

LASER DOPPLER IMAGING: A NEW MEASURE OF GENITAL BLOOD FLOW IN
FEMALE SEXUAL AROUSAL

by

SAMANTHA E. WAXMAN

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in conformity with the requirements for
the degree of Doctor of Philosophy

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Abstract

Female sexual arousal refers to one's feelings of sexual excitement and pleasure and has both physiological (i.e., objective) and psychological (i.e., subjective) components. It is an important, yet difficult phenomenon to investigate. As a result, many instruments have been used in an attempt to accurately measure female arousal; however, there are problems associated with each. Furthermore, the relationship between the subjective and physiological indicators of sexual arousal appears to be influenced by the instrument used to measure physiological sexual arousal. Specifically, instruments measuring physiological arousal internally (i.e., vaginal photoplethysmography) typically yield lower correlations between measures of physiological and subjective sexual arousal than instruments examining the external genitals (i.e., labial thermistor, thermal imager), which indirectly measure blood flow. Alternatively, laser Doppler imaging (LDI) is a direct measure of external genital blood flow but has only been used in one previous study that did not assess the relationship between physiological and subjective sexual arousal. The aims of the current study were to investigate the usefulness of LDI for assessing genital blood flow in women in response to erotic visual stimuli, and to explore the relationship between physiological and subjective indicators of sexual arousal. In addition, the role of psychosocial variables in predicting physiological and subjective sexual arousal was also examined. Eighty sexually healthy women completed a psychosocial interview and questionnaires. Participants also watched three 15-minute films during LDI scanning: two nature films (measuring acclimatization and baseline blood flow levels) and one randomly assigned experimental film (erotic, anxiety, humor, or neutral). They were asked to rate their level of subjective sexual arousal throughout

and following the third film. Results indicated that LDI was able to differentiate the erotic condition from the three non-erotic conditions, and that physiological and subjective sexual arousal were significantly correlated. Although the psychosocial variables did not significantly predict either component of sexual arousal, specific variables moderated the association. Psychological, sexual, and social variables, along with genital sensations, played significant roles in the relationship between subjective and physiological sexual arousal. These findings suggest that LDI is a useful instrument for measuring female sexual arousal, and that sexual arousal is a complex process that requires further empirical investigation.

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For my parents, who are now just finding out what my dissertation is really about.

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CHAPTER 1

Introduction

Female sexual arousal is an important component of sexual functioning, yet it is challenging to empirically examine. A considerable amount of research has explored various methods for measuring the physiological component of female sexual arousal, which includes using the vaginal photoplethysmograph (VPP; e.g., Chivers & Bailey, 2005; Chivers, Seto, & Blanchard, 2007; Laan, Everaerd, van der Velde, & Geer, 1995a), clitoral photoplethysmograph (Gerritsen et al., 2009), labial thermistor clip (e.g., Payne & Binik, 2006; Payne, Binik, Pukall, Thaler, Amsel, & Khalifé, 2007; Prause & Heiman, 2009), thermal imager (Kukkonen, Binik, Amsel, & Carrier, 2007), and magnetic resonance imaging (e.g., Deliganis et al., 2002; Maravilla et al., 2003a; Maravilla et al., 2003b; Maravilla et al., 2005; Suh, Yang, Heiman, Garland, & Maravilla, 2004). In addition to the physiological aspect of sexual arousal, many of these studies have explored the subjective experience of arousal, including the roles of psychological and social variables. Subjective sexual arousal is often referred to as psychological or mental sexual arousal, as it refers to a woman's individual perception of a stimulus as either being sexual or not. It is composed of a multitude of factors including: the experience of genital congestion, sensations from stimulation of engorging structures, and the affect and cognitions from the sexual event (Basson, 2007). The importance of studying female sexual arousal and sexual response is highlighted by the fact that as many as 19% of women between the ages of 18 and 59 report problems with vaginal lubrication (Laumann, Gagnon, Michael, and Michaels, 1994), a known correlate of sexual arousal (Masters & Johnson, 1966). However, before one can truly understand the causal and

maintaining factors of arousal difficulties, a well conceptualized model examining the physiological and subjective components of healthy female sexual arousal is necessary.

Therefore, the purpose of the current study was to investigate sexual arousal in healthy, young women. Laser Doppler imaging (LDI) was used to capture the physiological component of sexual arousal (i.e., blood flow to the external genitals), while the subjective component of sexual arousal was measured discretely (i.e., using post-film ratings of overall arousal) and continuously (i.e., using real-time ratings during stimulus presentation). Questionnaire data were also used to obtain information on the psychosocial aspects of sexual arousal. Results indicated that LDI was able to distinguish between genital blood flow in the erotic condition from the three non-erotic conditions. Additionally, it was demonstrated that the physiological (i.e., genital blood flow) and subjective (i.e., arousal ratings) components of sexual arousal were significantly correlated during the erotic condition. Several psychosocial variables were identified as significant moderators of the association between physiological and subjective sexual arousal. Furthermore, perceptions of genital sensations were found to mediate the relationship between the two components of female sexual arousal. The results from this study help to elucidate potential biopsychosocial mechanisms underlying the sexual arousal response. Ultimately, the findings of the current study contribute to the understanding of female sexual arousal in terms of validating a new instrument for the measurement of physiological sexual arousal, and providing information on the psychological and social factors involved in female sexual arousal.

CHAPTER 2

Literature Review

It is crucial to examine sexual functioning from a biopsychosocial perspective, especially when one considers that there is an elaborate interaction between biological factors (e.g., neurological, vascular, and endocrine systems), psychological factors (e.g., mood, personal beliefs), and social factors (e.g., interpersonal relationships; Althof et al., 2005) involved in women's sexual experiences. Historically, sexual response was explored from a biological or physiological viewpoint (see section below; Masters & Johnson, 1966); however, current research has emphasized the importance of including aspects of the psychosocial environment in the investigation of sexual response (e.g., Basson et al., 2001; Winton, 2001). Thus far, most research studies in this area have focused on a biopsychosocial perspective of factors involved in the development and maintenance of sexual dysfunctions. However, it is important to understand the factors that contribute to normal sexual functioning before adding the complexity of sexual difficulties.

The Sexual Response Cycle

Much of the literature regarding the physiological component of sexuality is based on studies conducted in the 1960's by Masters and Johnson. These investigators were the first to systematically measure physiological changes before, during, and after sexual activity, and the information collected led to the development of a model of the human sexual response cycle. Masters and Johnson's sexual response cycle (see Figure 1) involves a linear temporal progression of discrete phases beginning with sexual arousal or excitement, followed by plateau, orgasm, and resolution.

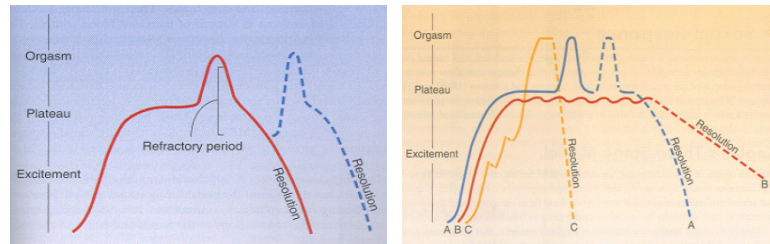


Figure 1. The sexual response cycles for males (left) and females (right) proposed by Masters and Johnson. As shown in the female sexual response graph, women tend to have more variety in their sexual response cycles as compared to men.

The first stage, excitement, is characterized by erection in men and by vaginal lubrication in women. Both men and women also experience muscle tension and increases in heart rate, blood pressure, and respiration. The second stage, plateau, is an advanced state of arousal that precedes orgasm. Despite the typical meaning of ‘plateau’ to indicate a leveling off of a physiological process and the striking depiction of this leveling off in Figure 1, this stage is actually characterized by increases in vasocongestion (i.e., swelling of genital tissues with blood causing erection of the penis and engorgement of the area surrounding the vaginal opening), myotonia (i.e., muscle tension), heart rate, blood pressure, and respiration in preparation for orgasm (Masters & Johnson, 1966).

Orgasm can be experienced by both males and females and is the point at which sexual tension is released (Masters & Johnson, 1966). It is accompanied by quick cycles of muscle contraction in the lower pelvic muscles, which surround both the anus and the primary sexual organs. Women also experience uterine and vaginal contractions (Rathus, Nevid, Fichner-Rathus, & Herold, 2004). In males, contractions of muscles surrounding the urethra and the base of the penis force the ejaculate through the urethra and out of the

body. The first 3 to 4 contractions are generally most intense and occur at 0.8-second intervals. Another 2 to 4 contractions occur at a somewhat slower pace. Orgasm in women is manifested by 3 to 15 contractions of the pelvic muscles that surround the vaginal canal. The contractions first occur at 0.8-second intervals, resulting in a release of sexual tension similar to the male, followed by 3 to 6 weaker and slower contractions (Rathus et al., 2004). The spacing of these contractions is much more variable in women as compared to men.

The resolution phase is the period following orgasm, in which the body returns to its pre-aroused state (e.g., muscles relax, blood pressure drops). There is an important sex difference to note in this phase. Unlike women, men typically enter a refractory period during which they are physiologically incapable of experiencing another orgasm or ejaculation. Women may become re-aroused very quickly to the point of repeated orgasm if they wish and if they receive continued sexual stimulation (Rathus et al., 2004).

One of the major strengths of the sexual response cycle is that it captures the physiological components of male and female sexual response and function in great detail. This strength, however, is weakened by the fact that it overlooks psychological and social factors that may contribute to sexual functioning or accompany sexual response (Rathus et al., 2004). In other words, although the physiological aspects of sexual function are accounted for by the sexual response cycle, it does not take the subjective components of sexual response into account. Indeed, such components play an important role in sexual response. For example, it has been argued that sexual arousal cannot be defined sufficiently without including both physiological and subjective (i.e., experience of excitement and pleasure) components, as the subjective experience helps

determine the response to a particular stimulus as sexual (Everaerd, Laan, Both, & van der Velde, 2000). Additionally, Leiblum (1998) found that affection, intimacy, and sexual satisfaction play an important role in sexual function. It has also been argued that psychosocial factors play a more important role in women's sexuality as compared to men's (Dunn, Croft, & Hackett, 1999).

To compensate for this lack of attention to psychological factors in sexual response, a revised version of the sexual response cycle was proposed by Kaplan (1979). Her model consisted of three phases: desire, excitement, and orgasm. The desire phase was incorporated as the psychological component, whereas the last two phases were primarily physiological in nature. In contrast to Masters and Johnson's model which viewed the stages as consecutive and cumulative, Kaplan viewed the components in her model as relatively independent from each other and with a potentially variable sequence. Certainly, sexual response involves a complex interplay of many factors, including biological, psychological, and social components.

The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; APA, 2004) was greatly influenced by the sexual response cycles developed by Masters and Johnson and Kaplan for the classification of the sexual dysfunctions. The DSM-IV defines the sexual dysfunctions as "disturbances in sexual desire and in the psychophysiological changes that characterize the sexual response cycle and cause marked distress and interpersonal difficulty" (p. 493). Sexual dysfunctions in women include hypoactive sexual desire disorder, sexual aversion disorder, sexual arousal disorder, orgasmic disorder, dyspareunia (i.e., pain during sexual intercourse), and vaginismus (i.e., a spasm of the muscles around the outer third of the vagina when

vaginal penetration is attempted). Although female sexual arousal disorder is a common sexual dysfunction, with as many as 19% of women between the ages of 18 and 59 reporting problems with vaginal lubrication (Laumann et al., 1994), little is known about female sexual arousal in general.

Female Sexual Arousal

Female sexual arousal is an important, yet difficult, phenomenon to investigate. Most studies focus on the physiological component of female sexual arousal by measuring vaginal vasocongestion (Chivers & Bailey, 2005; Chivers et al., 2007; Kukkonen et al., 2007; Laan et al., 1995a); however, aspects of psychological (e.g., mental health) and/or social (e.g., relationship quality) factors receive less empirical attention. One obstacle to understanding sexual arousal is that female sexual desire (feelings of sexual interest, including thoughts and fantasies) and arousal (one's feelings of sexual excitement and pleasure) are often discussed together in the literature (e.g., Basson, 2001; Basson, 2007; Basson, Brotto, Laan, Redmond, & Utian, 2005; Nappi, Ferdeghini, & Polatti, 2006), making it challenging to assess the physiological and psychosocial components that apply specifically to sexual arousal. This amalgamation may be due to the high correlations found between self-reported measures of desire and arousal (Beck, Bozman, & Qualtrough, 1991; Rosen et al., 2000). In addition, Graham, Sanders, Milhausen, and McBride (2004) showed that women typically do not perceive a difference between their feelings of sexual desire and arousal. Due to this potential overlap, some authors have suggested that desire and arousal are two components of the same mechanism within sexual response (e.g., Beck et al., 1991), whereas others have suggested that sexual desire is an earlier stage of the arousal process (Everaerd et al.,

2000). It is important to note, however, that the correlations between desire and arousal obtained in previous studies were not perfect correlations, which implies that unique features of both concepts may in fact exist. Therefore, it is necessary to investigate sexual arousal from a biopsychosocial perspective to help elucidate how arousal assists and promotes the progression through sexual activity.

Basson's conceptualization (2002a) of female sexual arousal describes the processing of sexual stimuli (see Figure 2), and can be viewed from a biopsychosocial perspective. According to Basson, upon presentation of a sexual stimulus, the limbic system subconsciously processes the information, immediately leading to vaginal vasocongestion (often referred to as objective, physiological, physical, or genital sexual arousal). Simultaneously, stimulus content and context are cognitively assessed. In contrast with the activation of the autonomic nervous system (which controls automatic processes within the body, such as heart rate or vasocongestion), the cognitive processes take place within an individual's consciousness, and can potentially trigger subjective sexual arousal. This process may be moderated by women's awareness of their genital arousal. In addition, physiological and subjective sexual arousal both elicit an affective response, which can be either positive or negative, triggering feelings such as pleasure and enjoyment or guilt and fear, respectively (however, physiological sexual arousal has failed to show an effect on affective response in two studies using VPP; Laan, Everaerd, van Bellen, and Hanewald 1994; Laan, Everaerd, & Evers, 1995b). Throughout this process, limbic functioning is modulated by affective and cognitive feedback, which affects the overall experience of subjective sexual arousal.

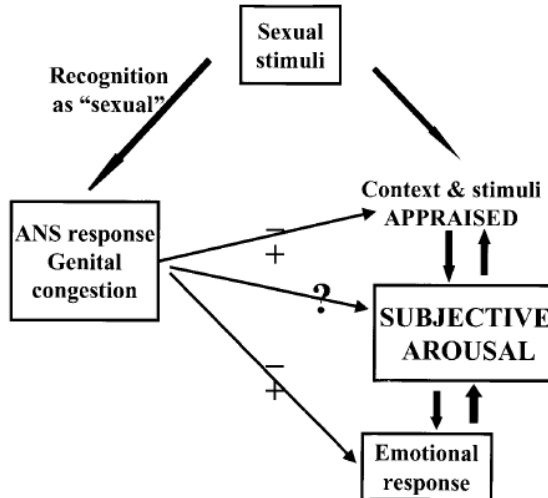


Figure 2. Model of women's subjective sexual arousal (Basson, 2002a)

As mentioned in Basson's model, a woman's experience of subjective sexual arousal is influenced by her assessment of the external, situational cues accompanying the presentation of sexual stimuli, a finding that has been supported in the literature (Barlow, 1986; Everaerd et al., 2000; Laan et al., 1994). For example, Barlow (1986) proposed that interpretations of the context in which sexual activity occurs influences the corresponding affective responses. More specifically, he postulated that sexual situations that elicit positive affect and expectancies increase an individual's attention and focus on erotic cues, thereby increasing autonomic arousal (i.e., genital vasocongestion). Laan et al. (1994) tested Barlow's theory by showing only women erotic films designed for both women and men and measuring their subjective, physiological, and affective responses. The authors found that female-oriented erotic films produced more positive affect, less negative affect, and more subjective sexual arousal. However, physiological sexual arousal did not differ between the two films. More recently, Lykins, Janssen, and Graham (2006) found that negative moods, including depression and anxiety, were associated

with decreased interest in sexual activity, as well as decreased self-reported sexual arousal. These findings suggest that when a woman states that she does not feel sexually aroused, it is likely because of how she experiences the sexual stimuli rather than because of any lack of physical changes in her body. In fact, in many cases, subjective sexual arousal may be completely absent even though women are physiologically registering the sexual nature of the presenting stimuli (i.e., vaginal lubrication is occurring; Laan et al., 1995a).

Psychology of Female Sexual Arousal

Several psychological and social factors (e.g., depression, anxiety, stress, anger, marital satisfaction) have been suggested to impact sexual arousal. However, the direction and strength of these relationships is highly variable (Basson et al., 2001), such that few variables consistently inhibit or enhance women's sexual arousal across groups. For example, the relationship between anxiety and sexual functioning is mixed for women, with the suggestion that it is more often negative than positive (Althof et al., 2005; Dunn et al., 1999). Graham et al. (2004) asked 80 women in focus groups to discuss what factors lead to their sexual excitement or inhibition. Negative moods, such as anxiety, reduced some women's ability to become aroused, while other women felt it increased their sexual arousal. This self-reported finding is supported by the research of Bradford and Meston (2006) in which a curvilinear relationship was found between anxiety and sexual arousal, such that women who possessed a moderate range of state anxiety showed greater increases in genital arousal in response to erotic films than those with lower or higher levels. This curvilinear relationship may help explain why some women have enhanced sexual arousal in relation to anxiety, while others feel inhibited.

Other psychosocial variables that have been suggested to impact sexual arousal include past negative experiences, low sexual self-image, feelings of lack of safety (regarding birth control, sexually transmitted infections, or emotional safety) or naïveté, negative emotions in response to physical arousal (Basson, 2001), anger (Graham et al., 2004), and depression (Althof et al., 2005; Basson, 2001; Dunn et al., 1999; Graham et al., 2004); however, none of these studies included a measure of physiological sexual arousal. Additionally, female sexual arousal problems have been found to strongly correlate with self-reported marital difficulties (Dunn et al., 1999). However, it is important to note that many of these psychosocial variables have not been tested empirically, leading to difficulties in interpretation.

