 minutes while their genital temperature stabilized. After 12 minutes elapsed, participants were notified to begin completing the first POMS. The subsequent baseline genital temperature measurement was therefore taken following a genital stabilization period of at least 15 minutes, as validated in other genital thermography studies (Kukkonen et al., 2007, 2010).

Participants followed additional instructions in the questionnaire booklet to expose the genital locations of interest and then provide sexual arousal/desire ratings at each of four testing times: before beginning to masturbate (Baseline), after masturbating almost to orgasm (“as close as possible without accidentally reaching orgasm, i.e., 80-90% of the way there”; Almost-Orgasm), after resuming masturbating and reaching orgasm (Post-Orgasm), and after a subsequent 15-minute rest period (Post-‘Orgasm+Rest’). Genital temperature measurement was taken first in an effort to record temperature before any decrease during questionnaire completion. Participants were asked to remain in a sitting (if male) or supine (if female) position during masturbation and to place their knees apart (if male) or on the stirrups (if female) during genital exposures; and, after orgasm, to refrain from further masturbation or viewing of erotic materials and to remain on the reclining chair for 15 minutes while they completed the masturbation orgasm and experience questionnaire and a second POMS. They were notified

via intercom after 15 minutes had elapsed, and then completed Post-‘Orgasm+Rest’ exposures and ratings. Upon completion of the session, participants were debriefed and received \$40 in compensation.

### **Data Reduction and Analyses**

**Sexual arousal and desire ratings.** Prior to analysis, a principal components analysis with varimax rotation was conducted on the six specific (i.e., other than “overall sexual arousal” and “overall sexual desire”) baseline sexual arousal and desire questions to establish whether a smaller number of stable factors could be used to assess subjective sexual response. Results indicated two factors, corresponding to (a) sexual arousal/physical sexual response (items: mental sexual arousal, genital sexual arousal, and physical sexual desire) and (b) sexual desire/psychological sexual response (items: mental sexual desire, desire to masturbate, and desire to orgasm). Scores for each item were standardized across all participants and testing times, then averaged at each testing time according to the factor structure described above to create factor scores.

**Genital temperature.** Genital temperature data for each testing time was obtained by averaging temperature readings over 10 seconds. Thermography data was missing for three female participants (due to exposure positions incompatible with camera placement, despite additional in-session instruction), who were excluded from genital temperature analyses. Glans penis data was missing at one testing time for four male participants (due to incompatible exposure position or computer malfunction), and these were replaced with their group mean for that testing time (total missing values = 1%). Due to significant differences in baseline temperature between the glans penis ( $M$  for circumcised men = 30.32°

Celsius,  $SD = 1.53$ , range = 26.52 – 32.97;  $M$  for uncircumcised men = 29.18° Celsius,  $SD = 1.88$ , range = 26.85 – 33.86), and glans clitoris ( $M = 33.15^\circ$  Celsius,  $SD = 0.87$ , range = 31.18 – 34.73) and gender difference in variability across testing times and participants ( $s^2$  for men = 4.14, and for women = 0.81° Celsius), genital temperature data was standardized within participants (ipsatized; grand  $M$  for each participant = 0,  $SD = 1$ , thus nullifying a main effect of gender) prior to analysis to control for individual and anatomical differences in genital temperature and responsiveness [as described by Harris, Rice, Quinsey, Chaplin, and Earls (1992) for phallometry data]. There was a significant difference in baseline room temperature between genders ( $M$  for men = 22.68° C and for women = 23.89° C),  $F(1, 70) = 22.05$ ,  $p < .001$ , and this variable was therefore included as a covariate.

There was no effect of sexual orientation or (for women) hormonal contraception usage on sexual arousal/desire scores, or interaction between these variables and Testing Time for sexual arousal/desire scores or ipsatized genital temperature (all  $p$ 's > .05), and these variables were therefore not included in reported analyses.

**Data analyses.** Following the hypotheses listed above:

We hypothesized that:

1. Two-way mixed-design ANOVAs (repeated-measures variable = Setting; between-subjects variable = Gender) and chi-square analyses were conducted on orgasm characteristics and other masturbation enjoyment variables to assess the impact of the laboratory setting and whether this differed by gender. An additional repeated-measures variable (Testing

Time) was included in the analysis of mood. In order to minimize Type II error in tests of null hypotheses (i.e., of a lack of difference between settings), analyses were conducted separately for each variable. The occasional question not completed at home was omitted from the analysis, as reflected by the degrees of freedom.

2. Two-way mixed-design ANOVAs were conducted on sexual arousal and desire factor scores (repeated-measures variable = Testing Time; between-subjects variable = Gender). A two-way mixed-design ANCOVA was conducted on ipsatized genital temperature (repeated-measures variable = Testing Time; between-subjects variable = Gender; covariate = Room Temperature). Tests of simple main effects and post-hoc Tukey/Tukey-Kramer HSD tests were conducted on significant results. Resolution of sexual arousal and sexual satiation were operationalized as the post-orgasmic return to within 0.10 standardized points/degrees of baseline levels of sexual arousal and desire, respectively; Chi-Square tests were used to compare their frequencies between genders.
3. Multiple regression analyses were conducted separately for men and women to determine the extent to which each of the following five sets of variables, grouped by theoretical question, predicted orgasmic pleasure: (a) the “build-up” of sexual arousal/desire prior to orgasm, (b) the resolution of sexual arousal/sexual satiation following orgasm, (c) other orgasm characteristics, (d) masturbation enjoyment, and (e) the frequency of sexual activity. Subjective sexual arousal, desire, and mood change scores were corrected to control for initial values, i.e., calculated as

percentages of the maximum potential change in the expected direction.

Pearson's correlation coefficients were calculated between orgasmic pleasure and predictor variables.

Significantly skewed variables were square-root transformed prior to analysis.

## **Results**

### **Similarity of Laboratory to At-Home Masturbation**

There was no Setting X Gender interaction for any orgasm or masturbation characteristic,  $p$ 's > .05, indicating that all effects of the laboratory setting applied equally to men and women.

**Orgasm.** The following orgasm characteristics were compared between settings and genders: orgasmic pleasure, intensity and satisfaction; and the relative duration and number of orgasmic sensations. There was a significant main effect of Setting on orgasmic pleasure,  $F(1, 70) = 4.40, p = .04$ , orgasmic intensity,  $F(1, 69) = 11.89, p = .001$ , and the number of orgasms experienced,  $F(1, 65) = 5.53, p = .02$ ; and of Gender on orgasmic intensity,  $F(1, 69) = 6.68, p = .012$ , satisfaction  $F(1, 69) = 5.45, p = .022$ , and relative duration of orgasmic sensations,  $F(1, 49) = 4.50, p = .039$ .