The cognitive arousal theory of emotions, proposed by Schachter and Singer (1962), presumes that the experience of emotion is the result of both physiological arousal and a state of “emotional” cognition in reaction to a stimulus. They argue that situational cues, as opposed to internal bodily sensations, are of utmost importance for the experience of emotion. In terms of sexual arousal, Everaerd et al. (2000) propose that after a woman appraises a situation as sexual, the erotic cues from this situation serve to trigger physiological reactions and commence the process of cognitive labeling. An essential proposition of the cognitive arousal theory is that for a particular situation to be experienced as sexual, an appropriate emotional attribution must occur even if genital arousal is already present. Moreover, Everaerd et al. (2000) argue that genital cues in women are less likely to determine subjective sexual arousal than the appraisal of external cues, because genital arousal in women produces fewer kinesthetic cues to assist with detection of signs of arousal as compared to male erection. Therefore, the authors

predict that women's evaluation of the context will account for more of the variance in the subjective experience of sexual arousal than feedback from genital sensations. It is important to note that Everaerd et al. (2000) discussed genital arousal as measured by the VPP (see below), which provides information about blood flow to the internal genitals (i.e., vagina) but not about blood flow to the external genitals (i.e., labia minora, labia majora, clitoris).

Subjective sexual arousal is most commonly assessed using a single item or numerical rating scale, asking participants to rate their feelings of sexual arousal *after* the presentation of a sexual stimulus. Although not as commonly used, continuous measures of sexual arousal allow participants to indicate their level of sexual arousal *during* the presentation of a sexual stimulus. Using this method, researchers are able to continuously evaluate the relationship between subjective and physiological sexual arousal throughout the entire stimulus presentation (Everaerd et al., 2000) and identify preferred and non-preferred scenes of the film. Wincze, Hoon, and Hoon (1977) were the first to use a continuous measure of sexual arousal, which was constructed from a lever mounted on a table that was moved by participants in a 90-degree arc to indicate level of sexual arousal. Laan et al. (1995a) also measured sexual arousal continuously by having participants move a lever. The lever was calibrated so that its placement determined how many of 10 lights were illuminated, with 1 light signaling no sexual arousal and all 10 lights signaling maximum sexual arousal. More recently, Rellini, McCall, Randall, and Meston (2005) created the "arousometer", a computer mouse mounted on a wooden track that is divided into 10 equally spaced intervals from -2 (*sexually turned off*) to 7 (i.e., *the highest level of feeling sexually turned on*). Previous research has shown high associations

between after- and during-film ratings (e.g., Rellini et al., 2005); however, it is important to note that both measures have their disadvantages. For example, discrete measures (i.e., numerical rating scales) require retrospective recall while continuous measures require participants to constantly monitor themselves, which may be distracting.

Physiology of Female Sexual Arousal

Female sexual response was first studied by Masters and Johnson (1966) who demonstrated that vasocongestion is one of the earliest and most reliable physiological correlates of sexual arousal in women. The most common method for measuring female sexual arousal is to examine changes in genital vasocongestion (Bartlik & Goldberg, 2000), as female sexual arousal involves increased blood flow in the circuitry of blood vessels located immediately under the vaginal epithelium. This process causes more fluid to pass through the vaginal epithelium into the vaginal lumen (i.e., inner walls), which leads to a rise in the volume of the lubrication fluid as well as a change in its composition. As a result of this increase in blood flow, swelling in genital structures is common and typically involves the areas around the urethra, around the anterior portion of the vagina beneath the superficial perineal muscles, as well as the shaft, head, and crura of the clitoris (Basson, 2007). Magnetic resonance imaging of sexual arousal in women has also shown that during the pre-orgasmic phase, the anterior vaginal wall lengthens by 1 cm and the uterus rises within the pelvis (Schultz, van Andel, Sabelis, & Mooyaart, 1999).

Non-genital changes involved in sexual arousal include increases in muscle tone, body temperature, respiration, heart rate, blood pressure, and skin sensitivity, as well as breast engorgement, nipple engorgement, and nipple erection (Basson, 2002; Graziottin,

2004). Additionally, changes in brain activation have been identified during sexual arousal using brain imaging technology. In particular, when watching erotic films, both male and female participants showed significant activation in the medial prefrontal, orbitofrontal, insular, occipito-temporal cortices of both hemispheres, in addition to activation in the amygdala, ventral striatum, and anterior cingulate cortex. These areas have been shown to play a role in decision-making, cognitive function, and emotions. In particular, the hypothalamus was found to play an important role in regulating sexual behaviour and physiological arousal (Karama et al., 2002).

Genital sexual arousal is an automatic process that does not require conscious processing of information and is reflective of hypothalamic activation (Basson, 2002b). In comparison to genital arousal, subjective sexual arousal appears to be a more gradual response that involves distinctive brain pathways that evaluate a stimulus through both conscious and unconscious processes (Basson, 2007). The amygdala, which is responsible for the processing and memory of emotional reactions, is the most crucial brain structure for interpreting and processing the meaning of a sexual stimulus. For example, it has been suggested that if the stimulus is perceived to be positive, then the amygdala will trigger a succession of neurobiological events that result in physiological sexual arousal. However, if the stimulus is perceived to be negative, the amygdala will typically impede both physiological and subjective sexual arousal, which can lead to a greater susceptibility for sexual dysfunction (Graziottin, 2006). This account is not always supported in the literature that explores women's genital response to sexual assault or threat. For instance, female genital arousal response, including orgasm, has

been observed following depictions of sexual threat in the laboratory (e.g., Laan et al., 1995b) or accounts of sexual assault (Levin & van Berlo, 2004).

Measuring Female Sexual Arousal with Photoplethysmography

It has long been accepted that female sexual arousal is a much more difficult phenomenon to measure than male sexual arousal, as vaginal lubrication and swelling of the female genitals are less obvious indicators of sexual arousal than penile tumescence (Bartlik & Goldberg, 2000). As a result, a multitude of instruments have been utilized in an attempt to measure female sexual arousal. The VPP is a device designed to measure changes in vasocongestion in the vagina. The VPP is a tampon-shaped probe that is inserted into the vagina to record changes in blood flow during exposure to an erotic stimulus. The VPP contains a light source and a phototransistor as a light detector. When the blood volume changes in the vagina, the amount of light scattered back to the light detector also changes (Everaerd et al., 2000).

The photoplethysmograph provides two values for measuring physiological sexual response: vaginal blood volume (VBV) and vaginal pulse amplitude (VPA; Meston, 2000), neither of which has an apparent zero point. VBV reflects slow changes in the pooling of blood in the vaginal tissue (Hatch, 1979), and is measured in units of blood volume change (Meston, 2000). VPA reflects changes in engorgement of the vagina with every heart beat, where higher amplitudes are suggestive of higher levels of blood flow (Geer, Morokoff, & Greenwood, 1974). VPA has consistently been found to be the more sensitive and specific measure of genital arousal (Laan et al., 1995b).

Among sexually healthy women, correlations between physiological and subjective measures of sexual arousal are often low, indicating that the presence of

genital vasocongestion does not necessarily result in the subjective experience of sexual arousal and vice versa. Hypotheses for these weak correlations were generated from the idea that women's ratings of sexual arousal may be more highly influenced by their general state of arousal, rather than by simply relying on feedback from their genitals (Graham et al., 2004). This hypothesis supports the view taken by Heiman (1977) who suggests the low correlation between subjective and physiological measures of sexual arousal may reflect an inability for women to detect subtle changes in vaginal blood flow. Therefore, in women, subjective sexual arousal is not necessarily influenced by peripheral feedback from consciously detected genital arousal. However, Laan et al. (1995a) found that the degree of correlation between measures of subjective and genital sexual arousal was dependent upon the detection of changes in the genitals. More specifically, it was found that subjective sexual arousal was linearly related to genital arousal, such that experimental conditions that generated large changes in genital arousal over trials resulted in greater corresponding levels of subjective sexual arousal. These findings suggest that peripheral feedback from consciously detected genital arousal does not account for the variance in subjective sexual arousal unless women are given the chance to use variations in genital responding as an indicator of sexual arousal (Laan et al., 1995a). More recently, Chivers et al. (2007) demonstrated that, for heterosexual women, the correlation between subjective and physiological sexual arousal (VPA) was large and significant ($r = .56$). The authors attributed this correlation to the finding that heterosexual women produced genital responses that were associated with the intensity of the sexual stimuli, thus replicating the finding by Laan et al. (1995a). Additionally, Chivers, Seto, Lalumière, Laan, and Grimbos (2009) demonstrated that across 134

primarily employing VPP, the average correlation between subjective and physiological sexual arousal for women was .30, suggesting a moderate effect.

An additional hypothesis for the weak subjective-genital relationship is the impact of male-produced erotic films on women's affect. As previously mentioned, Laan et al. (1994) investigated differences in women's levels of genital and subjective sexual arousal while watching either female-oriented or male-oriented erotic films. Female-oriented films involve female initiation of sexual activity and prolonged foreplay (i.e., stroking and kissing) before intercourse. As well, these films often portray sex partners as having equal roles in terms of sexual desire and pleasure, and are therefore considered more 'female friendly' than male-oriented films, which tend to place an almost exclusive emphasis on intercourse and male pleasure (Laan et al., 1994). These researchers found that women demonstrated higher subjective sexual arousal to female-oriented films as compared to male-oriented films, even though genital arousal did not differ between the two film types. As a result, the correlations between subjective and physiological sexual arousal were typically non-significant ($r_s = -0.45$ to 0.40).

When data are examined more closely to help explain the lower correlations, there is no consistent explanation for the physiological-subjective relationship across different women (Everaerd et al., 2000, Styles, MacLean, & Sultana, 2006; Laan et al., 1995a; Dekker & Everaerd, 1988). These inconsistencies are not surprising given that female genital vasocongestion does not necessarily reinforce sexual excitement (Basson, 2001), unlike the more obvious swelling of a man's penis during erection. This difference is largely due to the fact that the vagina is an internal structure, and thus lubrication in the internal genitalia provides very little proprioceptive feedback to women. More

specifically, the vagina contains only two types of receptors: pain and touch (i.e., Merkel tactile discs). In contrast to the vagina, the external genitals, including the mons, labia minora, labia majora, and clitoris, are more abundantly innervated with Meissner corpuscles (sensitive to touch), Merkel tactile discs, Pacinian corpuscles (sensitive to deep pressure touch and high frequency vibration), Ruffinian corpuscles (sensitive to skin stretch), and pain receptors (Krantz, 1958), thereby allowing sensations in the external genitals to be more easily detected.

Male sexual arousal is measured using penile plethysmography (or phallometry) which can be classified into two methods: volumetric or circumferential. Both methods require the placement of a device around the penis that measures changes in penile blood volume (due to increased blood flow) or circumference of the penis in response to sexual and nonsexual stimuli (Kuban, Barbaree, & Blanchard, 1999). For men, the correlations between genital and subjective sexual arousal are typically highly positive and significant (Everaerd et al., 2000). For example, Steinman, Wincze, Sakheim, Barlow, and Mavissakalian (1981) compared males and females on their physiological and subjective sexual arousal using a penile strain gauge (the main type of penile plethysmography) and VPP, respectively. They found that the males in their study had relatively stronger relationships between physiological and subjective sexual arousal, whereas more variable relationships were found for the female participants.

The inconsistencies between the physiological and subjective components of sexual arousal in women may also arise because women likely approximate their level of sexual arousal based on cues separate from changes in their genitals, such that they may focus on external stimulus information as opposed to internal physiological states to

determine their level of arousal (Rellini et al., 2005). For example, Korff and Geer (1983) examined women's subjective and physiological sexual arousal to determine the effect that attending to one's bodily sensations has on the relationship between subjective and physiological sexual arousal. Participants were divided into three groups: an experimental group which received instructions to attend to genital signals of arousal while viewing erotic slides, an additional experimental group that received instructions to attend to non-genital signals of sexual arousal while viewing erotic slides, and a control group which received no attention-related instructions. They found that the correlation between physiological and subjective sexual arousal was significantly higher among women in both attention groups (r ranges = 0.72-0.90) versus the control group (r ranges = 0.48-0.69). This finding suggests that drawing a participant's attention to their internal cues of sexual arousal increases the strength of the physiological-subjective relationship. Dekker and Everaerd (1988) replicated the work of Korff and Geer (1983) by instructing participants to either attend to images of sexual stimuli alone or attend to the images as well as their responses to them. Participants who were instructed to focus on the stimuli and their resulting responses demonstrated stronger genital responses and subjective sexual arousal as compared to the participants who focused on the stimuli only. However, a recent meta-analysis indicated that asking women to report on their perceptions of genital sensations resulted in lower concordance between physiological and subjective sexual arousal (Chivers et al., 2009). In addition, Salemink and van Lankveld (2006) showed that for women with and without sexual problems, distraction (i.e., working with digit pairs) affected genital sexual responding, such that VPA signals were significantly lower during the highest level of distraction than during the no distraction condition.

Retrospective ratings of subjective sexual arousal also decreased with increased levels of distraction; however, distraction had no effect on concurrent ratings of sexual arousal. For both groups of women, the correlation between physiological and subjective arousal was low and non-significant. Taken together, these results suggest that it is possible that the low or inconsistent correlations found in other studies may be related to a participant's diminished attention to physiological cues while focusing solely on the sexual stimuli or as a result of distraction.

A more recent study has shown that, in fact, there is a strong association between genital response and subjective sexual arousal in women, suggesting that perhaps the inability to find a correlation in previous research was due to errors in the statistical analyses or methodology employed. In terms of statistical analyses, repeated-measures ANOVAs have often been used to analyze the resulting data from VPP. However, Rellini et al. (2005) noted that several of the assumptions of repeated-measures ANOVAs (e.g., correlations between observations within a participant are all the same) will not allow for an analysis of the relationship between VPA and continuous measures of subjective sexual arousal. Instead, Rellini et al. (2005) performed hierarchical linear modeling (HLM) on the data, as it allows one to carry out a within-subjects analysis of the subjective and physiological sexual arousal relationship. As a result, they found that VPA and subjective sexual arousal ratings were, in fact, significantly related in women.

Although the VPP has been considered the gold standard for measuring female sexual arousal (Kukkonen et al., 2007), many researchers believe that there are inherent problems associated with using this instrument. For example, a woman must insert the device into her vagina prior to exposure to erotic stimuli, making it an intrusive process.

Moreover, the insertion of a device into the vagina likely influences the experience of sexual arousal for women in different ways (Kukkonen et al., 2007). For example, women with vulvodynia (or pain in the vulva) may experience pain when inserting the VPP into the vagina, which likely alters the experience of sexual arousal. Furthermore, this device provides only an indirect measure of blood flow via the recording of VPA. Finally, VPP is sensitive to movement artifacts, including muscle contractions, which can affect the signal output. Differences in physiology (e.g., resting levels of vaginal muscular tone and vaginal moistness) can also affect the signal (Geer & Janssen, 2000).

A new photoplethysmograph was recently developed that measures clitoral blood volume (clitoral photoplethysmograph, CPP; Gerritsen et al., 2009). The authors adapted the VPP to include an extra probe that is placed between the labia minora and is molded to fit the shape of a vulva, allowing VPP and CPP to be measured simultaneously. The device can be inserted by the participant, with the clitoral blood volume (CBV) signal being particularly resistant to movement artifacts. The authors also included a measure of skin conductance levels (SCLs), as clitoral bulb and sympathetic activity have been shown to have a strong relationship (Yilmaz et al., 2004). It was found that changes in SCLs significantly predicted changes in CBV, but not VPP, such that higher levels of changes in SCLs were associated with greater decreases in CBV. Additionally, CBV was generated in response to the erotic film presentation, like VPP. Finally, greater increases in CBV towards the end of the erotic film were associated with lesser increases in VPA. These authors suggest that perhaps VPA and CBV are measuring different physiological processes in that VPA may be more of an “automatic preparatory response” (p. 1686) and not necessarily genital arousal. Taken together, it appears as though CBV may be a valid

measure of female sexual arousal; however, the relationship between physiological sexual arousal (i.e., CBV) and subjective experiences of sexual arousal is still unknown, and further replication of the CPP is required.

Measuring Female Sexual Arousal via Temperature Changes

More recent methodologies have shown that, in contrast to the weak correlations between physiological and subjective levels of female sexual arousal derived from many studies using the internally-placed VPP, devices that examine changes in the external genitals have been shown to produce significant positive correlations between these two components of sexual arousal. Although much less commonly used than the VPP, the instruments that measure female sexual arousal in the external genitals have shown promising results. For example, use of the labial thermistor clip is based on the assumption that temperature on the skin's surface is reflective of changes in blood volume. It contains a highly sensitive surface thermistor that is fastened to the end of a metal clip, which is then attached to the widest part of the labium (singular of labia) minora (Payne & Binik, 2006). The labial thermistor clip was developed by Henson, Rubin, Henson, and Williams (1977), and after an initial strong interest, writings of its use disappeared from the literature. It has only recently regained popularity (Payne & Binik, 2006). The thermistor clip has shown promising results for measuring physiological sexual arousal in women as temperature of the labia has been shown to consistently increase with exposure to erotic stimuli and to correlate strongly with subjective sexual arousal ($r = .74, p < .01$; Payne et al., 2007). These, and other data suggest that perhaps the low correlations between women's physiological and subjective sexual arousal reported with the VPP may be an artifact of its internal placement and

measurement. It is likely that women would be more conscious of physiological changes in the labia – part of the female external genitalia – as opposed to changes in blood flow in the vagina, leading to higher correlations between the physiological and subjective measures. Recently, Prause and Heiman (2009) examined the labial thermistor clip in tandem with the VPP, while participants rated their concurrent subjective sexual arousal. The thermistor clip was able to differentiate sexual from non-sexual response, and was also sensitive to different levels of sexual arousal. Signals from the two devices were not significantly correlated with each for either high intensity or low intensity sexually arousing stimuli. Additionally, women's subjective sexual arousal corresponded more closely with the labial thermistor than with the VPP. As promising as the labial thermistor clip is for examining this increased correlation, some problems limit its use. For example, the surface area of the clip is very small (approximately 4.8 mm in diameter), and as a result, only a limited part of the genitals can be examined at any given time. As well, the labia minora of some women may be very small or nonexistent, making the placement of the clip difficult or impossible. In addition, temperature is an indirect measure of blood flow.