Orgasmic pleasure ratings were higher in the laboratory ( $M = 6.95, SD = 1.37$ , range = 3 – 9) than at home ( $M = 6.56, SD = 1.24$ , range = 4 – 9), and overall did not differ between genders,  $p > .05$ . Orgasmic intensity ratings were also higher in the laboratory ( $M = 6.43, SD = 1.54$ , range = 3 – 9) than at home ( $M = 5.54, SD = 1.74$ , range = 2 – 9), and men's overall ratings ( $M = 6.96, SD = 0.99$ , range = 4.50 – 8.50) were higher than women's ( $M = 6.55, SD = 1.03$ , range = 4 –

8.50). The average number of orgasms experienced during masturbation was higher at home ( $M = 1.12$ ,  $SD = 0.41$ , range = 1 – 3) than in the laboratory (always 1), and did not differ between genders,  $p > .30$ .

There was no effect of Setting on orgasmic satisfaction,  $p > .20$ , of which men's overall ratings ( $M$  satisfaction = 6.76,  $SD = 1.43$ , range = 3 – 9.50) were higher than women's ( $M = 6.16$ ,  $SD = 1.48$ , range = 2.50 – 8.50); or the relative duration of orgasmic sensations,  $p > .30$ , of which men's ratings ( $M$  relative duration = 5.39,  $SD = 1.71$ , range = 1 – 10) were again higher than women's ( $M = 4.75$ ,  $SD = 1.53$ , range = 1.50 – 8). There was no effect of Setting or Gender on the number of sensations experienced during orgasm (grand  $M = 17.90$  out of 40,  $SD = 6.52$ , range 5.50 – 31),  $p$ 's  $> .20$ .

**Other masturbation characteristics.** The following variables were compared between settings and genders: masturbatory pleasure, relaxation during masturbation, ease of reaching orgasm, peak sexual arousal, masturbation duration, use of erotic visual stimuli and sex toys, and mood disturbance. There was a significant main effect of Setting on relaxation during masturbation,  $F(1, 72) = 7.03$ ,  $p = .01$ , and the frequency of visual stimuli use,  $\chi^2(1, N = 72) = 9.45$ ,  $p = .002$ ; and of Gender on masturbatory pleasure,  $F(1, 70) = 4.05$ ,  $p = .048$ , relaxation during masturbation,  $F(1, 72) = 5.16$ ,  $p = .03$ , the frequency of erotic visual stimuli use (e.g., pornographic films) in both settings,  $\chi^2(1, N = 72) = 16.11$  and 24.67,  $p$ 's  $< .001$ , and the frequency of sex toy use in both settings,  $\chi^2(1, N = 72) = 6.55$  and 7.93,  $p$ 's  $< .05$ .

Ratings of relaxation during masturbation were higher at home ( $M = 6.97$ ,  $SD = 1.65$ , range = 3 – 10) than in the laboratory ( $M = 6.38$ ,  $SD = 1.74$ , range = 3

– 10), and overall higher in men ( $M = 7.03$ ,  $SD = 1.37$ , range = 4 – 10) than in women ( $M = 6.32$ ,  $SD = 1.33$ , range = 4 – 9.50). Ratings of peak subjective sexual arousal were higher in the laboratory ( $M = 6.55$ ,  $SD = 1.78$ , range = 2 – 9) than at home ( $M = 6.18$ ,  $SD = 1.55$ , range = 3 – 9), and overall did not differ between genders,  $p > .05$ . More participants used erotic visual stimuli at home (54%) than in the laboratory (38%), and overall more men used it (72%) than women (19%).

There was no effect of Setting on masturbatory pleasure,  $p > .30$ , of which men's overall ratings were higher ( $M = 6.82$ ,  $SD = 1.22$ , range = 3 – 9.50) than women's ( $M = 6.42$ ,  $SD = 1.24$ , range = 4 – 8.50); or on the frequency of sex toy use,  $p > .30$ , which was overall higher in women (17%) than in men (0%). There was no effect of Setting or Gender on ease of reaching orgasm (grand  $M = 7.59$ ,  $SD = 1.64$ , range = 3 – 10),  $p$ 's  $> .20$  and  $.05$ , respectively; or estimated masturbation duration (grand  $M = 10.85$  minutes,  $SD = 6.68$ , range = 1.50 – 30),  $p$ 's  $> .30$  and  $.10$ . Duration of masturbatory stimulation was only timed in the laboratory and did not differ between genders (grand  $M = 8.94$  minutes,  $SD = 4.66$ , range = 2.27 – 23.03),  $p > .30$ .

The analysis of mood disturbance scores (the sum of the POMS' negative mood subscales minus the vigor subscale) yielded only a significant main effect of Setting,  $F(1, 69) = 16.96$ ,  $p < .001$ , and Testing Time,  $F(1, 69) = 34.04$ ,  $p < .001$ , and a significant Setting X Testing Time interaction,  $F(1, 69) = 4.55$ ,  $p = .037$ , and Testing Time X Gender interaction,  $F(1, 69) = 7.51$ ,  $p = .008$ . At baseline, scores were higher at home (raw  $M = 17.22$  on a scale of -32 to 200,  $SD = 26.73$ , range = -24.00 – 103.63) than in the laboratory (raw  $M = 6.52$ ,  $SD =$

20.28, range = -32.00 – 92.66), and overall higher in women (raw  $M = 14.51$ ,  $SD = 18.30$ , range = -20.52 – 53.97) than in men (raw  $M = 8.15$ ,  $SD = 21.14$ , range = -22.00 – 69.80),  $p's < .05$ , but they did not differ after masturbation to orgasm in either setting or gender (raw grand  $M = 1.88$ ,  $SD = 14.26$ , range = -26.00 – 14.19),  $p's > .05$ .

**Summary of differences in orgasm and masturbation characteristics between settings and genders.** Compared to during masturbation at home, participants reported experiencing greater orgasmic pleasure and intensity (by 0.39 and 0.89/10), less mood disturbance prior to masturbation (by 10.70/232), feeling less relaxed during masturbation (by 0.59/10), and higher peak levels of subjective sexual arousal (by 0.37/10) in the laboratory. They were less likely to use erotic visual stimuli (by 16%) in the laboratory. They were instructed to have only one orgasm in the laboratory, but on average had more (1.12) during masturbation at home. All differences between settings applied equally to men and women. In both settings, men reported experiencing greater orgasmic intensity (by 1.23/10), orgasmic satisfaction (by 0.60/10), a longer relative duration of orgasmic sensations (by 0.64/10), a less negative mood prior to masturbation (by 6.36/200), greater relaxation during masturbation (by 0.71/10), and greater masturbatory pleasure (by 0.40/10) than women. Men were more likely (by a frequency difference of 53%) to use erotic visual stimuli during masturbation, and women were more likely (by a frequency difference of 17%) to use a sex toy.

### **Changes in Sexual Arousal and Desire with Masturbation and Orgasm**



There was a significant main effect of Testing Time on sexual arousal scores,  $F(3, 222) = 143.39, p < .001$ , no main effect of Gender,  $F(1, 74) = 0.80, p = .37$ , and a significant Testing Time X Gender interaction,  $F(3, 222) = 5.66, p = .002$  (presented in Figure 4 and described below), indicating that the pattern of change across testing times differed between men and women. There was also a significant main effect of Testing Time on sexual desire scores,  $F(3, 222) = 144.09, p < .001$ , no main effect of Gender,  $F(1, 74) = 0.12, p = .73$ , and a significant Testing Time X Gender interaction,  $F(3, 222) = 8.36, p < .001$  (presented in Figure 5 and described below), indicating that the pattern of change across testing times again differed between men and women.

There was no effect of Testing Time on genital temperature,  $F(3, 207) = 1.06, p = .37$ . There was a significant Testing Time X Gender interaction,  $F(3, 207) = 13.67, p < .001$  (presented in Figure 6 and described below), indicating that the pattern of change across testing times differed between men and women.

**During masturbation (Baseline to Almost-Orgasm).** At the Baseline testing time, there was no gender difference in sexual arousal scores, but sexual desire scores were higher and genital temperature was lower in men than in women. All measures increased significantly for both genders between Baseline and Almost-Orgasm. At the Almost-Orgasm testing time, there was no gender difference in sexual arousal scores or sexual desire scores, but genital temperature was significantly higher in men than in women.

**Following orgasm.**

***Immediate sequelae (Almost-Orgasm to Post-Orgasm).*** Post-hoc Tukey HSD tests revealed that sexual desire scores decreased significantly for both

genders between Almost-Orgasm and Post-Orgasm. Sexual arousal scores decreased significantly and genital temperature decreased marginally ( $p < .10$ ) for men, but neither changed for women. At the Post-Orgasm testing time, sexual arousal and desire scores were significantly lower and genital temperature was significantly higher in men than in women. Sexual arousal scores and genital temperature remained elevated compared to Baseline for both genders. Sexual desire scores had decreased to significantly below Baseline levels for men, but only to Baseline levels for women.

*Resolution of sexual arousal and sexual satiation.* Sexual arousal scores at Post-Orgasm were at (within 0.10 standardized points) or below Baseline levels for significantly more men (32%) than women (8%),  $\chi^2 = 6.73, p = .009$ . In contrast, genital temperature at Post-Orgasm was at or below Baseline temperature for significantly more women (34%) than men (8%),  $\chi^2 = 7.77, p = .005$ . Sexual desire scores at Post-Orgasm were at or below Baseline levels for significantly more men (81%) than women (45%),  $\chi^2 = 9.09, p = .003$ .

*Delayed sequelae (Post-Orgasm to Post-‘Orgasm+Rest’).* Sexual arousal and desire scores decreased significantly for both genders between Post-Orgasm and Post-‘Orgasm+Rest’. Genital temperature decreased significantly for men, but did not change for women. At the Post-‘Orgasm+Rest’ testing time, sexual arousal and desire scores remained significantly lower in men than in women, and genital temperature had become significantly lower in men, as well. Sexual arousal scores had decreased to below Baseline levels for men, but only to Baseline levels for women. Sexual desire scores had by this time decreased to significantly below Baseline levels for women as well as men. Genital

temperature had returned to Baseline levels for men, but remained elevated in comparison to Baseline for women.

*Resolution of sexual arousal and sexual satiation.* Sexual arousal scores at Post-‘Orgasm+Rest’ were at or below Baseline levels for significantly more men (87%) than women (66%),  $\chi^2 = 4.66, p = .031$ . There was no change from Post-Orgasm in the number of men or women for whom genital temperature was at or below Baseline levels. There was no gender difference in the number of participants for whom sexual desire scores at Post-‘Orgasm+Rest’ were at or below Baseline levels (overall, 87%),  $p > .30$ .

**Summary of gender differences in changes in sexual arousal and desire with masturbation and orgasm.** Subjective sexual arousal and desire decreased more quickly and profoundly after orgasm in men than in women. Genital temperature decreased marginally for men immediately after orgasm and significantly by the end of the rest period, but remained elevated for women. More men than women exhibited resolution of subjective sexual arousal both immediately and 15 minutes following orgasm. Similarly, more men than women exhibited sexual satiation immediately following orgasm, but frequencies were equally high by the end of the rest period. There was no parallel gender difference in resolution of the increase in genital temperature during masturbation; temperature following orgasm was more likely to be the same or lower than Baseline temperature in women than in men.

### **Predictors of Orgasmic Pleasure**

#### **Changes in sexual arousal and desire.**

***“Build-up” before orgasm.*** The following variables were entered into the multiple regression analysis on orgasmic pleasure: percentage of maximum potential increase in sexual arousal and desire scores, and increase in genital temperature from Baseline to Almost-Orasm. Orgasmic pleasure was significantly predicted by the pre-orgasmic increase (from Baseline to Almost-Orasm) in sexual arousal/desire for both men,  $R^2 = .22$ ,  $F(3, 33) = 3.01$ ,  $p = .044$ , and women,  $R^2 = .44$ ,  $F(3, 31) = 8.13$ ,  $p < .001$ . There were no significant individual predictor variables for men, although the increase in sexual arousal scores nearly reached statistical significance,  $\beta = .43$ ,  $t(33) = 1.92$ ,  $p = .064$ , and was significantly correlated with orgasmic pleasure,  $r(36) = .47$ ,  $p = .003$ . There were two significant predictors for women: the increase in sexual desire scores,  $\beta = .41$ ,  $t(31) = 2.09$ ,  $p = .045$ , and the increase in genital temperature,  $\beta = .43$ ,  $t(31) = 3.17$ ,  $p = .003$ ; both of these variables were significantly positively correlated with orgasmic pleasure,  $r(36) = .48$ ,  $p = .002$ , and  $r(33) = .47$ ,  $p = .004$ , respectively.