Another promising method of measurement for female sexual response is thermal imaging. Thermal imaging detects infrared radiation from the skin using high-resolution, fast-scanning cameras and produces images of that radiation (Kukkonen et al., 2007). It is a non-invasive type of measurement; it does not require insertion into the vagina or even genital contact. Like the labial thermistor clip, it also provides an absolute scale of measurement (i.e., temperature). Using thermal imaging, Kukkonen et al. (2007) examined sexual response in sexually functional men and women. Participants were

randomly assigned to one of three film conditions (neutral, humour, or erotic) after watching a neutral video to establish baseline temperature. A humour film was used because when compared with the erotic film, it would represent a physiologically arousing but non-sexual condition. Genital temperature was recorded as the measure of physiological sexual arousal while self-reported ratings of sexual arousal, humour, and relaxation formed the basis of the subjective measures. Temperature was also recorded on the inner thigh, which served as a control area. The authors found that, during the erotic film condition, both men and women showed increased genital temperature as compared with baseline. In addition, genital temperature during the erotic film was found to be highly and significantly correlated with subjective ratings of sexual arousal for both men and women (r s range from 0.34-0.71 with Fisher's transformations and results show no significant differences between men and women). There were no significant changes in thigh temperature for either men or women, indicating that the thermal imager was measuring genitally-specific arousal changes in response to the erotic film and not overall increases in temperature. This method of measuring female sexual response is certainly a promising avenue to pursue; however, as mentioned in relation to the labial thermistor, one major problem with this methodology exists. Temperature is indirectly related to blood flow; that is, one can only assume that as temperature of the area increases in response to sexual stimulation, so does blood flow. One way to solve this issue is to use techniques that directly measure blood flow in response to sexual stimulation.

Measuring Female Sexual Arousal through Change in Genital Blood Flow

Magnetic resonance imaging (MRI) and laser Doppler imaging (LDI) are two methods for the direct measurement of female sexual response (i.e., blood flow change in

the genitals). MRI has been used in several recent studies to examine changes in female genitalia and pelvic organs associated with sexual arousal (e.g., Deliganis et al., 2002; Maravilla et al., 2003a; Maravilla et al., 2003b; Maravilla et al., 2005; Suh et al., 2004). Like thermal imaging, the MRI procedure is genitally noninvasive and nonintrusive, as the participant is alone in the testing room while the MRI program is run from a separate room. However, several studies have been using MS-325, a gadolinium-based MRI blood pool agent that binds to albumin, which needs to be injected into participants intravenously to obtain clearer images for the identification of genital structures. Genital changes due to the presentation of erotic stimuli include increased enhancement of the clitoris, vestibular bulbs, and labia minora (Suh et al., 2004). In addition, a significant correlation was found between clitoral volume increase and self-reported sexual arousal in response to the presentation of an erotic film (Maravilla et al., 2005). The main advantage of MRI is that it allows the sexual responses of women to be measured and quantified even though the genital and pelvic structures typically lie below the surface of the skin, making it nearly impossible to directly observe (Maravilla & Yang, 2008).

LDI is a non-invasive procedure that directly measures superficial blood flow in the skin. Doppler imaging is based on the principle that there is a change in the frequency of light when it interacts with an object in motion (e.g., blood; Wardell, Jakobsson, & Nilsson, 1993); therefore, when cells are moving, a small portion of light is shifted, detected, and converted into an electrical signal that can be further processed. The quantity that is measured using LDI is referred to as flux, which is defined as the product of mean blood cell number and speed (Leahy, de Mul, Nilsson, & Maniewski, 1999). For the current study, the term blood flow will be used to refer to measurement obtained from

the LDI. To measure blood flow to the external genitals, the imager is typically placed a short distance from the vulva and can gather signals from a depth of up to 2-3 mm below the surface of the skin. The LDI has been used in one previous study to examine changes in vulvar blood flow as a measure of female sexual arousal. Styles et al. (2006) found a significant increase in blood flow to the vulvar area after participants read a chapter of erotic fiction, with maximal change in blood flow occurring in the fourchette (i.e., posterior portion of the vulva). Although the authors asked participants to rate their subjective sexual arousal using a numerical rating scale, they did not report any data regarding the relationship between physiological and subjective arousal. Therefore, at this time, it is unknown whether physiological sexual arousal (as measured by LDI) is correlated with subjective sexual arousal.

The LDI may offer several advantages over other measures of female sexual arousal. First, using the LDI to record vasocongestion requires no direct hands-on contact with the participants' genitals and no internal insertion is required. Second, the LDI provides an absolute measure of unit of blood flow (i.e., flux or units of blood flow), which is known to be associated with the vasocongestion response during sexual arousal (Styles et al., 2006). Third, LDI does not require the injection of a foreign substance (e.g., MS-325) to assist the observation of changes in vasocongestion, which is physically invasive and may lead to a contrast reaction with other medications or therapies (Heiman & Maravilla, 2007). Fourth, LDI can assess blood flow to the external genitals, an area where women are more likely to notice changes as compared to inside the vagina. In addition, the LDI provides a direct measure of sexual arousal as it measures actual changes in blood flow to the genitals.

Research Objectives

Given that many currently used methods for measuring female sexual arousal have several disadvantages, it is important to find a method that corrects for some of these problems in order to obtain a more accurate picture of female sexual arousal. LDI is a new technique for measuring female sexual arousal that has shown promising results (Styles et al., 2006); however, it requires further validation of its usefulness. Therefore, the aim of this study was to investigate the utility of LDI for measuring sexual arousal in sexually healthy women. Findings of increased genital blood flow during the viewing of an erotic film (versus a non-erotic/neutral film and two physiologically arousing but non-erotic films, i.e., humor, anxiety-provoking) will provide further support, in combination with the findings of Styles et al. (2006), that LDI is a suitable device for obtaining a direct measurement of sexual arousal through changes in genital blood flow. It was hypothesized that changes in blood flow, as measured by LDI, would significantly differentiate the erotic condition from the neutral, humor, and anxiety conditions. In particular, it was expected that the erotic condition would lead to significantly higher levels of blood flow in the genitals than the three non-erotic conditions.

A second aim of this study was to examine the relationship between physiological and subjective sexual arousal in women when using LDI. It was hypothesized that change in blood flow from the baseline condition to the experimental condition would significantly and positively correlate with ratings of subjective sexual arousal, and that this change in blood flow would be explained by subjective ratings of sexual arousal. A final aim of this study was to explore the role of various psychosocial variables in predicting physiological and subjective sexual arousal in sexually healthy women.

However, given the inconsistencies in the literature regarding psychosocial factors related to arousal (Basson et al., 2001), the associated hypotheses were exploratory. Given the finding that sexual arousal problems strongly correlate with self-reported marital difficulties (Dunn et al., 1999), and the assumption that sexuality-based interpersonal factors (e.g., lack of adequate stimulation, lack of intimacy) affect female sexual arousal (Everaerd et al., 2000), it was hypothesized that higher levels of sexual function and arousability, and higher sexual and relationship satisfaction would predict greater physiological and subjective sexual arousal. In addition, negative mood states, such as depression and anxiety are often associated with decreased sexual interest and arousal. For example, Lykins et al. (2006) found that the majority of women in their sample showed decreased sexual interest and sexual response (i.e., arousal) when feeling depressed or anxious. Therefore, it was also hypothesized that physical and mental health would predict greater physiological and subjective sexual arousal.

CHAPTER 3

Method

Participants

Participants were 88 sexually healthy women between the ages of 18 and 29 recruited via advertisements (see Appendix A) placed in local newspapers, posters placed in locations frequented by young women in the community (e.g., campus buildings, fitness centers), emails to listservs, and online advertisements (e.g., Facebook). Trained lab members screened interested women over the telephone prior to scheduling the testing appointment (see Appendix B). Exclusion criteria consisted of 1) limited sexual experience (i.e., having limited experience with kissing, manual stimulation, oral stimulation, various intercourse positions, and anal play, and is defined as one standard deviation below the mean on the Derogatis Sexual Functioning Inventory; Derogatis, 1978, see below), 2) regular use of antidepressant or other medication known to affect sexual functioning or interfere with blood flow, 3) psychiatric or psychological diagnosis known to interfere with sexual functioning, 4) the presence of any genital piercing, 5) cigarette smoking, 6) current or past alcohol and/or drug abuse, 7) any type of cardiovascular disease and/or neurological condition (e.g., epilepsy, diabetes), 8) peri- or menopausal status, 9) diagnosis of a sexual dysfunction, 10) non-heterosexual, 11) under 18 or over 30 years of age, 12) no gynecological examination in the past 18 months, and 14) never having seen an erotic film or stated discomfort with viewing this kind of film. Data from eight participants were excluded from the analyses for the following reasons: three participants due to very thick pubic hair which limited the laser Doppler's capability to measure blood flow in the underlying skin areas, one participant

was taking medication with possible sexual side effects, one participant due to burns on her genitals as a result of laser hair removal, one participant moved considerably during the scanning of her genitals, making her data invalid, and one participant accidentally covered her genitals with the privacy drape for two of the five scans during the experimental film. Thus, the final sample size for this study was 80.

Materials

Psychosocial Interview

The interview was used to gather information regarding socio-demographics, gynecological and medical history, and relationship and sexual history.

Questionnaires

Derogatis Sexual Functioning Inventory (DSFI). The DSFI (Derogatis, 1978) is a 254-item self-report measure designed to measure the quality of a person's current sexual functioning. The test is arranged into 10 subtests that are reflective of the principal components of sexual behaviour. The current study used the Experiences subtest, which contains 24 items that assess petting activities, oral sex, intercourse, and masturbation, with a possible score range of 0-24. Participants are required to indicate whether they have ever engaged in the particular sexual activity (yes/no). Test-retest coefficients and internal consistency for the DSFI Experience subtest are .90 (Derogatis & Melisaratos, 1979). Content analysis of the Experience subtest indicates that a wider range of sexual behaviours is sampled by this subtest than comparable measures and that this subtest is both a reliable and valid measure of sexual behaviour (Andersen & Broffitt, 1988). This questionnaire was used as part of the screening interview to ensure that participants were in fact reporting previous sexual experience; any prospective participant who indicated a

level of sexual experience one SD below the mean was not eligible for the study. A Cronbach alpha value was not calculated for this measure, as the range of potential responses was restricted (i.e., in order to be eligible for the study, participants had to have a minimum score of 15 on this scale).

Female Sexual Functioning Index (FSFI). The FSFI (Rosen et al., 2000) is a 19-item scale that assesses sexual functioning in the previous 4 weeks. Six domains are addressed: desire, arousal, lubrication, pain, orgasm, and satisfaction. All items are rated on a 5-point Likert scale, ranging from 0 or 1 to 5, with anchors that vary depending on the wording of the question. For several items on the scale, a score of 0 denotes no sexual activity. Total scores range from 2 to 36, with higher scores suggesting greater sexual functioning. All subscale scores range from 0 to 6 with the exception of the desire subscale, which ranges from 1.2 to 6. A clinical cut-off of 26.55 has been established in the literature for sexual dysfunction (Wiegel, Meston, & Rosen, 2005). The six subscales have been found to have excellent internal reliability with Cronbach alpha values of .82 or higher. The current study demonstrated an alpha value of .80.

Sexual Arousability Inventory (SAI). The SAI (Hoon, Hoon, & Wincze, 1976) is a 28-item scale that measures perceived arousability to a variety of sexual experiences. Each item describes a sexual experience and/or situation, which is rated on a 7-point Likert scale of how sexually aroused the individual would feel when engaged in the particular activity. The scale ranges from -1, adversely affects arousal (unthinkable, repulsive, distracting) to 5, always causes sexual arousal (extremely arousing). The wording of most items was changed from referring to “a loved one” to referring to “a sexual partner” to include those participants who were not in committed relationships.

Participants may receive scores in the range of -28 to 140, with higher scores suggesting greater sexual arousability. Within the current sample of sexually healthy women, the Cronbach alpha value was .95.

Center for Epidemiological Studies-Depression (CES-D). The CES-D (Radloff, 1977) is a 20-item scale that assesses the frequency of affective and somatic symptoms of depression in the previous week. All items are rated on a 4-point Likert scale, ranging from 0 (rarely or none of the time) to 3 (most or all of the time). The CES-D is scored by summing the individual responses to yield a total score, with a possible range from 0-60. Scores at or above 16 are suggestive of clinical depression. The measure demonstrates high internal consistency, with Cronbach alpha values ranging from .84 for the general population to .90 for clinical samples. Test-retest reliability ranges from .48 to .67 (Radloff, 1977). Within the current sample of sexually healthy women, the Cronbach alpha value was .74.

State-Trait Anxiety Inventory Form Y-1(STAI). The STAI (Spielberger, 1983) is a 40-item scale that measures the presence and severity of anxiety. The STAI distinguishes between the temporary condition of "state anxiety" and the more general and long-standing quality of "trait anxiety." The current study included the administration of the state portion of the measure (20 items), as these items provide an indication of the current experience of participants. Responses are rated on a 4-point Likert scale, ranging from 1 (not at all) to 4 (very much so), with a possible range of scores from 20-80 (M = 36.17; SD = 10.96 for females between 19-39 years of age; Spielberger; 1983). The internal consistency for the state portion of the STAI has been shown to range from a Cronbach alpha of .45 to .92, with higher coefficients typically found when the scale is

administered under conditions of psychological stress (Spielberger, Gorsuch, & Lushene, 1970). Test-retest reliability for the state portion of the STAI tends to be low, as would be expected for a measure that is intended to measure current levels of functioning that are likely influenced by situational factors (Spielberger et al., 1970). The current Cronbach alpha value was .66, which is consistent with previous research.

Short-Form Health Survey (SF-12). The SF-12 (Ware, Kosinski, & Keller, 1996) is a 12-item self-report instrument that measures overall physical and mental health status. The SF-12 self-assessment responses are divided into physical (PCS) and mental health (MCS) component scales. The scales are scored using sets of regression weights, which are converted to t scores with a mean score of 50 and standard deviation of 10. Therefore, scores above 50 represent greater health. The PCS measures physical functioning, physical role limitation, and bodily pain. The MCS measures mental role limitation, vitality, and social functioning. Both the PCS and MCS have evidence of high internal consistency (Cronbach's alpha = 0.81 & 0.76, respectively; Jakobsson, Hallberg, & Westergren, 2004). A Cronbach alpha value could not be computed because there is no total score for the scale.

Dyadic Adjustment Scale (DAS). The DAS (Spanier, 1976) is a 32-item measure designed to assess the quality of the current relationship as perceived by married or cohabitating couples. In the current study, the DAS was administered only to individuals in relationships; however, participants were not required to be married or cohabitating to complete the measure. The questionnaire requests that participants answer questions in regards to their relationships and does not specify whether the couple is married or cohabitating; therefore, the wording of the questionnaire did not change. The DAS yields

a total score, with a possible range of 0-150, which indicates the couple's general satisfaction with the intimate relationship, as well as providing indices of four other aspects of the relationship: satisfaction, cohesion, consensus, and affectional expression. The total score was obtained by summing individual subscale scores. This score was then converted to a t score with a mean of 50 and standard deviation of 10. Higher scores are indicative of greater dyadic adjustment, and t scores of 39 or less are indicative of significant relationship concerns. The total score of DAS has been found to have excellent internal consistency, demonstrating a Cronbach alpha from .69 to .96. For the current study, the inter-item reliability was excellent ($\alpha = .88$). The DAS has also demonstrated concurrent validity, as it has been shown to correlate ($r = .86$) with the Locke-Wallace Marital Adjustment Scale, a measure of relationship adjustment (Locke & Wallace, 1959).

Dyadic Sexual Communication Scale (DSCS). The DSCS (Catania, 1986) is a 13-item scale designed to measure how respondents perceived the discussion of issues related to the sexual relationship with their partners. This measure was administered only to those participants in a relationship. All items are rated on a 6-point Likert scale with anchors ranging from "disagree" to "agree strongly". Total scores range from 13-78. The DSCS has been shown to have adequate internal consistency (Cronbach alpha of .81). In addition, it has been shown to effectively discriminate individuals reporting sexual difficulties from those who have healthy sexual functioning. The inter-item reliability for this study was .82.

Golombok Rust Inventory of Sexual Satisfaction (GRISS). The GRISS (Rust & Golombok, 1985) is a 28-item questionnaire that assesses sexual dysfunction among

individuals in heterosexual relationships. Only the female version of the GRISS was administered to those participants who were in a relationship. In addition to a total score, the female version provides subscale scores of anorgasmia (inability to achieve orgasm), vaginismus (muscles spasms that make vaginal penetration difficult and painful), infrequency, noncommunication, dissatisfaction, nonsexuality, and avoidance. All items are rated on a 5-point Likert scale with labels of never, hardly ever, occasionally, usually, and always. The possible range of scores is from 0-100. Acceptable reliability and validity scores have been shown for the GRISS (Rust & Golombok, 1986). Specifically, a large split-half reliability for women's total score of .94 with subscales values ranging from .61 to .83 was found. Test-retest reliabilities for pre- and post-therapy data were found to be adequate (Cronbach alpha of .65). In addition, the GRISS also demonstrated adequate discriminative validity for clinical and nonclinical groups of women (Cronbach alpha of .63; Rust & Golombok, 1986). Within the current sample of sexually healthy women, the Cronbach alpha value was .76.

Index of Marital Satisfaction (IMS). The IMS (Hudson, 1997) is a 25-item scale designed to measure the severity of problems in a dyadic relationship. All items are rated on a 7-point Likert scale with anchors ranging from "none of the time" to "all of the time". Total scores range from 0-100, where higher scores indicate more severe relationship problems. Scores at or above 30 are suggestive of relationship difficulties. The IMS has been shown to have adequate internal consistency (Cronbach alpha of .88). The current sample showed a Cronbach's alpha value of .80. The total score of the IMS has also been shown to correlate with the Locke-Wallace Marital Adjustment Scale. This measure was administered only to those participants in relationships.

Quality of Marriage Index. The QMI (Norton, 1983) is a 6-item inventory that assesses relationship dissatisfaction. Norton included only evaluative items on the QMI as he believed descriptive items (e.g., communication variables) would preclude the study of these items in relation to relationship satisfaction. All items are rated on a 7-point Likert scale with anchors ranging from “very strong disagreement” to “very strong agreement”. Inter-item reliability ranges from .68 to .86. The Cronbach’s alpha value for the current study was .90. This measure was administered only to those participants in relationships.

Measures of Sexual Arousal

Laser Doppler scans. Genital perfusion (i.e., blood flow to tissue) was mapped using a laser Doppler perfusion imager (moorLDI2-IR laser Doppler imager, Moor Inc., Axminster, England). The LDI utilizes a low power laser beam in a raster pattern (i.e., a predetermined pattern of scanning lines within a display space) over the surface of exposed skin. An infra-red beam is used in combination with a visible red aiming beam; thus, no direct physical contact with the genitals is needed. The LDI was used to determine differences in blood flow within a given area of the genitals repeatedly, allowing one to generate values of blood flow over time. The sensitivity of the laser was pre-set for each participant for a distance of 30-40 cm (recommended by Moor Inc.). The LDI can gather signals from a depth of 2-3 mm below the surface of the skin. This output signal was stored in a personal computer (Dell Inspiron). A colour-coded image was generated and presented on the monitor from the collected blood flow values. To facilitate identification of different structures in the scanned area, a black and white photograph was also generated. The LDI obtained a scan of 256 X 128 pixels, which is

equivalent to one scan every 2 minutes and 43 seconds. Five scans were collected for the length of the video (approximately 15 minutes). To determine the flux value for each scan, regions of interest were generated for each participant, which included visible areas of the labia minora and clitoris.