Orgasmic pleasure was also significantly positively correlated in men with the increase in sexual desire scores,  $r(35) = .36$ ,  $p = .031$ , but not genital temperature,  $p > .05$ ; and in women, with the increase in sexual arousal scores,  $r(36) = .35$ ,  $p = .033$ .

***Resolution/satiation following orgasm.*** The following variables were entered into the multiple regression analysis on orgasmic pleasure: percentage of maximum potential decrease in sexual arousal and desire scores, and decrease in genital temperature from Almost-Orasm to Post-Orasm, and from Post-Orasm to Post-‘Orasm+Rest’. Orgasmic pleasure was significantly associated with the

post-orgasmic decrease (immediate: from Almost-Orgasm to Post-Orgasm; delayed: Post-Orgasm to Post-‘Orgasm+Rest’) in sexual arousal/desire for women,  $R^2 = .48$ ,  $F(6, 28) = 4.37$ ,  $p = .003$ , but not men,  $R^2 = .14$ ,  $F(6, 31) = 0.84$ ,  $p = .55$ . There were two significant predictors for women: the immediate decrease in genital temperature,  $\beta = .35$ ,  $t(28) = 2.18$ ,  $p = .043$ , and the delayed decrease in sexual arousal scores,  $\beta = -.66$ ,  $t(28) = -2.99$ ,  $p = .006$ ; both of these variables were significantly correlated with orgasmic pleasure,  $r(33) = .41$ ,  $p = .015$ , and  $r(36) = -.40$ ,  $p = .012$ , respectively.

Orgasmic pleasure was also significantly negatively correlated in women with the immediate decrease in sexual desire scores,  $r(36) = -.37$ ,  $p = .024$ , but not with the post-orgasmic decrease in any other variable,  $p$ 's  $> .05$ . It was not correlated in men with the post-orgasmic decrease in any variable,  $p$ 's  $> .05$ .

### **Other aspects of sexual experience.**

**Orgasm characteristics.** The following variables were entered into the multiple regression analysis on orgasmic pleasure: orgasmic intensity, satisfaction, and relative duration and number of orgasmic sensations. Orgasmic pleasure was significantly predicted by other orgasm characteristics for both men,  $R^2 = .68$ ,  $F(4, 31) = 16.78$ ,  $p < .001$ , and women,  $R^2 = .75$ ,  $F(4, 32) = 23.43$ ,  $p < .001$ . Orgasmic intensity was the only significant predictor for both men,  $\beta = .70$ ,  $t(31) = 4.02$ ,  $p < .001$ , and women,  $\beta = .78$ ,  $t(32) = 4.48$ ,  $p < .001$ , and was significantly positively correlated with orgasmic pleasure for both genders,  $r(36) = .81$  and  $.87$ , respectively,  $p$ 's  $< .001$ .

Orgasmic pleasure was also significantly positively correlated with orgasmic satisfaction in both men,  $r(36) = .68$ , and women,  $r(36) = .74$ ,  $p$ 's  $< .001$ .

.001; the relative duration of orgasmic sensations in women only,  $r(36) = .57, p < .001$ ; and the number of orgasmic sensations in men only,  $r(36) = .51, p < .001$ ;  $p$ 's for the other gender  $> .05$ .

***Masturbation enjoyment.*** The following variables were entered into the multiple regression analysis on orgasmic pleasure: masturbatory pleasure, relaxation during masturbation, ease of reaching orgasm, and decrease in mood disturbance from baseline to post-orgasm. Orgasmic pleasure was significantly predicted by masturbation enjoyment for both men,  $R^2 = .35, F(4, 33) = 4.51, p = .005$ , and women,  $R^2 = .42, F(4, 33) = 5.85, p = .001$ . Masturbatory pleasure was the only significant predictor for both men,  $\beta = .63, t(33) = 3.70, p = .001$ , and women,  $\beta = .57, t(33) = 2.63, p = .013$ , and was significantly positively correlated with orgasmic pleasure for both genders,  $r(36) = .59$  and  $.58$ , respectively,  $p$ 's  $< .001$ .

Orgasmic pleasure was also significantly positively correlated with relaxation during masturbation in women only,  $r(36) = .42, p = .01$ ;  $p$  for men  $> .05$ . It was not correlated in either gender with ease of reaching orgasm or the decrease in negative mood,  $p$ 's  $> .05$ .

***Sexual activity frequency.*** Variables entered into the multiple regression analysis on orgasmic pleasure: masturbation frequency, partnered sex frequency, and time since having an orgasm. Orgasmic pleasure was significantly predicted by frequency of sexual activity for men,  $R^2 = .25, F(3, 34) = 3.77, p = .019$ , but not women,  $R^2 = .07, F(3, 34) = 0.83, p = .49$ . Recent masturbation frequency was the only significant predictor for men,  $\beta = .54, t(34) = 2.46, p = .019$ , and was significantly positively correlated with orgasmic pleasure,  $r(36) = .50, p = .001$ .

Orgasmic pleasure was not correlated in men with any other sexual activity frequency variable, or in women with any such variable,  $p$ 's > .05.

### **Summary of gender differences in the correlates of orgasmic pleasure.**

Orgasmic pleasure was significantly predicted by sexual/desire “build-up” during masturbation for both genders, but the predictor variables differed: in men, it was predicted by a greater increase in sexual arousal (which neared significance), and in women, by a greater increase in sexual desire and genital temperature. It was only significantly predicted by the resolution of sexual arousal/desire in women: specifically, a greater immediate decrease in genital temperature following orgasm and a lesser delayed decrease in sexual arousal.

In both genders, orgasmic pleasure was also significantly predicted by other orgasm characteristics (specifically, greater orgasmic intensity) and masturbation enjoyment (specifically, masturbatory pleasure). It was only predicted by sexual activity frequency in men: specifically, a greater recent frequency of masturbation.

### **Discussion**

In this study, healthy men and women masturbated in the laboratory using their typical technique and provided sexual arousal and desire ratings and genital temperature measurements before masturbation, after masturbating almost to orgasm, immediately after orgasm, and 15 minutes after orgasm. The majority of participants were able to reach orgasm and comply with instructions to delay orgasm until after the second testing time. Participants also masturbated at home prior to their laboratory session, and their masturbation enjoyment was compared to that experienced in the laboratory. There were few significant differences

between settings, and all were slight and applied equally to both genders. As hypothesized, participants reported feeling more relaxed during masturbation at home than in the laboratory. Orgasmic pleasure and intensity were slightly higher in the laboratory, perhaps because of this lesser relaxation during masturbation (and therefore greater relief of tension with orgasm) and/or the novelty of the laboratory environment. Participants reported a more negative mood prior to masturbation at home than in the laboratory, which may have contributed to their decision to masturbate at that particular time; mood improved in both settings and equalized following masturbation. They were more likely to use visual erotic stimuli at home, possibly due to greater convenience or comfort doing so privately. The laboratory setting does not appear to meaningfully detract from the enjoyment of masturbation for men or women, even with the addition in the laboratory of multiple measurements of sexual arousal/desire and instructions to interrupt masturbation at almost-orgasm. These results provide support for the ecological validity of studying solitary orgasm in the laboratory and its resiliency to experimental demands.

As hypothesized, for both genders, subjective sexual arousal and desire and genital temperature increased significantly during masturbation almost to orgasm. Sexual desire decreased immediately following orgasm for both genders, but significantly more so in men than women. In men, subjective sexual arousal also decreased significantly and genital temperature decreased marginally, but unexpectedly neither changed in women. During the 15-minute rest period after orgasm, subjective sexual arousal and desire decreased similarly in both genders. In men, genital temperature also decreased significantly, but again this did not



change in women. These findings indicate a significant gender difference in both physiological and subjective sexual arousal and desire following orgasm.

To our knowledge, these findings are the first to replicate Masters and Johnson's (1966) observations of men's more consistent decrease in physiological sexual arousal following orgasm. Whether this pattern also indicates a greater "refractory period" in men remains to be verified in future studies which assess gender differences in the ability to achieve erection/vasocongestion or reach another orgasm following orgasm. Our similar results for subjective sexual arousal and desire suggest that men's more typical discontinuation of sexual stimulation following orgasm is based not only on a lack of erection but also on a lack of psychological sexual excitation or interest. As expected, more men than women exhibited resolution of subjective sexual arousal and sexual satiation immediately after orgasm, and resolution of subjective sexual arousal 15 minutes after orgasm. Although we did not find a similar pattern for physiological sexual arousal, this was likely because men's temperature increased by significantly more than women's and remained elevated compared to baseline even following the rest period, 15 minutes after orgasm.

As hypothesized, a greater build-up of sexual arousal and desire prior to orgasm significantly predicted orgasmic pleasure. Men who experienced greater increases in subjective sexual arousal, and to a lesser extent sexual desire, endorsed having more pleasurable orgasms. In men, the increase in genital temperature was not related to orgasmic pleasure. Women who experienced greater increases in sexual desire and genital temperature, and to a lesser extent subjective sexual arousal, also endorsed having more pleasurable orgasms. These

findings provide support in both genders for the intuitive recommendation to enhance the experience of orgasm by delaying it until having reached high levels of sexual arousal and desire.

As hypothesized, orgasmic pleasure was related to the decrease in sexual arousal and desire following orgasm in women but not men. This suggests that men's sexual excitement and interest after orgasm is not influenced by orgasm quality. In women, greater orgasmic pleasure was followed by a greater immediate decrease in physiological sexual arousal but, unexpectedly, a smaller delayed decrease in subjective sexual arousal and, to a lesser extent, a smaller immediate decrease in sexual desire. These findings appear to be contradictory, but may be explained by the following hypotheses: (a) women's highly pleasurable orgasms were also highly intense, and may have involved more intense contractions of the pelvic floor musculature, which could have diverted the increased vasocongestion of the clitoris to the vaginal area, and (b) the recent memory of more pleasurable/intense orgasmic sensations may sustain rather than resolve women's psychological sexual arousal and desire after orgasm. Future studies should assess whether there are behavioural correlates of this persistence of subjective sexual arousal and desire following relatively highly pleasurable orgasms, such as more often pursuing additional sexual stimulation and orgasms. In this study, we inquired about having recently experienced more than one orgasm during one or more masturbation sessions, but not about the frequencies of or preferences for "multiple" orgasms during masturbation or with a partner.

Also as hypothesized, orgasmic pleasure was predicted in both genders by other aspects of the orgasm experience, and it appears to be particularly

influenced by orgasmic intensity and, to a lesser extent, satisfaction. It was also predicted in both genders by masturbation enjoyment, and appears to significantly contribute to overall appraisals of masturbatory pleasure. Recent frequency of sexual activity was only related to orgasmic pleasure in men, and unexpectedly those who experienced greater orgasmic pleasure reported a higher recent frequency of masturbation. It is possible that men who particularly enjoy masturbatory orgasms (i.e., rate them highly relative to all of the orgasms they have ever experienced) more often engage in masturbation. These men may also have more permissive attitudes about masturbation and/or have learned what masturbatory technique maximizes their orgasmic pleasure. Certain techniques have been promoted in self-help books as enhancing orgasm, such as “edging” (repeatedly coming close to orgasm then allowing arousal to slightly subside), and future studies could investigate the impact of employing different masturbation techniques on orgasmic pleasure.

This study had several limitations, including a relatively small sample size. As in all sex research, participants were likely more sexually open than the general population, as they were willing to masturbate in the laboratory while a thermal recording of their genital area was being taken, and they may have also been more easily orgasmic. Nonetheless, recruitment of healthy young adult participants was not at all difficult (several commented during debriefing that they were happy to be paid to do what they do at home for free!). By necessity, we had to exclude the small number of participants who were not able to reach orgasm in the correct time frame or at all in the laboratory. The percentage of non-heterosexual participants (32%) was also higher than that of the general

population (10-13% of young adults identify as not 100% heterosexual; Savin-Williams, Joyner, & Rieger, 2012); however, participants masturbated using their typical technique, and there was no effect of sexual orientation on subjective sexual arousal or desire or genital temperature. With respect to the procedures, the similarity of laboratory to at-home masturbation may depend on the use of a minimally-invasive measure of physiological sexual arousal such as thermography, and cannot be generalized to the use of other measures. Participants reported experiencing some sexual arousal and desire at baseline, with average ratings of 3.5 out of 10, and their genital temperature may have been similarly elevated, which would have restricted the extent of temperature change. Since participants provided genital temperature measurements before sexual arousal and desire ratings, the latter may be slight underestimates of levels experienced immediately following masturbation almost to orgasm and to orgasm. In addition, because participants were instructed to stop masturbating at almost-orgasm (“as close as possible to orgasm without accidentally reaching orgasm”), and resumed masturbating afterwards, levels of sexual arousal and desire at almost-orgasm were likely slightly lower than the levels reached immediately before orgasm. Finally, the results of this study can be generalized only to masturbation, since we did not assess patterns during partnered sex.