Subjective Sexual Arousal. Subjective sexual arousal was assessed with a series of numerical rating scales. Participants were asked questions pertaining to feelings of relaxation, enjoyment, humor, and sexual arousal on a scale from 0 (not at all) to 10 (the most ever). In addition, there were questions pertaining to peak sexual arousal, comparison of sexual arousal in the current situation to other situations of sexual arousal, and the influence of the scanning on sexual arousal. These questionnaires have been used in previous research (Kukkonen et al., 2007). In addition, a measure of continuous sexual arousal was also used. Participants used a wireless mouse to indicate their level of sexual arousal throughout the films by pressing either the right or left mouse buttons. Participants rated their sexual arousal on a scale from 0 (not at all sexually aroused) to 10 (the most sexually aroused I've ever been). Participants started at zero and indicated an increase in subjective sexual arousal by clicking the right mouse button. If participants felt that their sexual arousal was decreasing, they clicked the left mouse button to indicate such change. The computer system provided participants with an auditory reminder as to their current position on the rating scale every 30 seconds. This technique is less likely to distract women from processing the erotic cues than previous techniques that provided visual (e.g., Wincze et al., 1977; Laan et al., 1995a) feedback regarding the level of reported sexual arousal, as visual techniques require participants to divert their eyes from the erotic material, possibly resulting in distraction.

Films

Two neutral films were shown to all participants prior to the experimental film viewing. The first film was a neutral film that consisted of still images of nature accompanied by calming music. The second film that participants watched was a travelogue of the Yukon and Alaska. This film was used to obtain a standard, baseline level of blood flow with which to compare blood flow during the experimental film clips. Participants were then randomly assigned to one of four experimental film conditions: i) a neutral control film that consisted of a travelogue of the Amazon; ii) a humor control film that consisted of three separate segments of *The Best Bits of Mr. Bean*; iii) an anxiety control film that consisted of scenes from the movie *Cujo*, and iv) a female-oriented erotic film based on criteria deemed to be sexually arousing to women (Day, Cook, & Wolfe, 2001; Janssen, Carpenter, & Graham, 2003; Vertue, Davies, & Weiland, 1999). The erotic film consisted of various sexual activities including kissing, touching of the breasts, manual stimulation of the female genitals, oral stimulation of the male and female genitals, and vaginal penetration; however, given the timing of the LDI scans (one scan for every 2 minutes and 43 seconds), the segments of the erotic film broke down as follows: 1) scenes depicting kissing, and breast touching and kissing; 2) scenes depicting cunnilingus and manual stimulation of female genitals; 3) scenes depicting cunnilingus, manual stimulation of female genitals, and fellatio; 4) scenes depicting fellatio and penile-vaginal intercourse; and 5) scenes depicting penile-vaginal intercourse and female orgasm. All of the films, except for the film containing scenes from *Cujo*, have been used in previous research on female sexual arousal (Kukkonen et al., 2007; Laan et al., 1995b). All films were 15 minutes in length.

Visual Presentation of the Stimuli. Olympus eyetrek FMD-250W i-goggles (Center Valley, PA, USA), attached to a laptop computer (Toshiba, Tecra), were used to show the films and questionnaires to participants in a private manner. Instead of writing responses to the questionnaires, which may have distracted participants from their arousal, participants were simply required to report answers to the questions orally. The experimenter was seated behind a thick curtain and recorded participants' answers to the questionnaires.

Procedure

The research was approved by the Queen's University Health Sciences Ethics Review Board. Upon completion of the telephone screen, eligible participants were instructed to abstain from alcohol or caffeine for at least four hours and from sexual intercourse for 24 hours before the laser Doppler scan to ensure blood flow in the genitals was at non-aroused levels. Appointments were scheduled during the luteal phase (days 7-11) of the participants' menstrual cycles as a means of controlling the effect that cyclic changes can have on sexual arousal and genital sensitivity (Slob, Bax, Hop, Rowland, & van den Werff en Bosch, 1996). On the day of testing, participants were provided with the letter of information and consent form to sign (see Appendix C). All participants provided written informed consent. Participants then completed the interview (see Appendix D) and questionnaires (see Appendix E).

Following the interview and questionnaire portion of the study, participants were asked to undress from the waist down and assume the lithotomy position (i.e., legs spread open with feet in stirrups to expose the genital region to be scanned). Once the participant was in position, the examiner placed the LDI scanner approximately 30-40 cm from the

woman's vulva. The room temperature was maintained at 22-26 °C (Bohm-Starke, Hilliges, Blomgren, Falconer, & Rylander, 2001; Kukkonen et al., 2007), with less than one degree variation within subjects.

The LDI portion of the study began with a 15-minute acclimatization period to help the participant adjust to the testing environment and to reduce vasoconstrictor tone. During this time, the participant watched a neutral video. Subsequently, baseline vulvar blood flow scans were taken while a second neutral film was viewed (also 15 minutes in length). These scans and all subsequent vulvar scans measured 6.7 cm height x width, resulting in a high-resolution image of 32,768 pixels. Following the baseline scans, participants were shown one of the four experimental videos to which they had been randomly assigned. During the experimental film, participants recorded their continuous subjective experience of sexual arousal with a wireless mouse. Five scans of the vulvar area occurred during each of the film presentations, one every 2 minutes and 43 seconds. Immediately following the termination of the third video, participants completed the series of numerical rating scales pertaining to feelings of relaxation, enjoyment, humor, and sexual arousal (see Appendix E for specific questions). Following completion of the study, which was approximately 2 hours in length, participants were provided with a debriefing sheet (see Appendix F), and compensated \$25 for their time.

CHAPTER 4

Results

Descriptive Statistics

Data Considerations

All data were analyzed using SPSS version 17.0. The data were screened for accuracy and missing values prior to conducting the analyses. A prorated scale score was calculated using means replacement for participants with missing data, if there was no more than 10% missing data on that particular scale (Tabachnick & Fidell, 1996). However, if more than 10% of the data was missing, the participant's data were not used for the particular item. Significance was set at $p < .05$; however, trends are reported for values between .05 and .08.

Total Sample Demographic Characteristics

Eighty sexually healthy women, between 18 and 29 years of age, were included in the study with 20 participants in each of the four conditions. There were no significant differences among groups in terms of age, education, ethnicity, religion, or relationship status. The majority of participants were either currently undertaking a college or university degree ($n = 55, 68.8\%$) or had already obtained a degree of higher learning ($n = 23, 28.8\%$). Participants had spent, on average, 15.68 years in school ($SD = 2.26$, range = 12-22). In addition, 73 of the 80 women (91.3%) identified their full-time employment status as being a student. With respect to relationship status, the majority of the sample reported being in a relationship ($n = 58, 72.5\%$). Demographic information is summarized in Table 1.

Table 1

Total Sample Demographics

Measure	<i>M (SD) or N (%)</i>
Age	20.92 (2.71)
Ethnicity	
Caucasian	65 (81.3)
Asian	8 (10.0)
Middle Eastern	2 (2.5)
Mixed (i.e., parents of 2+ ethnicities)	5 (6.3)
Religious Affiliation	
Catholic	14 (17.5)
Christian	8 (10.0)
Jewish	4 (5.0)
Other*	2 (2.5)
None	52 (65.0)
Education	
High school graduate	1 (1.3)
Some college or undergraduate education	55 (68.8)
College or undergraduate degree	7 (8.8)
Some graduate or professional training	10 (12.5)
Other graduate or professional training	6 (7.5)
Other**	1 (1.3)

Measure	<i>M (SD)</i> or N (%)
Relationship Status	
Single, not dating	12 (15.0)
Casual sex with one consistent partner	7 (8.8)
Casual sex with multiple partners	2 (2.5)
Dating one partner regularly	21 (26.3)
Dating one partner regularly – long distance	25 (31.3)
Living with partner/Common-law	10 (12.6)
Other**	3 (3.8)

Note. *Other religious affiliations included Buddhism and Agnostic. **Other was not specified.

Total Sample Sexuality Characteristics

There were no significant differences among experimental groups on any of the sexuality characteristics. With respect to past or present gynecological issues, the following were reported: Chlamydia ($n = 3, 3.8\%$), gardnerella vaginalis ($n = 4, 5\%$), genital warts or human papillomavirus (HPV; $n = 2, 2.5\%$), syphilis ($n = 1, 1.3\%$), and bladder or urinary tract infections ($n = 38, 47.5\%$). With respect to sexual history, the average age of first intercourse was 16.96 ($SD = 1.31$, range = 14-20), and the average number of partners with whom penile-vaginal penetration was experienced was five ($SD = 5.04$, range 0-31). The majority of the sample was using hormonal contraceptives ($n = 61, 76.3\%$). Some participants reported mild sexual complaints including: pain during intercourse ($n = 2, 3.5\%$), decreased levels of desire ($n = 15, 18.8\%$), and difficulty obtaining or absence of orgasm ($n = 21, 26.3\%$). In addition, diminished or lack of lubrication at the time of vaginal penetration was reported in 20% ($n = 16$) of the total sample. Explanations provided for this experience were: not being in the mood ($n = 3$), being distracted ($n = 2$), preferring artificial lubrication for personal comfort ($n = 3$), and/or a lack of sufficient foreplay ($n = 8$). Difficulty attaining or maintaining sexual excitement or arousal was reported by 8.8% ($n = 7$) of the sample; however, participants rated their level of distress with this difficulty as 3/10 on average ($SD = 2.08$, range = 0-6). These findings are consistent with Laumann et al.'s (1999) prevalence study, which found complaints of low sexual desire, arousal problems, and painful intercourse to occur in 22%, 14%, and 7% of women in the general population, respectively.

Most participants rated the duration of foreplay as between 11-19 minutes ($n = 38, 47.5\%$), 25 (31.3%) participants were able to achieve orgasm almost every time they

engaged in penetrative intercourse, and the average duration of intercourse (i.e., from the beginning of thrusting until thrusting stopped) was 9.95 minutes ($SD = 17.39$, range = 5-60). Additionally, participants in the four conditions did not differ with respect to their level of sexual arousal in response to erotica ($M = 7.0$ out of 10, $SD = 1.54$, range = 3-10), during masturbation ($M = 6.91$ out of 10, $SD = 2.08$, range = 0-10), or during foreplay ($M = 8.24$ out of 10, $SD = 1.07$, range = 5-10; data obtained from psychosocial interview).

Means and Standard Deviations for Psychosocial Variables

Means, standard deviations, and ranges for all measures of the total sample are shown in Table 2. To examine potential differences in psychosocial variables (i.e., relationship satisfaction, dyadic adjustment, sexual satisfaction, sexual communication, sexual functioning, depression, anxiety, and mental and physical health), a MANOVA was conducted to compare scores on the psychosocial measures by film condition. The four film conditions did not differ with respect to any of the variables, Wilk's $\lambda = .39$, $F(33, 92.04) = 1.04$, $p = .43$. The means and standard deviations for the GRISS (Brotto, Basson, & Gorzalka, 2004), FSFI (Frohlich & Meston, 2005; Rosen et al., 2000), QMI (Uebelacker, Courtnage, & Whisman, 2003), SAI (Flax, 1980), and DSCS (Catania, 1986) were consistent with previous research examining sexually healthy women. In addition, scores on the DAS, IMS, CES-D, FSFI, and SF-12 Physical Health Component were below the recommended cutoff scores, suggesting an absence of difficulties in these areas. Participants scored just below the cutoff of 50 on the SF-12 Mental Health Component subscale, suggesting some difficulties with mental health. Lastly, scores on the STAI were more than one standard deviation above the mean provided by Spielberger

Table 2

Means, Standard Deviations, and Range for Questionnaires by Total Sample

Measure	<i>N</i>	Range	<i>M</i>	<i>SD</i>
Index of Marital Satisfaction (IMS)	58	0-52.0	12.74	9.31
Quality of Marriage Index (QMI)	58	6.0-45.0	36.02	7.55
Dyadic Adjustment Scale (DAS)	45	29-64	53.47	7.75
Golombok-Rust Inventory of Sexual Satisfaction (GRISS)	58	5.0-52.0	20.40	9.34
Dyadic Sexual Communication Scale (DSCS)	58	46-78	68.16	7.68
Short-Form Health Survey-Physical (SF-12 PCS)	80	32.4-64.28	53.91	6.15
Short-Form Health Survey-Mental (SF-12 MCS)	80	27.25-61.31	47.95	8.52
State-Trait Anxiety Inventory (STAI)	80	44.0-56.0	50.89	2.21
Center for Epidemiological Studies-Depression (CES-D)	80	0-37.0	9.24	7.22
Sexual Arousability Inventory (SAI)	80	61.0-140.0	97.96	16.76
Female Sexual Functioning Inventory (FSFI)	80	21.3-36.0	30.65	3.33

Note. Clinical cut-off scores are: FSFI (at or below 26.55 indicates the presence of sexual problems), CES-D (at or below 16 is suggestive of clinical depression), STAI (above 35.72 indicates the presence of state anxiety), SF-12 MCS and PCS (below 50 is suggestive of poorer health), DAS (at or below 39 is indicative of relationship concerns), and IMS (at or above 30 is suggestive of relationship difficulties).

(1983; $M = 35.72$; $SD = 10.4$), suggesting that participants were experiencing elevated levels of state anxiety during the initial portion of the study.

Comparison of Genital Blood Flow across Film Conditions

All analyses related to genital blood flow were performed using two procedures. The first procedure involved computing a change score (mean experimental blood flow value minus mean baseline blood flow value) for each participant. The change score was then used as the dependent variable for physiological sexual arousal. Zumbo (1999) recommended using change scores when: 1) the standard deviation at time 1 is less than that at time 2, and 2) the ratio of these standard deviations is less than the correlation between times 1 and 2. The standard deviation for the total sample at time 1 was 54.82 and at time 2 was 135.71; therefore, the first requirement was met. The ratio of the standard deviations at time 1 and 2 was .31, and the correlation between time 1 and time 2 was .50; thus, the second requirement for using change scores was met. However, given the criticisms noted in the literature regarding the use of change scores (e.g., Cronbach & Furby, 1970), the data were also analyzed using ANCOVAs in which baseline levels of blood flow were co-varied out of the analyses and mean experimental blood flow value was used as the dependent variable.

Using change scores, a one-way between-subjects ANOVA was conducted to compare the effect of film condition (erotic, humour, anxiety, or neutral) on genital blood flow change. There was a significant effect of blood flow change at the $p < .001$ level for the four conditions, $F(3, 76) = 28.38$, $\eta^2 = .53$. Post-hoc comparisons using the Tukey's honestly significant difference (HSD) test indicated that the mean genital blood flow change for the erotic condition ($M = 198.89$, $SD = 153.88$) was significantly greater than

for the humour ($M = 12.94$, $SD = 9.88$), anxiety ($M = 15.05$, $SD = 11.95$), and neutral ($M = 12.80$, $SD = 16.80$) films. Mean blood flow values for the four conditions are illustrated in Figure 3.

By comparison, using change scores in thigh blood flow from baseline to experimental conditions as a non-genital control measure of blood flow, a one-way between-subjects ANOVA was conducted to compare change in thigh blood flow across the four films types. No significant change in thigh blood flow was found, $F(3, 76) = 2.25$, $p = .09$. Additionally, participants in the erotic condition who were taking hormonal contraceptives did not differ with respect to change in blood flow as compared to participants using other non-hormonal forms of birth control, $F(1, 18) = .33$, $p = .54$.

Using the ANCOVA method, a mixed-model ANCOVA, controlling for baseline blood flow, was also performed. The between-subjects factor was film condition and the within-subjects factor was time (scans 1-5). A significant between-subjects effect was found for condition, $F(3, 75) = 34.07$, $p < .001$, $\eta^2 = .58$, and pairwise comparisons revealed that the erotic condition was significantly different from the non-erotic conditions (all $ps < .001$), which were not significantly different from each other. Film groups did not differ at baseline with respect to blood flow values, $F(3, 76) = .72$, $p = .54$. There was no significant main effect of time, $F(3.01, 225.64) = .97$, $p = .41$; however, the interaction of time and condition was significant, $F(9.03, 225.64) = 7.52$, $p < .001$, $\eta^2 = .23$. In this analysis, the data did not meet the assumption of sphericity; therefore, a Greenhouse-Geisser correction was used. An examination of the means of blood flow at each time point for all conditions indicated that, for the erotic condition

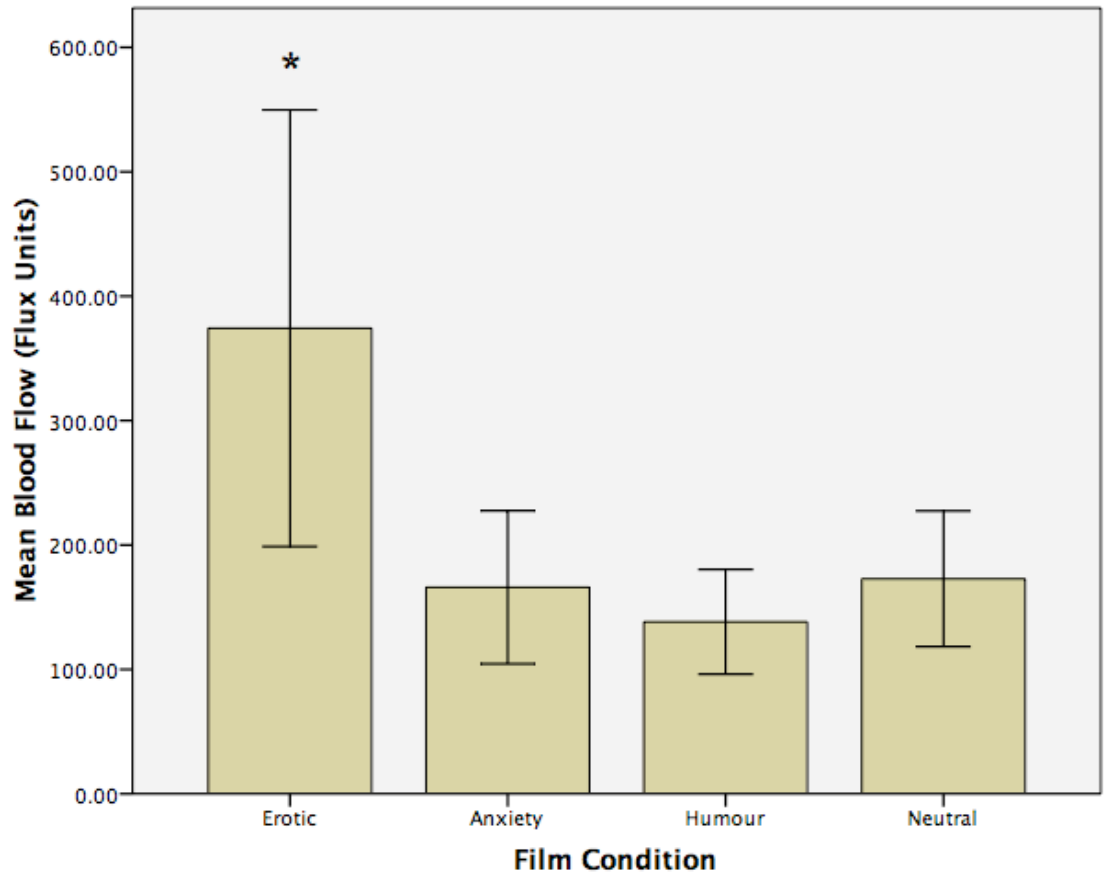


Figure 3. Mean blood flow values across experimental conditions. The * indicates that blood flow during the erotic condition was significantly higher than blood flow during the non-erotic conditions ($p < .001$). Error bars represent standard deviation.

only, blood flow at scan 1 was significantly lower than blood flow at scans 2, 3, and 5 ($p < .05$). Blood flow at scan 2 was significantly higher than blood flow at scan 4 ($p < .05$). Blood flow during scans 3, 4, and 5 was not significantly different (see Figure 4). Examples of genital blood flow during baseline and experimental film conditions (anxiety and erotic) can be seen in Figure 5.