The experimental paradigm used in this study has numerous potential applications, including the investigation of the impact of psychological (e.g., anxiety) and pharmacological (e.g., SSRIs) manipulations on the ability to reach orgasm and on orgasm quality. In principle, there is little reason why it should not be standard practice to study orgasm in the laboratory, as is currently done for

sexual arousal. This paradigm could also be used to study partnered sex and orgasms, with a similar comparison to sex at home to demonstrate ecological validity.

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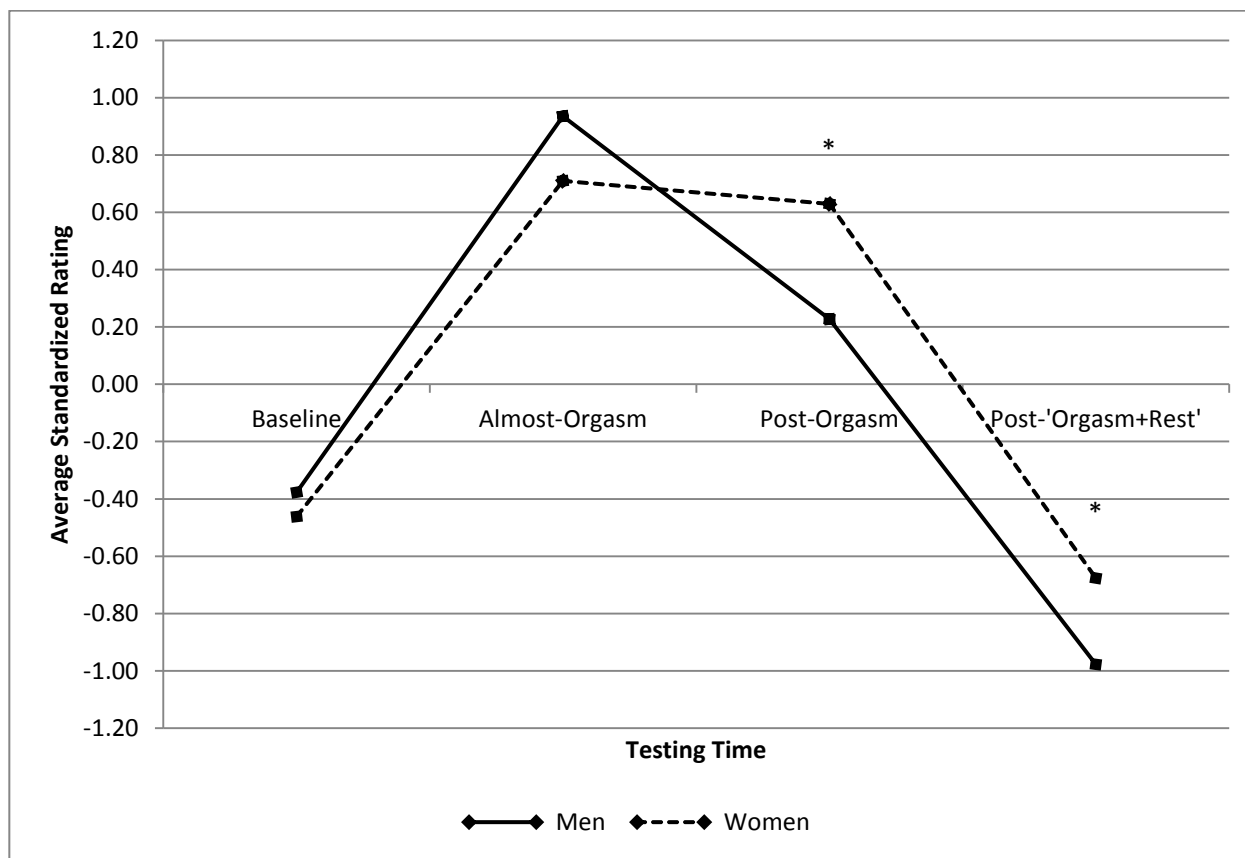
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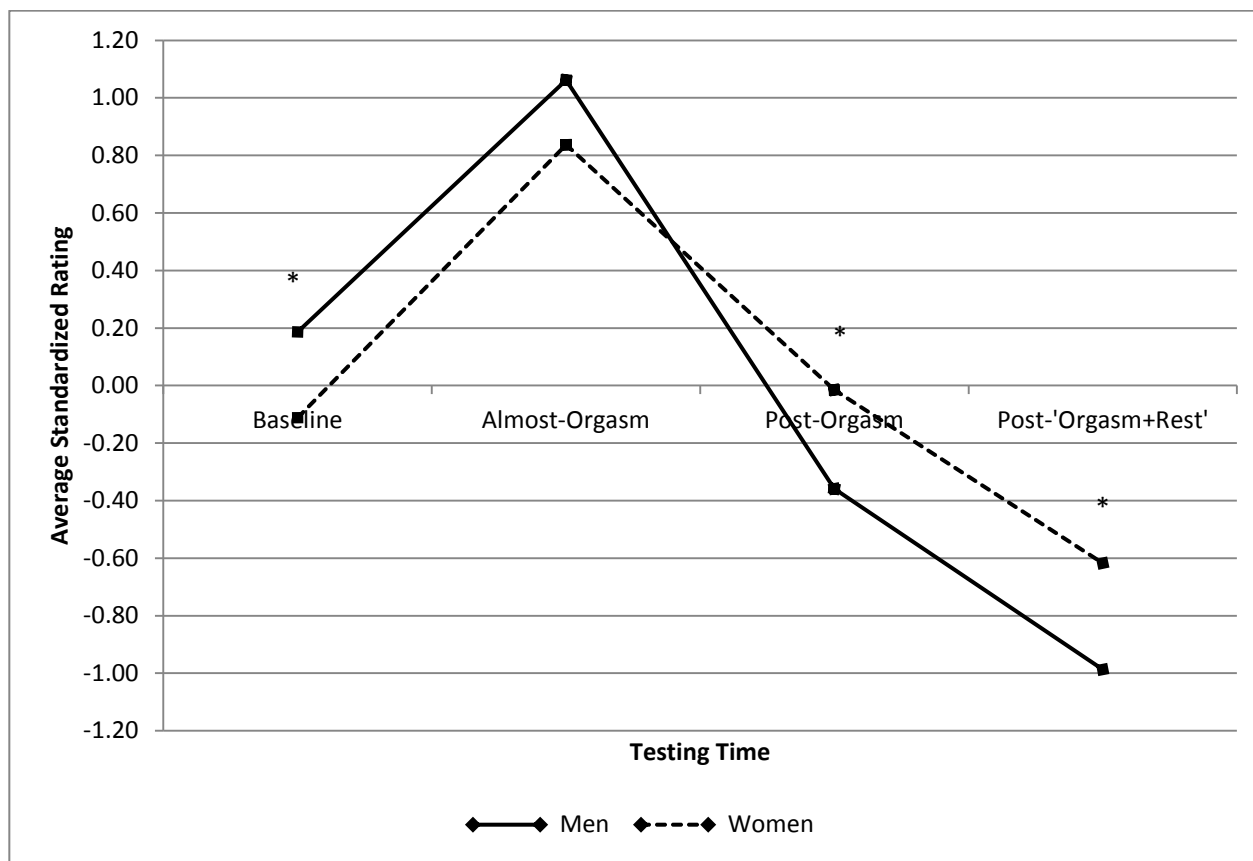
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Figure 4. Sexual arousal scores by testing time and gender.