Sexual and Non-Sexual Arousal Pre- and Post-Film Presentation

Subjective experiences of sexual and non-sexual arousal were measured using a questionnaire presented before and after viewing the experimental films. To examine potential differences in sexual and non-sexual arousal before the experimental films, a MANOVA was conducted to compare pre-film states by condition (erotic, humor, anxiety, or neutral). No differences were found among the four conditions on any of the pre-film questions, Wilk's $\lambda = 1.17$, $F(24, 200.72) = 1.17$, $p = .27$; however, significant differences emerged when examining post-film states. A MANOVA of the post-film questionnaire revealed significant differences among film conditions on various ratings of sexual and non-sexual arousal, Wilk's $\lambda = .011$, $F(45, 184.97) = 14.51$, $p < .001$. Follow-up univariate ANOVAs indicated that each question on the post-film questionnaire differed by film condition (see Table 3 for F statistics and partial η^2 values), such that film condition had more of an effect on sexual arousal and fear questions than on non-sexual, enjoyment questions.

Participants in the erotic condition ($M = 4.55$, $SD = 1.82$) found the video to be significantly less relaxing than those in the humor ($M = 6.70$, $SD = 2.43$) and neutral conditions ($M = 8.25$, $SD = 1.16$), and significantly more relaxing than those in the anxiety condition ($M = 2.80$, $SD = 2.14$). The neutral film was rated as most relaxing,

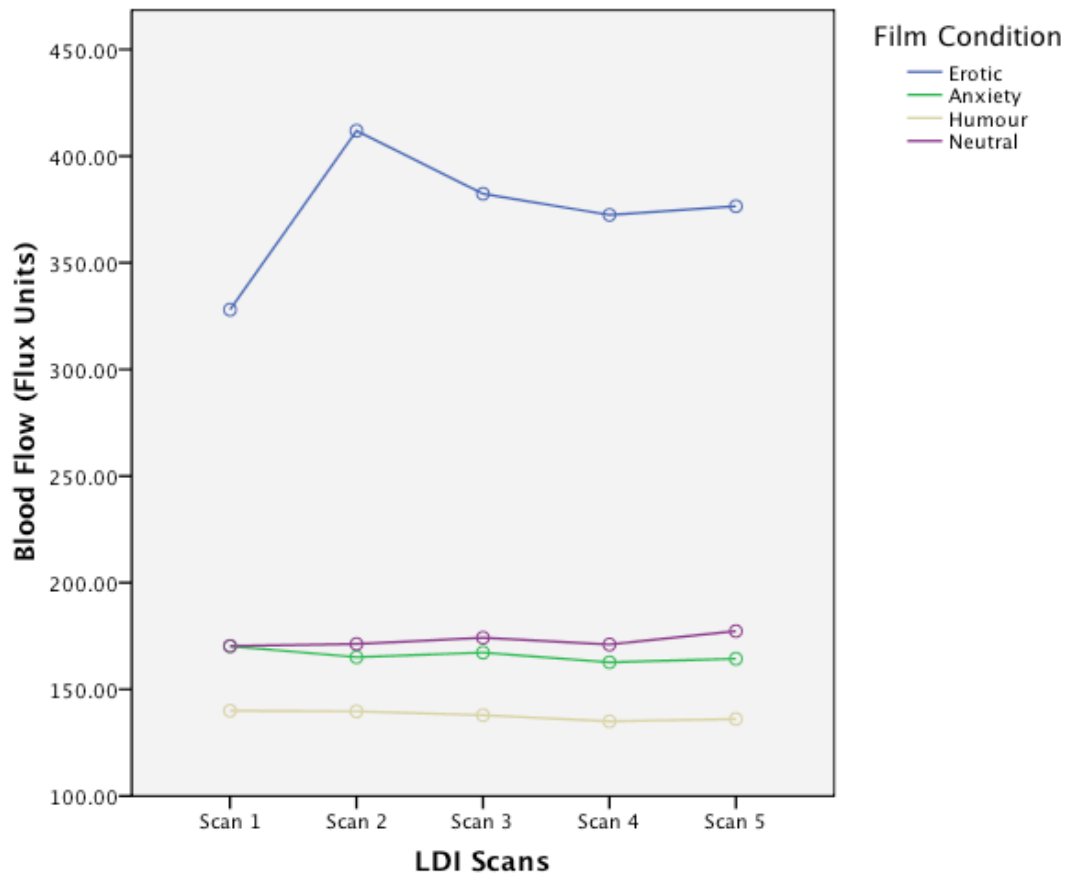


Figure 4. Mean blood flow values for each scan during the experimental film conditions.

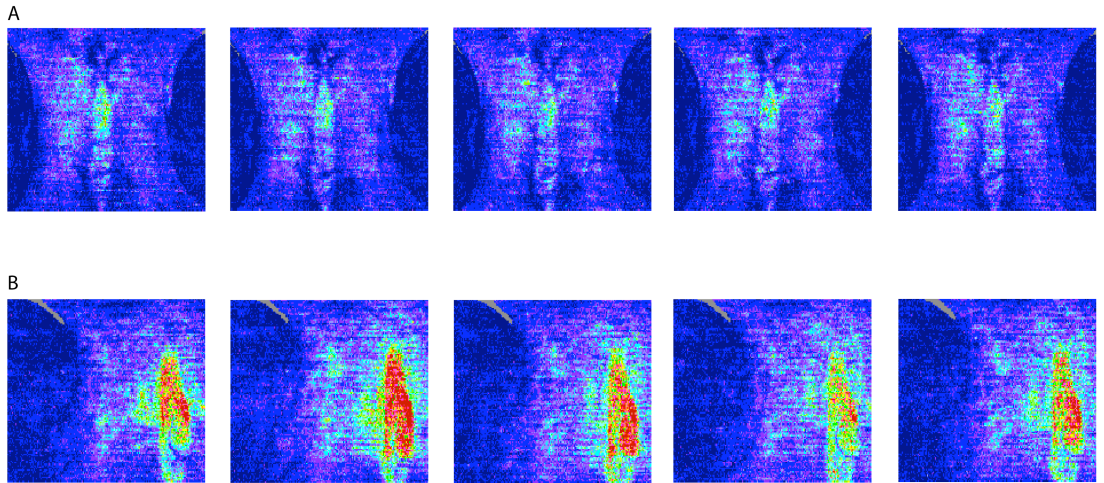


Figure 5. Genital blood flow during anxiety and erotic film viewing. (A) A participant viewing the anxiety film. (B) A participant viewing the erotic film.

followed by the humor film, erotic film, and finally, the anxiety film. All four conditions differed significantly from each other with respect to film enjoyment, with participants in the anxiety condition rating their film as significantly less enjoyable ($M = 2.10$, $SD = 1.48$) than participants in the neutral ($M = 4.90$, $SD = 2.38$), erotic ($M = 5.10$, $SD = 2.24$), and humor ($M = 5.95$, $SD = 1.93$) conditions. Participants in the erotic condition ($M = 3.70$, $SD = 2.45$) found their film to be significantly more humorous than participants in the anxiety ($M = 1.15$, $SD = 2.18$) and neutral condition ($M = 1.30$, $SD = 1.59$); however, participants in the humor condition found their film to be the most funny ($M = 5.65$, $SD = 2.78$). Participants in the anxiety condition found their film to be significantly more anxiety-provoking (anxiety: $M = 5.90$, $SD = 2.10$ vs. erotic: $M = 2.45$, $SD = 2.37$ vs. humor: $M = 1.75$, $SD = 2.29$ vs. neutral: $M = 0.50$, $SD = 1.05$) and frightening (anxiety: $M = 5.95$, $SD = 2.31$ vs. erotic: $M = 0.80$, $SD = 1.36$ vs. neutral: $M = 0.10$, $SD = 0.31$ vs. humor: $M = 0$, $SD = 0$) than participants in the other three conditions. All questions pertaining to subjective sexual arousal significantly differentiated the erotic condition from the three non-erotic, control conditions (see Table 3). Lastly, it is important to note that several participants felt that having their genitals filmed affected them in some way. More specifically, some participants felt that having their genitals filmed increased their level of sexual arousal ($n = 26$), level of relaxation ($n = 21$), and how funny they found their film ($n = 31$), while other participants felt that genital filming decreased their sexual arousal ($n = 18$), relaxation ($n = 41$), and humor ($n = 5$; see Table 4 for specific percentages).

Table 3

Means and Standard Deviations of Post-Film Responses by Film Condition

Question Description	Erotic <i>M (SD)</i>	Anxiety <i>M (SD)</i>	Humor <i>M (SD)</i>	Neutral <i>M (SD)</i>	<i>F</i>	Partial η^2
How relaxing did you feel during this film?	4.55 (1.82)	2.80 (2.14)	6.70 (2.43)	8.25 (1.16)	30.20*	.54
How much did you enjoy the film?	5.10 (2.25)	2.10 (1.48)	5.95 (1.93)	4.90 (2.38)	13.42*	.35
How funny did you find the film?	3.70 (2.45)	1.15 (2.18)	5.65 (2.28)	1.30 (1.59)	19.91*	.44
How anxious did you become during this film?	2.45 (2.37)	5.90 (2.10)	1.75 (2.29)	0.50 (1.05)	26.08*	.51
How frightening was this film?	0.80 (1.36)	5.95 (2.31)	0 (0)	0.10 (0.31)	89.33*	.78
How sexually aroused did you become during this film?	6.50 (2.24)	0.20 (0.52)	0.55 (1.05)	0.25 (0.55)	114.16*	.82
How would you rate your peak sexual arousal during the film?	6.35 (2.52)	0.30 (0.73)	0.60 (1.05)	0.30 (0.73)	83.36*	.77
How sexually aroused were you mentally during the film?	5.60 (2.50)	0.30 (0.80)	1.00 (1.38)	0.40 (0.75)	54.96*	.69
Did watching the video make you feel like having sex with a partner?	6.90 (2.88)	0.40 (1.10)	0.85 (1.57)	0.40 (0.99)	62.58*	.71

Question Description	Erotic	Anxiety	Humor	Neutral	<i>F</i>	Partial
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>		η^2
Did watching the video make you feel like masturbating?	5.65 (3.38)	0.10 (0.31)	0.70 (1.34)	0.35 (0.93)	39.51*	.61
How sexually aroused were you physically during the film?	6.05 (2.46)	0.45 (0.95)	0.95 (1.32)	0.25 (0.72)	66.59*	.72
How much genital change did you feel during the film?	5.80 (2.38)	0.85 (1.60)	0.85 (1.14)	0.35 (0.81)	52.03*	.67
How much lubrication (wetness) did you feel during the film?	4.70 (2.72)	0.30 (0.66)	0.60 (0.75)	0.40 (0.75)	40.83*	.62
How much genital tingling or fullness did you feel during the film?	5.45 (2.65)	0.30 (0.66)	0.85 (1.35)	0.30 (0.66)	51.53*	.67

Note. * $p < .01$.

Table 4

Impact of Genital Filming by Condition

Impact of Genital Filming	Erotic	Anxiety	Humor	Neutral
	N (%)	N (%)	N (%)	N (%)
Increase in sexual arousal	7 (35%)	4 (20%)	11 (55%)	4 (20%)
Decrease in sexual arousal	10 (50%)	3 (15%)	2 (10%)	3 (15%)
No change in sexual arousal	3 (15%)	13 (65%)	7 (35%)	13 (65%)
Increase in humor	12 (60%)	5 (25%)	8 (40%)	6 (30%)
Decrease in humor	1 (5%)	1 (5%)	3 (15%)	0 (0)
No change in humor	7 (35%)	12 (70%)	9 (45%)	14 (70%)
Increase in relaxation	5 (25%)	6 (30%)	6 (30%)	4 (20%)
Decrease in relaxation	13 (65%)	8 (40%)	8 (40%)	12 (60%)
No change in relaxation	2 (10%)	6 (30%)	6 (30%)	4 (20%)

Comparison of Continuous versus Discrete Measures of Subjective Sexual Arousal

To determine whether individuals in the erotic condition were already experiencing feelings of sexual arousal prior to viewing the erotic film, pre-film questions pertaining to sexual arousal were correlated with post-film sexual arousal questions; however, no significant relationships emerged. This finding suggests that participants in the erotic condition were not predisposed in terms of their arousal response prior to the presentation of the erotic stimulus.

To obtain a measurement of concurrent subjective sexual arousal, continuous ratings of sexual arousal were obtained while participants viewed the experimental films. Continuous ratings of sexual arousal were assessed for all participants; however, given that participants in the three non-erotic film conditions did not show any changes in their self-reported sexual arousal, only data from participants in the erotic condition were analyzed. Overall, participants' ratings of sexual arousal ranged from 0 to 10 (out of 10), with a mean rating of 4.93 ($SD = 2.33$). Continuous subjective sexual arousal data across the five scans is summarized in Table 5. Two participants did not report any change in their subjective sexual arousal throughout the duration of the film (i.e., their ratings did not change from 0). When queried after the film about their experience, one participant reported feeling awkward during the procedure, and both participants noted that they did not find the actors in the film to be sexually attractive.

To determine the relationship between concurrent subjective sexual arousal and retrospective recall of sexual arousal, a correlation was performed between overall subjective sexual arousal (single question from the post-film questionnaire) and

Table 5

Continuous Sexual Arousal Ratings Across Scans for Erotic Condition (n = 17)

Continuous Arousal Ratings	<i>M (SD)</i>	Range
Scan 1	1.90 (1.38)	0 – 4.63
Scan 2	5.10 (2.71)	0 – 9.58
Scan 3	5.64 (2.86)	0 – 10.0
Scan 4	5.75 (2.72)	0 – 8.54
Scan 5	6.26 (2.68)	0 – 9.05
Overall Scan Mean	4.93 (2.33)	0 – 7.83

Note. Continuous ratings of sexual arousal ranged from 0 (not at all sexually aroused) to 10 (the most sexually aroused I've ever been). Continuous sexual arousal data was missing for three participants due to administration errors.

continuous ratings of sexual arousal. Continuous subjective sexual arousal ratings were averaged for each of the five LDI scans, allowing for the comparison of continuous subjective sexual arousal and blood flow throughout the films. It was found that overall subjective sexual arousal was significantly and positively correlated with continuous ratings of sexual arousal at each of the five scans (scan 1: $r = .67, p < .01$; scan 2: $r = .86, p < .001$; scan 3: $r = .84, p < .001$; scan 4: $r = .87, p < .001$; scan 5: $r = .93, p < .001$) and with the overall continuous sexual arousal mean ($r = .91, p < .001$).

Factor Analysis of Post-Film Questionnaire

To further examine the relationship between genital blood flow and subjective ratings of sexual arousal, a principal components analysis was conducted on the 15 post-film questions. Both the Kaiser (1960) criterion and the scree test indicated the presence of two factors. The two factors accounted for 62.13% and 19.98% of the variance, respectively. Using a varimax rotation and a factor loading cutoff of .40, the first factor consisted of all ten sexual arousal questions, with factor loadings ranging from .81 to .98 (not absolute values; i.e., all values were within the positive range). The second factor consisted of the non-arousal questions with factor loadings from .48 to .91 (absolute values; i.e., values ranged from negative to positive). These two factors were therefore interpreted as *sexual arousal* and *non-sexual enjoyment*. Of these, only the sexual arousal factor was significantly and positively correlated with change in blood flow ($r = .79, p < .001$), and with blood flow during each of the five experimental film scans (scan 1: $r = .64, p < .001$; scan 2: $r = .75, p < .001$; scan 3: $r = .74, p < .001$; scan 4: $r = .76, p < .001$; scan 5: $r = .76, p < .001$).

Correlations and Regression between Subjective and Physiological Arousal

In order to examine the relationship between physiological and subjective ratings of sexual arousal, Pearson correlations were obtained for the relevant variables for the erotic condition only, as this condition was the only one in which ratings of subjective sexual arousal changed. Using change scores for blood flow, between-subjects correlations showed that blood flow change was positively and significantly correlated with all of the subjective ratings of sexual arousal ($r = .45-.60, ps < .05$), with the exception of mental sexual arousal ($r = .39, p = .09$). The pattern of findings was similar when using partial correlations; when mean experimental blood flow was examined while controlling for baseline blood flow, peak sexual arousal, feelings of wanting to have sex, physical sexual arousal, genital change, lubrication, and continuous sexual arousal were all significantly and positively correlated with physiological sexual arousal ($r = .47-.59, ps < .05$). In addition, there were trends towards significance for overall sexual arousal, urge to masturbate, and tingling in the genitals ($r = .42-.44, ps = .06-.08$; see Table 6 for all correlations). Additionally, continuous ratings of sexual arousal were significantly correlated with blood flow during scan 1 ($r = .64, p < .01$), scan 2 ($r = .63, p < .01$), scan 3 ($r = .60, p < .05$), and scan 4 ($r = .51, p < .05$). There was a trend for scan 5 to be significantly correlated with genital blood flow ($r = .43, p = .08$). Within-subjects correlations of continuous sexual arousal and genital blood flow were computed for 17 participants in the erotic condition (see Table 7). The Pearson r values ranged from moderate to large ($rs = -0.82-0.89$); however, most were non-significant, suggesting insufficient power (i.e., total of five data points per participant).