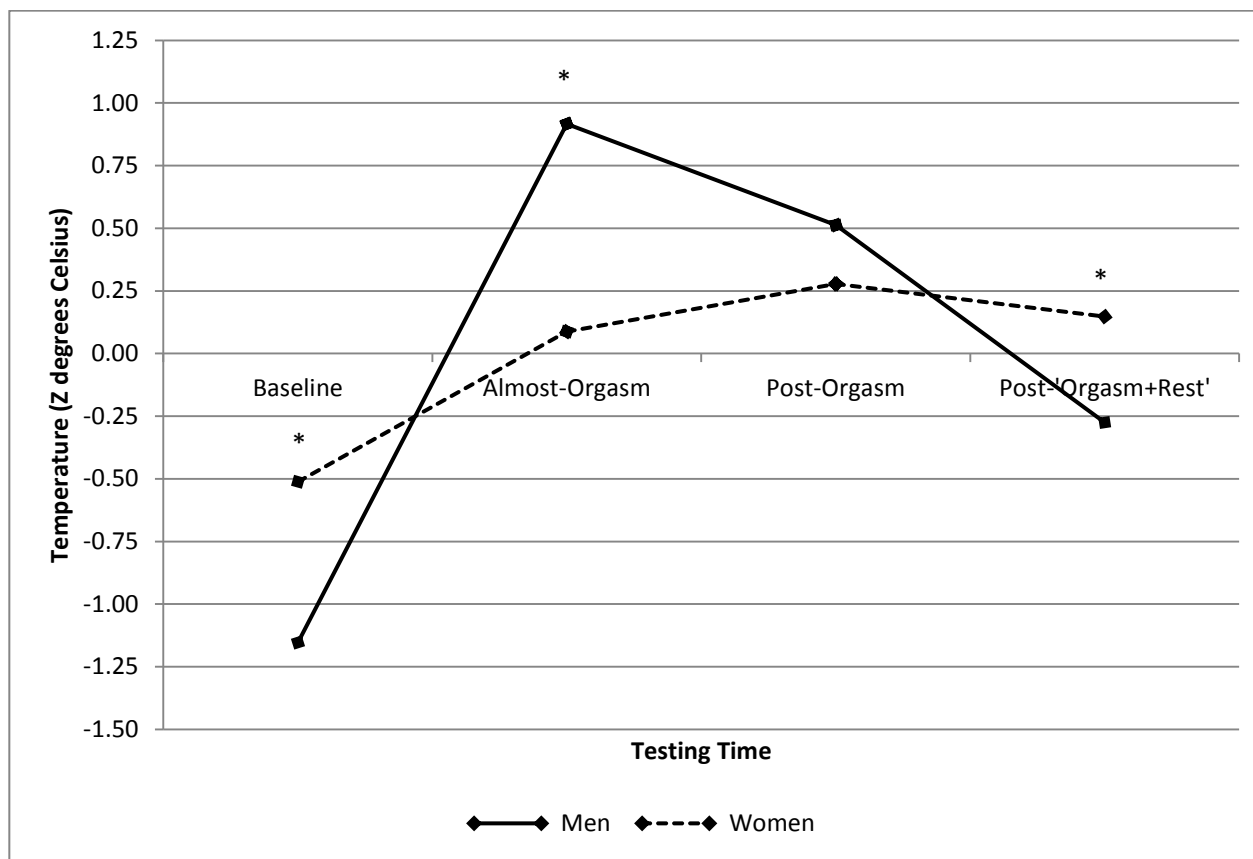
\*  $p < .05$

Figure 5. Sexual desire scores by testing time and gender.



\*  $p < .05$

Figure 6. Genital temperature by testing time and gender.



\*  $p < .05$

## GENERAL DISCUSSION

The overall goal of this thesis was to test selected traditional assumptions about sexual arousal, orgasm and pleasure, as much as possible using a prospective, laboratory paradigm. Reviews were first presented on female orgasmic disorder and its treatment, and the effect of female genital mutilation/cutting (FGM/C) and its surgical repair on orgasm. Two experimental studies were conducted: the first tested the effect of masturbation, sexual arousal and orgasm on genital pain and pleasurable sensitivity, while the second investigated gender differences in sexual arousal and desire with masturbation to orgasm, and predictors of orgasmic pleasure. The results of these studies provide support for the feasibility and ecological validity of studying orgasm in the laboratory. Recruitment of healthy, young adult participants willing to masturbate in the laboratory and undergo standardized measurement of their sensitivity or physiological sexual arousal was surprisingly easy, and the procedures were well-accepted by participants.