Table 6

Correlations between Blood Flow Values and Post-film Sexual Response Questions For the Erotic Condition (n = 20)

Question Description	Change Score <i>r</i>	Experimental Mean <i>r</i>
Overall, how sexually aroused did you become during this film?	.49*	.44 ^a
How would you rate your peak sexual arousal during the film?	.54*	.51*
Overall, how sexually aroused were you mentally during the film?	.39	.32
Did watching the video make you feel like having sex with a partner?	.53*	.48*
Did watching the video make you feel like masturbating?	.47*	.42 ^c
Overall, how sexually aroused were you physically during the film?	.52*	.48*
How much genital change did you feel during the film?	.51*	.47*
How much lubrication (wetness) did you feel during the film?	.60**	.59**
How much genital tingling or fullness did you feel during the film?	.45*	.43 ^b

Note. Change scores represent the difference between baseline blood flow and experimental blood flow. Experimental mean represents average blood flow across the experimental condition. * $p < .05$, ** $p < .01$, ^a $p = .06$, ^b $p = .07$, ^c $p = .08$.

Table 7

Within-Subjects Pearson Correlations for Blood Flow and Continuous Subjective Arousal for Each Participant in the Erotic Condition (n = 17)

<i>r</i>																
-.82	-.49	-.30	.00	.00	.31	.40	.51	.66	.66	.73	.74	.82	.83	.84	.87	.89*

Note. Continuous ratings of sexual arousal ranged from 0 (not at all sexually aroused) to 10 (the most sexually aroused I've ever been). Continuous arousal data was missing for three participants due to administration errors. * $p < .05$.

Furthermore, overall sexual arousal (discrete ratings) significantly predicted change in genital blood flow from baseline to the experimental condition, $\beta = .49$, $t(18) = 2.37$, $p < .05$. Likewise, continuous sexual arousal ratings were also a significant predictor of change in blood flow, $\beta = .52$, $t(15) = 2.34$, $p < .05$. When genital blood flow during the experimental condition, while controlling for baseline blood flow, was used as the independent variable, there were trends towards significance (overall sexual arousal: $\beta = .48$, $t(17) = 2.03$, $p = .06$; continuous sexual arousal: $\beta = .52$, $t(14) = 2.11$, $p = .05$).

Correlations between Psychosocial and Sexual Arousal Variables

Pearson product-moment correlations were obtained to examine the bivariate relationships between depression, anxiety, physical and mental health, sexual functioning, arousability, sexual communication, relationship satisfaction (2 scales: QMI and ISM), dyadic adjustment, subjective sexual arousal, and blood flow change for the total sample. The intercorrelation matrix is shown in Table 8. Physiological sexual arousal (i.e., blood flow change) was significantly correlated with only subjective sexual arousal. However, sexual functioning (as measured by the FSFI) was correlated with physiological ($r = .21$, $p = .06$, trend) and subjective ($r = .24$, $p < .05$) sexual arousal, such that increased blood flow or increased feelings of sexual arousal were associated with greater overall sexual functioning. All relationship questionnaires (IMS, QMI, and DAS) were significantly correlated with sexual communication, sexual satisfaction, and sexual functioning. Sexual functioning and arousability were significantly correlated with each other, and with sexual communication and sexual satisfaction. The magnitude of the correlations indicated a medium effect size, except for the degree of associations between

Table 8

Intercorrelations for the Total Sample

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13
1. IMS	-----												
2. QMI	-.54**	-----											
3. DAS	-.60**	-.60**	-----										
4. GRISS	.68**	-.39**	-.41**	-----									
5. DSCS	-.55**	.28*	.31*	-.67**	-----								
6. SF-12 PCS	-.31*	.05	.22	-.32*	.28*	-----							
7. SF-12 MCS	-.29*	.36**	.09	-.23	.18	-.33**	-----						
8. STAI	-.20	.22	-.10	-.17	.19	.13	.30**	-----					
9. CES-D	.25	-.12	-.19	.25	-.03	-.06	-.61**	-.30**	-----				
10. SAI	-.25	-.06	.12	-.41**	.30*	-.04	.06	.10	.03	-----			
11. FSFI	-.48**	.30*	.31*	-.74**	.44**	.05	.09	.13	-.16	-.33**	-----		
12. Subjective	-.24	.16	.19	-.20	.08	-.05	.02	-.20	.05	.19	.24*	-----	

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13
13. Physiological	-.24	.19	.18	-.26	.07	-.04	.03	-.04	-.01	.18	.21	.79**	-----

Note. * $p < .05$, ** $p < .01$. Sample size ranges from 45 to 80 participants depending on missing data (i.e., only participants in relationships completed all questionnaires, and data from a questionnaire was excluded if more than 10% of the data was missing for that measure). IMS = Index of Marital Satisfaction; QMI = Quality of Marriage Index; DAS = Dyadic Adjustment Scale; GRISS = Golombok-Rust Inventory of Sexual Satisfaction; DSCS = Dyadic Sexual Communication Scale; SF-12 PCS = Short-Form Health Survey-Physical Health Component; SF-12 MCS = Short-Form Health Survey-Mental Health Component; STAI = State-Trait Anxiety Inventory; CES-D = Center for Epidemiological Studies-Depression; SAI = Sexual Arousability Inventory; FSFI = Female Sexual Functioning Index; Subjective = overall subjective rating of sexual arousal; Physiological = genital blood flow change. Correlations of .10, .30, and .50 correspond to small, medium, and large effect sizes, respectively (Cohen, 1992).

sexual functioning and satisfaction, and between physiological and subjective arousal which indicated large effect sizes.

With respect to the psychological variables, depression and anxiety were only significantly related to each other, and to general mental health. Mental health was also significantly correlated with two indices of relationship satisfaction (i.e., QMI and IMS), while physical health was only correlated with the IMS. These associations suggest that decreases in mental and/or physical health are associated with decreases in relationship satisfaction. Physical health was also significantly correlated with sexual communication and sexual satisfaction, such that poorer physical health was associated with poorer sexual communication and satisfaction. Furthermore, sexual functioning was the only variable to significantly predict discrete ratings of subjective sexual arousal, $\beta = .24$, $t(78) = 2.21$, $p < .05$. There was a trend, however, for sexual functioning to predict change in genital blood flow, $\beta = .21$, $t(78) = 1.93$, $p = .06$.

It is important to note that there are other clinically relevant correlations that, because of smaller sample sizes, were not statistically significant; however, they were similar to statistically significant correlations with respect to their magnitude. For example, moderate effect sizes were found for: IMS with STAI, CES-D, SAI, subjective sexual arousal, and physiological sexual arousal; QMI with STAI; DAS with SF-12 PCS; and GRISS with SF-12 MCS, CES-D, subjective sexual arousal, and physiological sexual arousal.

Analysis of Moderating Effects

Considerations of Assumptions

Before proceeding with the moderation analyses, the data were examined to ensure that they met the necessary assumptions for multiple regression. First, the normality of each variable was assessed by examining the z-skewness and z-kurtosis values, which were calculated by dividing the skewness and kurtosis statistic by their respective standard error values. A distribution was considered non-normal if the z-value was greater than 3 or less than -3. In the current study, there were three z-kurtosis (physical health, dyadic adjustment, and relationship satisfaction [QMI]) and four z-skewness (physical health, dyadic adjustment, and relationship satisfaction [QMI], and sexual communication) values outside of the +/- 3 range. The variables that did not meet the assumption of normality (i.e., DAS, QMI, DSCS, SF-12 PCS) were reflected and transformed using the square root transformation to correct for moderate negative skewness and kurtosis. The results were conducted using both the transformed and non-transformed variables, and consistent results were found between the two types of analyses. Therefore, for ease of interpretation, results from the non-transformed data are presented. Second, there were no Cook's distances greater than 1.0, and the Mahalanobis' distances for all cases were below the critical value, $\chi^2_{(10)} = 23.21$, indicating that the data were free of multivariate outliers. Third, there were no correlations greater than .80 among the variables, and the Variance Inflation Factor (VIF) did not exceed 10, confirming the absence of multicollinearity. Finally, to test for the assumptions of linearity and homoscedasticity, bivariate scatter plots were examined, and no violations were observed.

Analyses of Moderation

The moderation analyses were tested with multiple linear regressions for each individual psychosocial variable to determine its role as a moderator in the relationship between physiological and subjective sexual arousal. A moderator is a variable that influences the direction and/or strength of the association between an independent or predictor variable and a dependent variable (Baron & Kenny, 1986). According to Baron and Kenny (1986), moderators often are introduced when there are unexpectedly weak or inconsistent associations between a predictor and an outcome variable across studies. Therefore, the previous literature showing weak or inconsistent relationships between subjective and physiological sexual arousal highlights the necessity of exploring potential moderators.

The moderator model proposed by Baron and Kenny (1986) involves three causal paths that lead to the outcome variable (see Figure 6). With respect to the current study, Path *a* represents the impact of subjective or physiological sexual arousal as a predictor, Path *b* represents the impact of a particular psychosocial variable as a moderator, and Path *c* represents the interaction or product of the predictor and moderator. The moderator hypothesis is supported if the interaction (path *c*) is significant.

Two moderation models were conducted based on findings from previous research. In the first model, overall subjective sexual arousal was treated as the dependent variable, while change in blood flow from baseline to experimental film was treated as the independent variable. In the second model, blood flow change was treated as the dependent variable and overall subjective sexual arousal as the independent variable. Depression, anxiety, mental and physical health, arousability, sexual functioning, dyadic

adjustment, relationship satisfaction, sexual satisfaction, and sexual communication were tested as moderators in both models.

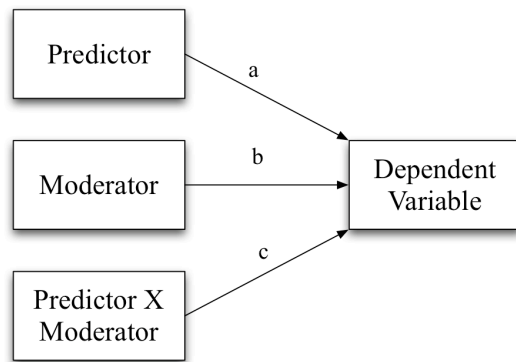


Figure 6. Moderator Model (Baron & Kenny, 1986).

For moderation analysis, it is ideal that the moderator variable is uncorrelated with both the independent and dependent variables to provide a clearly interpretable interaction term; however, analyses can still be conducted if variables are correlated. In the current study, only the FSFI total score was significantly correlated with the subjective sexual arousal.

Several researchers (Aiken & West, 1991; Baron & Kenny, 1986; Cohen, Cohen, West, & Aiken, 2003; Jaccard, Turrisi, & Wan, 1990) have suggested centering or standardizing (i.e., z-transforming) variables. Aiken and West (1991) recommend standardizing continuous predictor and moderator variables because it allows one to plot significant moderator effects with greater ease. Once variables have been standardized, an interaction term is calculated by multiplying the standardized predictor and moderator variable. The predictor and moderator are then entered as the first step in the regression

equation, followed by the interaction terms in the second step (Aiken & West, 1991; Cohen et al., 2003; Jaccard et al., 1990).

When interpreting results, it is important to examine the unstandardized (b) rather than standardized (β) regression coefficients as the β coefficient for the interaction term is not properly standardized and therefore not interpretable (Aiken & West, 1991). Once a significant moderator has been identified in this manner, one explores the interaction by testing the significance of the simple slopes of the regression lines representing the relationship between the predictor and dependent variables at specific values of the moderator. This analysis provides information regarding the significance of the association between the predictor and dependent variable at different levels of the moderator. Cohen and Cohen (1983) suggested using the mean of the moderator variable, one standard deviation above the mean (High value), and one standard deviation below the mean (Low value). If a significant interaction exists, any two simple slopes are considered significantly different from one another.

Moderation Analysis for Erotic Condition

An SPSS macro (Simple-2way; O'Connor, 1998) for testing moderation and calculating simple slopes was used for participants in the erotic condition, as this condition was the only one in which blood flow significantly changed. In the first model, physiological sexual arousal (i.e., blood flow change) was treated as the predictor variable and subjective sexual arousal was treated as the outcome variable. Measures of sexual satisfaction, sexual communication, and mental health emerged as significant moderators between subjective and physiological sexual arousal (GRISS: $\Delta R^2 = .26$, $F(1, 11) = 5.38$, $p < .05$; DSCS: $\Delta R^2 = .43$, $F(1, 11) = 13.07$, $p < .001$; SF-12 MCS: $\Delta R^2 = .25$,

$F(1, 16) = 8.44, p < .01$). In addition, there was a trend ($p = .05$) for dyadic adjustment to moderate the relationship (DAS: $\Delta R^2 = .36, F(1, 6) = 6.01, p = .05$; see Table 9 for significant and non-significant F statistics). With respect to the simple slopes, individuals with more positive sexual communication showed a stronger relationship between subjective and physiological sexual arousal (DSCS: $b = 3.08, t = 4.30, p = .01$) than individuals with more negative sexual communication (DSCS: $b = -.46, t = -1.02, p = .33$; see Figure 7). Individuals with better dyadic adjustment showed a significant relationship between subjective and physiological sexual arousal (DAS: $b = 2.85, t = 3.25, p = .02$), while poorer dyadic adjustment was not associated with this relationship ($b = -1.32, t = -1.34, p = .23$, see Figure 8). Likewise, individuals with better mental health showed a strong relationship between subjective and physiological sexual arousal ($b = 2.25, t = 3.89, p = .01$), while poorer mental health was not associated with this relationship ($b = -.13, t = -.30, p = .77$; see Figure 9). Finally, although inconsistent with the other findings, individuals with lower sexual satisfaction had a stronger relationship between the two components of sexual arousal (GRISS: $b = 3.72, t = 2.89, p = .02$), while greater sexual satisfaction was not associated with the relationship (GRISS: $b = .50, t = 1.19, p = .26$; see Figure 10).

With respect to model 2, where subjective sexual arousal was the predictor variable and physiological sexual arousal was the outcome variable, none of the psychosocial variables moderated the relationship between subjective and physiological sexual arousal. According to Cohen (1992), to detect medium effects in multiple regression with two independent variables, the sample size for each group must be greater

Table 9

Interaction Effects for the Erotic Condition

Questionnaire	Model 1		Model 2	
	<i>F</i>	<i>F</i> ²	<i>F</i>	<i>F</i> ²
Quality of Marriage Index	1.40	.13	.04	.00
Index of Marital Satisfaction	.26	.02	.35	.03
Dyadic Adjustment Scale	6.01 ^a	1.00	.21	.03
Golombok-Rust Inventory of Sexual Satisfaction	5.38*	.49	1.91	.17
Dyadic Sexual Communication Scale	13.07**	1.19	.07	.01
Female Sexual Functioning Inventory	3.06	.19	1.97	.12
Center for Epidemiological Studies-Depression	2.07	.13	.33	.02
State-Trait Anxiety Inventory	.61	.04	.60	.04
Sexual Arousability Index	.90	.06	.58	.04
Short-Form Health Survey – Mental Health Component	8.44*	.53	.08	.01
Short-Form Health Survey – Physical Health Component	.00	.00	.00	.00

Note. * $p < .05$. ** $p < .01$. ^a $p = .05$. F^2 values of .02, .15, and .35 correspond to small, medium, and large effect sizes, respectively (Aiken & West, 1991; Cohen & Cohen,

1983). F^2 is considered to be a more accurate estimate of effect size in multiple regression than R^2 (Cohen, 1988).

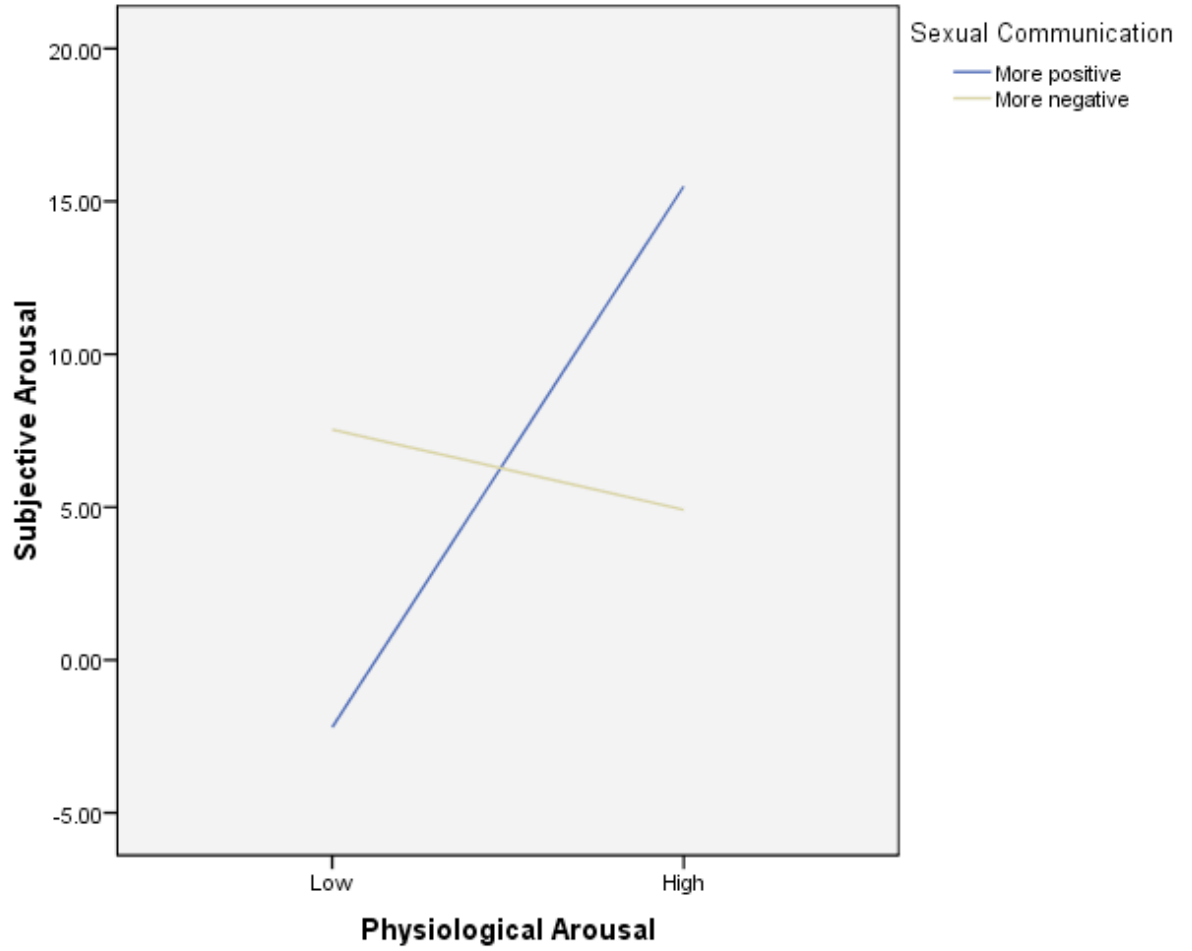


Figure 7. Simple slopes analysis showing the relationship between physiological and subjective sexual arousal for positive and negative sexual communication.

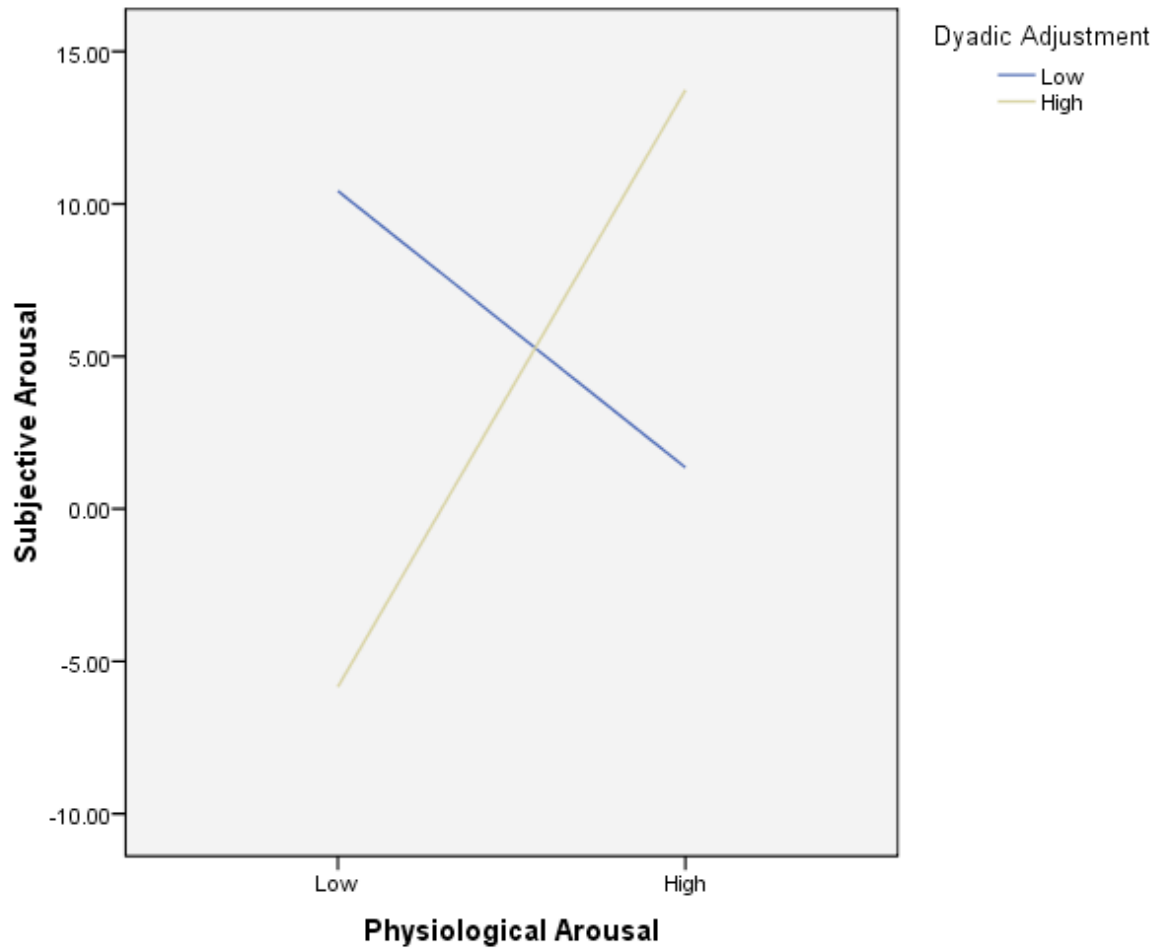


Figure 8. Simple slopes analysis showing the relationship between physiological and subjective sexual arousal at high and low levels of dyadic adjustment.

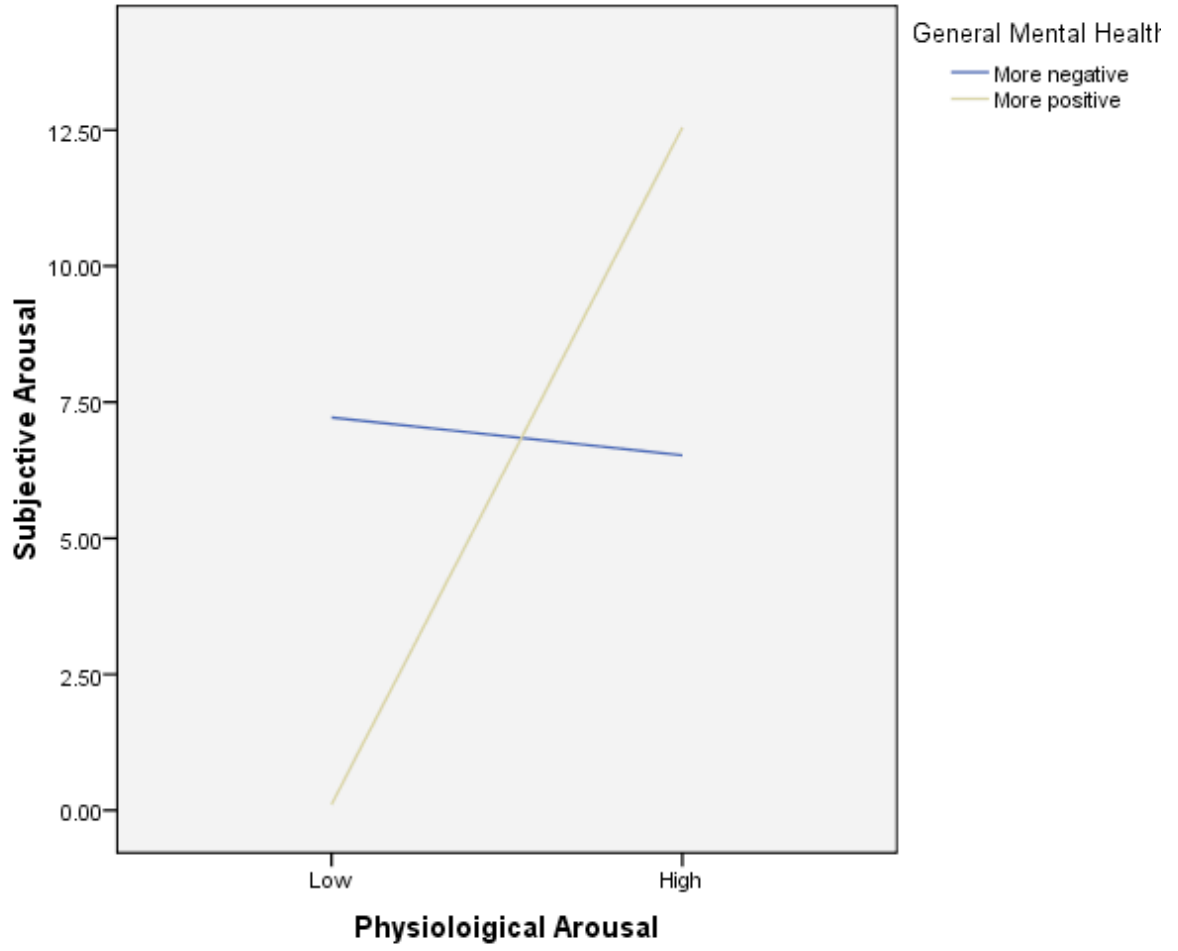


Figure 9. Simple slopes analysis showing the relationship between physiological and subjective sexual arousal for positive and negative mental health.

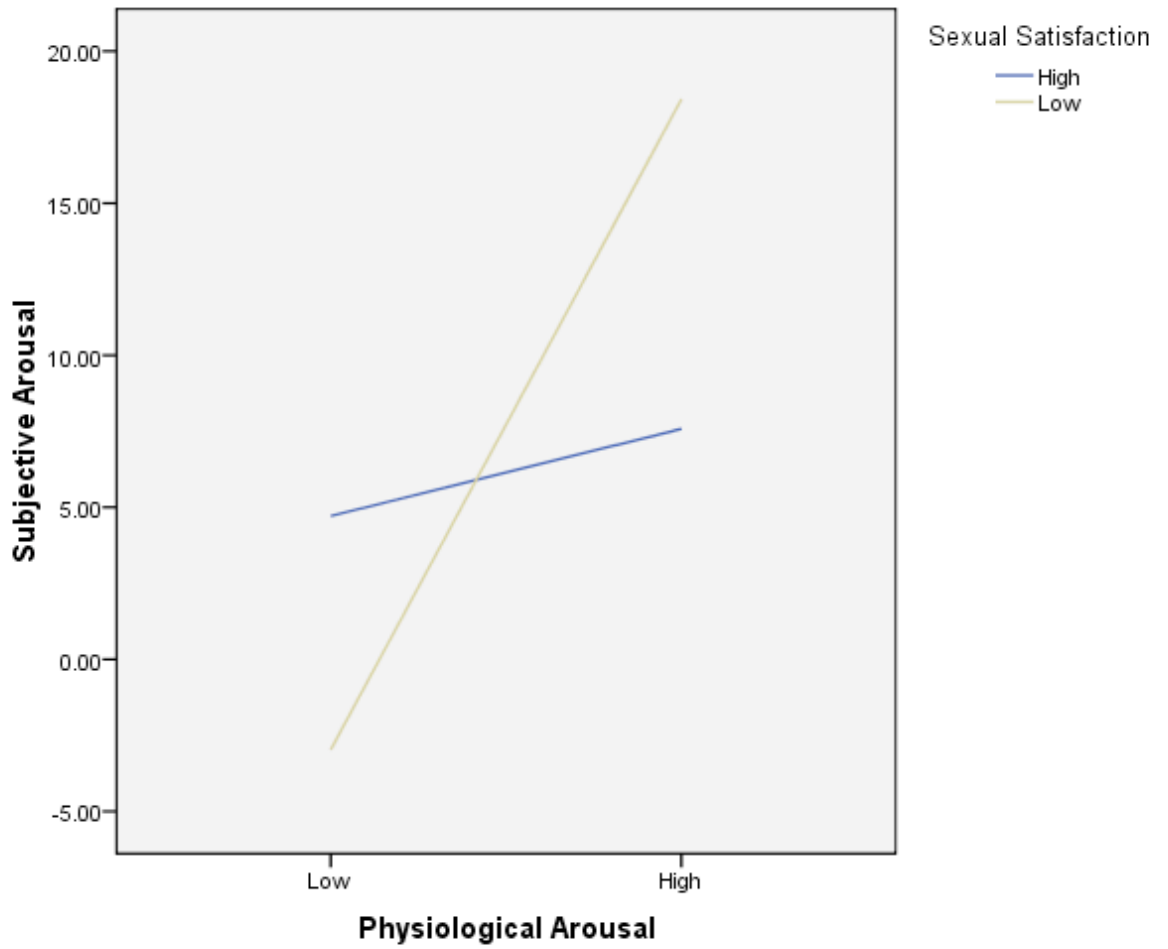


Figure 10. Simple slopes analysis showing the relationship between physiological and subjective sexual arousal at high and low levels of sexual satisfaction.

than 67 participants. Given the small sample size ($n = 20$) of the erotic condition, there may have been insufficient power to detect all significant moderators.

Analysis of Mediating Effects

Mediation analysis is generally conducted using the three step criteria established by Baron and Kenny (1986). First, the total effect of the independent (or predictor) variable on the dependent variable must be significant (Path c of Figure 11, direct effect model). Second, the relationship between the mediator and the independent variable must be significant (Path a of Figure 11, mediation model). Third, the mediator must be a significant predictor of the dependent variable in an equation controlling for the independent variable (Path b of Figure 11, mediation model).

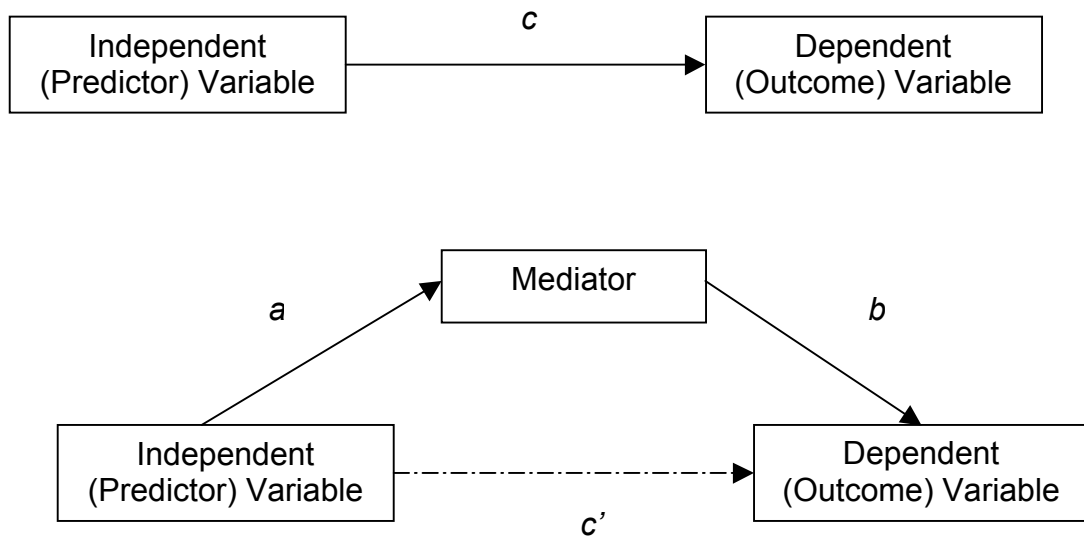


Figure 11. Mediation model proposed by Baron and Kenny (1986). The direct effect model is found in the upper portion of the figure, while the mediation (direct/indirect effect) model is found in the lower portion.

If, for this third requirement, there is a significant decline in the direct association between the independent variable and outcome variable (Path c' of Figure 11, mediation model), then the pattern of results is consistent with a mediation hypothesis. Once these conditions have been met, the significance of the indirect, or mediated, effect must be tested (Baron & Kenny, 1986). The indirect effect is the product of Paths a and b , which represents the mediated effect of the independent variable on the dependent variable through the mediator. This test is mathematically equivalent to a significance test of the drop in the direct effect when controlling for the mediator (Holmbeck, 2002).

Mediation Analysis for Erotic Condition

A mediation analysis was conducted for the genital sensation questions of the post-film questionnaire (i.e., feelings of genital lubrication, perceptions of genital changes, and feelings of genital tingling) to determine their univariate roles as mediators in the relationship between physiological and subjective sexual arousal (see Table 10). Genital lubrication mediated the relationship between physiological and subjective sexual arousal. The total effect of physiological sexual arousal on subjective sexual arousal was significant, $\beta = .49$, $p < .05$, as well as the association between physiological sexual arousal and genital lubrication, $\beta = .60$, $p < .01$. The association between genital lubrication and subjective sexual arousal, when controlling for physiological sexual arousal, was also significant, $\beta = .77$, $p < .01$. When genital lubrication was included in the equation, the direct effect between physiological and subjective sexual arousal became non-significant, $\beta = .03$, $p = .88$. Sobel's test was used to test whether the drop in the direct path was significant. The indirect effect of physiological sexual arousal on

Table 10

Standardized Regression (Path) Coefficients of Mediational Models with Genital Sensations as Mediators of Physiological and Subjective Sexual Arousal for the Erotic Condition

Mediator	Total Effect (Path <i>c</i>)	Direct effect, controlling for mediator (Path <i>c</i> ')	Physiological arousal effect on mediator (Path <i>a</i>)	Mediator effect on subjective arousal (Path <i>b</i>)	Indirect Effect (<i>ab</i>)
Genital Lubrication	.49*	.03	.60**	.77**	.46**
Genital Change	.49*	.06	.51*	.83**	.42**
Genital Tingling	.49*	.13	.45*	.79**	.36 ^a

Note. * $p < .05$. ** $p < .01$. ^a $p = .06$. Indirect effect is the product of physiological sexual arousal effect on mediator (Path *a*) and mediator effect on subjective sexual arousal (Path *b*). The significance of the indirect effect is equivalent to a test of the significance of the drop in the direct effect when controlling for the mediator. Paths *a*, *b*, *c*, and *c*' refer to those found in Figure 11.

subjective sexual arousal through genital lubrication was significant, $z = 2.76$, $p < .01$, indicating that the drop in the coefficient of the direct path was also significant (Holmbeck, 2002). Thus, the sensation of genital lubrication is a significant and full mediator of the relationship between physiological and subjective sexual arousal.

Perception of genital changes also mediated the relationship between physiological and subjective sexual arousal. The total effect of physiological sexual arousal on subjective sexual arousal was significant, $\beta = .49$, $p < .05$, as was the association between physiological sexual arousal and genital change, $\beta = .51$, $p < .05$. The association between perception of genital changes and subjective sexual arousal, when controlling for physiological sexual arousal, was also significant, $\beta = .83$, $p < .001$. When perception of genital changes was included in the equation, the direct effect between physiological and subjective sexual arousal became non-significant, $\beta = .06$, $p = .66$. The indirect effect of physiological sexual arousal on subjective sexual arousal through perception of genital changes was significant, $z = 2.42$, $p < .05$. Thus, perception of genital changes is also a significant mediator of physiological and subjective sexual arousal.