To return to the traditional assumptions presented in the General Introduction, our results indicated the following:

1. Stimulation of the external clitoris appears to be important to women's ability to reach orgasm, but it is not known for how many it is necessary. FGM/C, which typically involves excision of the external clitoris, is associated with sexual difficulties in general, including orgasmic dysfunction. The surgical restoration of the external clitoris has facilitated orgasm in affected women who were previously anorgasmic.

2. Sexual arousal does not decrease genital pain sensitivity or increase pleasurable sensitivity; instead, masturbation/sexual arousal increases genital pain sensitivity (as measured by pain thresholds) and merely maintains pleasurable sensitivity.
3. Orgasm does not decrease peripheral pain sensitivity; instead, masturbation to orgasm is followed by increased pain sensitivity on both genital and non-genital locations. Stimulation is, however, on average more aversive after orgasm: pain sensitivity is higher on the vulvar vestibule (though not on the clitoris or forearm) and pleasurable sensitivity is lower on both genital locations after masturbation to orgasm than almost to orgasm.
4. Men's sexual arousal does consistently decrease after orgasm, whereas women's remains elevated. Sexual desire decreases in both genders, but more quickly in men than in women.
5. Orgasms are more pleasurable following a greater build-up of sexual arousal, for both genders. In women, orgasmic pleasure is followed by a greater decrease in genital temperature and a lesser decrease in subjective sexual arousal and desire.
6. It is possible to maintain ecological validity while studying orgasm in the laboratory.

The results of the study presented in Manuscript Three on sensitivity changes with sexual arousal and orgasm indicate several areas for future research. As noted in the conclusions, this study should be replicated with women with

sexual dysfunction and altered genital sensitivity (e.g., vulvodynia). In Payne and colleagues' (2007) study of sensitivity and sexual arousal, women with provoked vestibulodynia had overall higher pain sensitivity than healthy women but followed the same pattern of change with sexual arousal, and this may extend to after orgasm. Should this be the case, education about normal increases in vulvar vestibular pain sensitivity during sexual arousal and after orgasm, and the importance of maximizing pleasure and lubrication, should be integrated into dyspareunia treatment recommendations. Men do not exhibit the same type of superficial genital pain as women; however, those with chronic pelvic pain often experience pain with ejaculation (Davis, Binik, Amsel, & Carrier, 2013). The nature of this pain could be investigated prospectively with some modifications to this experimental paradigm (e.g., the omission of sensory testing and the inclusion of self-report measures of pain quality and intensity at orgasm).

The negative correlation that we found between clitoral pleasurable sensitivity and pain sensitivity could be due to pleasure suppressing pain (if the early presence of pleasure delays the onset of pain), and/or pain suppressing pleasure (if the early presence of pain causes the individual to discontinue stimulation and decreases opportunities to experience pleasure). The relationship between pleasure and pain is complex and deserving of additional research attention. While undesired pain is associated with decreased pleasure and sexual arousal (e.g., in women with dyspareunia; Basson, 2012), desired pain can enhance sexual enjoyment [e.g., in a bondage-discipline/sadism-masochism (BDSM) context; Moser & Kleinplatz, 2006]. The pain in the latter situation is not thought to be pleasurable in and of itself, but experienced as such because of

the meaning the recipient attributes to the pain (i.e., creating a power differential; Cross & Matheson, 2006), and possibly also because it contributes to an overall more intense sensory experience. Men and women who enjoy receiving mild pain (e.g., spanking, biting) during sexual activity may exhibit a different relationship between stimulation painfulness and pleasurable than those who do not, and this could be tested in a follow-up study.

The association that we found between hormonal contraception and higher pain sensitivity and lower pleasurable sensitivity should be replicated in a study that includes a more thorough assessment of hormonal contraception history, hormonal assays, and levels of sexual desire at each testing time. We hypothesized that women using hormonal contraception might have lower desire for stimulation, and this could be due to resultant decreased free testosterone levels (Burrows, Basha, & Goldstein, 2012).

The results of the study presented in Manuscript Four on gender differences in sexual arousal, desire, and orgasmic pleasure also indicate several areas for future research. Our finding of men's greater decrease in sexual arousal following orgasm is consistent with the presence of a refractory period, during which further erection and orgasms are inhibited. The presumed gender difference in the refractory period could be tested by introducing additional stimulation following orgasm (e.g., an erotic film clip) and measuring physiological and subjective sexual arousal. Anecdotal reports suggest that men's refractory period increases in duration with age (Levin, 2009), and this could also be tested in the laboratory. These studies should incorporate more extensive questioning about the preference for only one vs. multiple orgasms during a given session of sexual activity. It is



expected that men and women who prefer to experience more than one orgasm would exhibit a lesser post-orgasmic decrease in sexual arousal and desire following their first orgasm. Thermography worked very well in our study as a minimally-invasive measure of physiological sexual arousal, and could also be used in these follow-up studies. I plan to fully analyze our genital temperature data and its relationship to subjective sexual arousal ratings, as this will provide additional information on the validity of thermography as a measure of physiological sexual arousal; it has thus far only been validated during passive sexual arousal (i.e., without masturbation or orgasm; Kukkonen, Binik, Amsel, & Carrier, 2007, 2010).

The experimental paradigm used in these two studies has many other potential applications, including the study of partnered sex and orgasms. A similar comparison to sex at home would establish whether partner variables compromise ecological validity in the laboratory. Men and women may exhibit different patterns of genital sensitivity, sexual arousal or desire with a partner than during masturbation, and/or have different predictors of their orgasmic and sexual pleasure, such as emotional intimacy. As noted in Manuscript Four, this paradigm could also be used to study the way in which psychological and pharmacological manipulations affect genital sensitivity, the ability to reach orgasm, and orgasm quality. For example, women's ability to reach orgasm is hypothesized to be impaired by cognitive distraction, and this could be confirmed by inducing distraction (e.g., anxiety, negative body image) and testing its impact on orgasmic ease and latency. Certain anti-depressant medications, such as SSRIs, significantly delay or inhibit orgasm; although this is generally an undesired side

effect, there is emerging evidence that short-acting SSRIs are an effective treatment for premature ejaculation (e.g., dapoxetine; McMahon, 2012). Their effect has never been tested in the laboratory, and doing so would serve two opposing purposes: to determine which types have a lesser negative impact on orgasm and should be preferentially prescribed for depression, and which types are most effective at delaying orgasm and should be preferentially prescribed for premature ejaculation.

The results of the present research indicate a complex interplay between physiological and psychological aspects of sexual experience, and future research should continue to integrate both types of measures to increase our understanding of their interaction.

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