Lastly, for feelings of genital tingling, the total effect of physiological sexual arousal on subjective sexual arousal was significant, $\beta = .49$, $p < .05$, as was the association between physiological sexual arousal and genital tingling, $\beta = .45$, $p < .05$. The association between genital tingling and subjective sexual arousal, when controlling for physiological sexual arousal, was also significant, $\beta = .79$, $p < .001$. When genital tingling was included in the equation, the direct effect between physiological and subjective sexual arousal became non-significant, $\beta = .13$, $p = .36$. However, a trend

towards significance emerged when the indirect effect of physiological sexual arousal on subjective sexual arousal through genital tingling was examined, $z = 2.16$, $p = .06$. This finding suggests that sensations of genital tingling may be a significant mediator of physiological and subjective sexual arousal with more statistical power.

CHAPTER 5

Discussion

The current study addressed three main objectives concerning female sexual arousal. The first objective was to examine the usefulness of LDI for measuring blood flow change in response to an erotic film. It was hypothesized that changes in blood flow, as measured by LDI, would significantly differentiate the erotic condition from the neutral, humor, and anxiety conditions. In particular, it was expected that the erotic condition would lead to significantly higher levels of blood flow in the genitals than the three non-erotic conditions given that an increase in blood flow is indicative of the vasocongestion response of sexual arousal. The results of the current study suggest that LDI is a promising instrument for measuring the physiological component of female sexual arousal, as LDI was able to differentiate sexual arousal (i.e., during the erotic condition) from non-sexually-aroused states (i.e., during the three non-erotic conditions). Participants in the erotic condition experienced significant increases in blood flow from the baseline to the experimental condition, whereas participants in the non-erotic conditions maintained relatively stable blood flow throughout the baseline and experimental conditions. The clarity of the results is consistent with what was found by Kukkonen et al. (2007), such that one simply has to look at participants' genital blood flow values to determine whether or not they were in the erotic condition (Figure 5). Consequently, the results suggest that LDI is a valid and useful instrument for measuring blood flow to the external genitals as an indicator of sexual arousal in women.

The second objective was to investigate the relationship between physiological and subjective sexual arousal in women who experienced changes in their sexual arousal

(i.e., participants in the erotic condition). It was hypothesized that the degree of blood flow change from the baseline to the experimental condition would significantly and positively correlate with ratings of subjective sexual arousal. Furthermore, it was expected that this change in blood flow could be explained by subjective ratings of sexual arousal. In terms of the relationship between physiological and subjective sexual arousal, the current findings demonstrated that genital blood flow change during the erotic condition was significantly and positively associated with subjective ratings of sexual arousal, both when a change score was used and when baseline blood flow was statistically controlled. Moreover, the change in genital blood flow from the baseline to the experimental condition was strongly and significantly explained by subjective ratings (both discrete and continuous) of sexual arousal. This finding suggests that if women are asked how subjectively aroused they are, their responses would likely correspond with changes in their level of genital blood flow during each of the five erotic scans and with their overall degree of physiological sexual arousal.

A third major objective of the study was to elucidate the complex relationship between various psychosocial variables and the physiological and psychological components of female sexual arousal during the erotic condition. Given the inconsistencies within the literature regarding the relationship between psychosocial factors and sexual arousal, the hypotheses were exploratory. Higher levels of sexual functioning and arousability, sexual and relationship satisfaction, and physical and mental health were expected to predict greater physiological and subjective sexual arousal. No predictions were made for state anxiety due to the discrepancies within the literature, in that anxiety can increase or decrease sexual arousal depending on the individual. The

correlational analyses revealed that sexual functioning was the only variable that was significantly correlated with subjective sexual arousal; however, there was a trend for an association between sexual functioning and genital blood flow change. The same pattern of results was found when regression analyses were conducted. Therefore, given the lack of significant correlations between the psychosocial variables and subjective and physiological sexual arousal, and the strong relationship between subjective and physiological sexual arousal, moderation analyses were conducted. The relationship between subjective and physiological sexual arousal was significant when participants were satisfied with their partnered relationships and sexual communication, and dissatisfied with their sexual relationships. In addition, greater mental health also enhanced the association between physiological and subjective sexual arousal. A mediation analysis was also performed examining the role of self-perceived genital sensations in the relationship between subjective and physiological sexual arousal. Genital lubrication and genital change fully mediated the relationship, while there was a trend for genital tingling to mediate the relationship. These findings highlight the need for a biopsychosocial approach to examining female sexual arousal.

Explaining the Relationship between Subjective and Physiological Arousal

As previously noted, physiological sexual arousal (as measured via LDI of external genital blood flow) was significantly and positively correlated with subjective ratings of sexual arousal. The findings from the current study provide further support for the presence of a strong and significant relationship between women's psychological and physiological experiences of sexual arousal. The weak or non-significant correlations between subjective and physiological sexual arousal found in previous research have led

to the belief that women, as compared to men, are disconnected from their genitals, whereby they are unable to detect physiological changes when sexually aroused. Recent studies examining indirect and direct correlates of sexual arousal in the external genitals of women have shown that significant correlations exist between subjective and physiological sexual arousal (e.g., Kukkonen et al., 2007; Maravilla et al., 2005; Payne & Binik, 2006).

The findings from the current LDI study, in addition to those of Kukkonen et al. (2007), Payne and Binik (2006), and Maravilla et al. (2005), suggest that when the physiological component of female sexual arousal is measured externally, women may be better able to accurately describe their level of sexual arousal than when genital arousal is measured internally. It may be that external measures of sexual arousal (e.g., LDI, thermal imaging, labial thermistor clip) are more sensitive to the kinds of stimuli that are involved in proprioceptive feedback (e.g., change in genital blood flow, heat), whereas internal measures (e.g., VPP) may not be able to detect these subtle changes, although there has been no research to support this hypothesis. In other words, external measures of sexual arousal may measure the physiological responses that women are more attuned to (either consciously or subconsciously). The magnitude of the significant correlations observed in the current study ($r = 0.45-0.60$) are comparable to that found in Kukkonen et al.'s (2007) research (range of r s from 0.34-0.71 depending on the film segment at which average temperature was calculated). Furthermore, the strength of these correlations is similar to that found between subjective and physiological sexual arousal in men (range $r = 0.48-0.68$) when thermal imaging is employed (Kukkonen et al., 2007). These commonalities support the idea that previous discrepancies between men and women

were likely the result of methodological differences, and not necessarily the result of inherent gender differences in physiological or psychological awareness.

An additional explanation for the significant correlations found between subjective and physiological sexual arousal in the current study may be due to the use of a female-oriented erotic film. Previous literature has attributed the weak subjective-physiological sexual arousal relationship to the use of male-oriented erotic films, which could have negatively influenced women's affect by, generating feelings of shame, guilt, and aversion. For example, Laan et al. (1994) investigated differences in women's levels of genital and subjective sexual arousal while watching either female- or male-oriented erotic films. They found that women showed higher subjective sexual arousal ratings to female-oriented films as compared to male-oriented films, even though genital arousal (as measured by the VPP) did not differ between the two film types. However, a recent meta-analysis found that having women view female-oriented erotic films did not result in greater concordance between physiological and subjective sexual arousal (Chivers et al., 2009). Taken together, the significant correlation between subjective and physiological sexual arousal in this study lends support to the use of female-oriented films and instruments designed to measure external genital arousal in future research investigating female sexual arousal. However, it should be noted that this study did not explore the relationship between physiological and subjective sexual arousal using male-oriented films and LDI.

Psychosocial Variables and Female Sexual Arousal

Several psychosocial variables, including dyadic adjustment, sexual dissatisfaction, sexual communication, and general mental health were identified as

significant moderators between the components of physiological and subjective sexual arousal. The moderation results could be interpreted in light of Basson's (2002a; Figure 2) model of sexual arousal. As previously described, the model asserts that following the presentation of a sexual stimulus, the systems within the brain begin to work subconsciously to process the information, leading to an immediate vasocongestive response in the genitals. A visual inspection of the current data obtained during the erotic film suggests that the physiological response (i.e., increase in genital blood flow) occurred very quickly following the onset of the erotic stimulus, lending support to the idea that the genital response is highly automatic. The next phase of sexual arousal involves the appraisal of the contextual cues surrounding the sexual stimulus. Basson (2002a) argues that a woman's conscious experience of sexual arousal is variably influenced by her awareness of genital arousal. The model also proposes that there is an emotional element to physiological and subjective sexual arousal, whereby the sexual arousal response is viewed as either positive or negative and results in a corresponding emotional reaction.

Given the physiological, contextual, and emotional variables described in Basson's (2002a) model, it seems most appropriate to examine sexual arousal from a biopsychosocial framework as was endeavored in the current study. With respect to the social component, sexual communication, sexual dissatisfaction, and dyadic adjustment were significant moderators in the relationship between physiological and subjective sexual arousal. Previous research examining interpersonal factors related to sexual arousal found that sexual arousal problems are correlated with self-reported marital difficulties (Dunn et al., 1999). Unfortunately, there has been no previous research

examining the role of social variables on sexual arousal in sexually healthy women. Therefore, the findings from the current study suggest that interpersonal relationships may play an important role in the association between subjective and physiological sexual arousal by increasing the strength of the relationship. However, the finding from the GRISS, which suggest that individuals who are more sexually dissatisfied have stronger relationships between the two components of sexual arousal, is inconsistent with what one would expect and does not fit with the rest of the data. Although the DAS and GRISS measure different aspects of relationships, there are areas that overlap (e.g., the concept of discussing important issues, agreement between partners), and thus, the scales should act as moderators in a consistent manner. There does not appear to be a reasonable explanation for the finding of sexual dissatisfaction as a moderator that enhances the relationship between physiological and subjective sexual arousal within the literature or from a theoretical standpoint.

With respect to the psychological component, general mental health (SF-12 Mental Health Component Scale) was the only psychological variable that moderated the association between physiological and subjective sexual arousal, suggesting that individuals with fewer mental health concerns have stronger relationships between the two components of sexual arousal. These findings are supported by the work of Dunn et al. (1999), which found sexual arousal problems in women to be strongly related to anxiety. Depression, on the other hand, did not significantly affect the relationship between subjective and physiological sexual arousal. This finding is surprising given that Dunn et al.'s (1999) research also implicated depression in the experience of sexual arousal problems in women. The lack of significant findings may be explained by the

following. First, the current sample was not depressed (i.e., average scores were below the clinical cutoff score on the CES-D). Perhaps different findings may have occurred in a sample of depressed women. Second, the range of scores on the CES-D was somewhat truncated (the current study range was 0-37, while the possible range is 0-60), thereby restricting the likelihood that significant results would be found.

With respect to self-reported physical changes in the genitals, it was found that sensations of lubrication, perception of genital changes, and feelings of genital tingling mediated the relationship between physiological and subjective sexual arousal; increased genital blood flow led to increased genital sensations, which in turn, was associated with increased subjective sexual arousal. These findings lend empirical support to the argument proposed by Everaerd et al. (2000) that genital changes are necessary for the subjective experience of sexual arousal to be labeled and experienced as sexual.

Previous research has suggested that among sexually healthy women, genital vasocongestion does not necessarily result in the subjective experience of sexual arousal. Researchers have suggested that women's ratings of sexual arousal may be more highly influenced by their general state of arousal, rather than by simply relying on feedback from their genitals (Graham et al., 2004), thereby leading to weak correlations. This hypothesis is supported by Heiman's (1977) suggestion that the low correlation between measures of subjective and physiological sexual arousal may reflect an inability for women to detect subtle changes in vaginal blood flow. Therefore, according to Heiman (1977), peripheral feedback from consciously detected genital arousal seems to be a relatively unimportant determinant of subjective sexual arousal in women.

Research using the VPP (e.g., Laan et al., 1995a), however, has found that the degree of correlation between measures of subjective and physiological sexual arousal is dependent upon the detection of changes in the genitals. In Laan et al.'s (1995a) research, participants were instructed to move a lever, illuminating one to ten lights, when they felt an increase in genital sensations. Participants were assigned to one of four conditions: a decreasing condition where participants were shown the same erotic film clip on repeated trials within a session, a stable condition where participants were shown film clips that differed with respect to sexual content but were approximately the same in terms of stimulus intensity, an increasing condition where participants were shown film clips that increased in stimulus content intensity, and a random condition where participants were shown the clips from the increasing condition but in random order. The authors found that subjective sexual arousal was linearly related to genital arousal, such that experimental conditions that generated large changes in genital arousal over trials (e.g., the increasing and random conditions) resulted in greater corresponding levels of subjective sexual arousal. These findings extend Heiman's (1977) hypothesis in that they suggest that feedback from consciously detected genital arousal explains very little of the variance in subjective sexual arousal *unless* women have the chance to use variations in genital responding as an indicator of sexual arousal (Laan et al., 1995a). The findings from the Laan et al. (1995a) study correspond with the mediation results of the current study, in particular, that perceptions of genitals change significantly mediated the relationship between physiological and subjective sexual arousal. It should be noted that participants in the current study were not specifically instructed to attend to their genitals. It can, therefore, be inferred that women use the sensations associated with genital

responding to cue their subjective sexual arousal more than previously assumed, particularly when sexual arousal is assessed in the external genitals. It is likely that the diffuse innervation of the external genitals allows sensations to be more easily detected as compared to inside the vagina (Krantz, 1958).

Although the psychosocial variables examined in the current study were not directly related to physiological or subjective sexual arousal, exploring their role as moderators allows one to understand the impact these variables may have on the mental and physical components of female sexual arousal. In addition, identifying sensory mediators may help explain the link between physiological and subjective sexual arousal. Although the data from the current study only support model 1 (a model similar to Basson, 2002a), it is possible that with a larger sample of participants, model 2 may also exist. Perhaps when physiological sexual arousal is treated as the dependent variable, the same or different psychosocial variables emerge as significant moderators; the resulting findings may help to further explain the complexities of female sexual arousal.

Theoretical Implications

The results of this study are consistent with a biopsychosocial model of sexual arousal, such that the biological component (i.e., genital blood flow) is related to the psychological component, with various physical, psychological, and social variables moderating and mediating the relationship. Traditionally, sexual response has been studied from a biological or physiological viewpoint (e.g., Masters & Johnson, 1966); however, recent research studies including the present study emphasize the importance of including aspects of the psychosocial environment in the investigation of sexual response (e.g., Basson et al., 2001; Winton, 2001). Graham et al. (2004) stated that existing models

of sexual arousal and dysfunction are too genitally focused and ignore the many factors that may impact sexual arousal. The findings from the current study support the view taken by Graham et al. (2004), in that both the subjective and physiological components of sexual arousal were shown to play significant roles in the experience of sexual arousal, and that psychological and social factors increased or decreased the strength of both components. The current study is one of the first to examine the complex interplay among the biological, psychological, and social factors involved in sexual arousal in sexually healthy women, and highlights the necessity of examining these factors in relation to healthy sexual functioning before exploring the complexity of sexual dysfunction.

Schachter and Singer's (1962) cognitive arousal theory of emotions proposes that situational cues play a principle role in the experience of emotion, and that physical cues are less important. The theory proposes that there is a linear relationship such that a situation is appraised as sexual, then physiological arousal and cognitive labeling occur. Given the bi-directional relationship observed in the current study between physiological and subjective sexual arousal, as well as the moderating psychosocial variables, it is unlikely that a linear relationship exists. It is, therefore, important to examine the pertinent biopsychosocial variables concurrently. Examining the components in isolation may limit one's ability to fully comprehend the complex nature of female sexual functioning, and in particular, sexual arousal. Newer models of sexual arousal need to include both psychological and genital arousal, as well as the various factors that influence the experience of sexual arousal. The information gained from examining these processes in sexually healthy women can then be applied to understanding the factors that

may be affected in women with sexual difficulties such as arousal problems, low sexual desire, genital pain, and orgasmic difficulties.

Given that the current study found significant moderators as well as significant mediators, it may logically follow that moderated mediation effects may exist in the relationship between physiological and subjective sexual arousal (MacKinnon, Fairchild, & Fritz, 2007). Moderated mediation attempts to explain both how and when a given effect occurs (Frone, 1999). It involves a variable mediating the effect of an independent variable on a dependent variable, and the mediated effect is dependent on the level of a moderator (MacKinnon et al., 2007). Although the sample size in the present study precludes an investigation of such an effect, it may be theorized that psychological, social, and sexual variables moderate the effect of perceived genital sensations (e.g., lubrication, tingling, genital change) on physiological and subjective sexual arousal (see Figure 12). The proposed model suggests that following the onset of a sexual stimulus, an automatic physiological sexual arousal response occurs, leading to perceptions of genital sensations. Moderators may then influence one's translation of these genital sensations into an experience of subjective sexual arousal. For example, individuals in satisfying relationships may have a stronger association between their genital sensations and subjective sexual arousal, while individuals in less satisfying relationships may not become subjectively aroused as a result of perceiving their genital sensations. Perhaps there are other processes involved that block an individual's subjective sexual arousal, for example, negative thoughts about their partner.

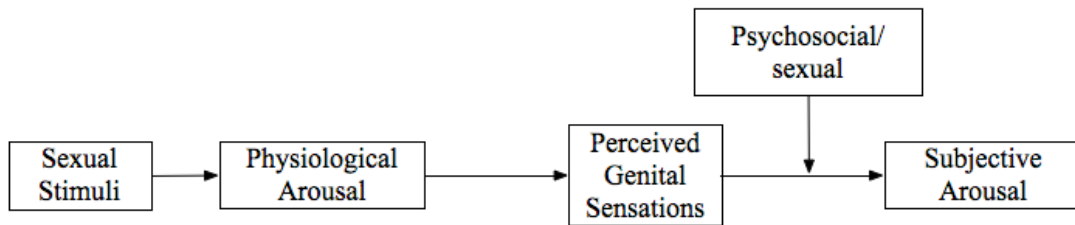


Figure 12. Proposed moderated mediation model for the relationship between physiological and subjective sexual arousal.

Limitations of the Current Study

Although LDI is able to correct for some of the limitations of other instruments, it also has several disadvantages that should be noted. For example, LDI is sensitive to movement and therefore, may not be appropriate for studies measuring and comparing male and female sexual arousal. In addition, the LDI equipment used in the present study is unable to provide continuous measurement of the genitals during the presentation of sexual stimuli. LDI is also unable to obtain reliable blood flow data when dense pubic hair is present, as the laser beam cannot penetrate coarse hair. Finally, as with thermal imaging and MRI technologies, a major drawback of LDI is the cost of the equipment, which starts at US\$60,000. However, the cost is a one-time expense, and the equipment can be used with an infinite number of participants at no additional charge other than maintenance and recalibration.

Further limitations of the study should be noted. First, the study did not utilize a crossover method where a participant would act as her own control and see both erotic and non-erotic videos. Although this protocol would have helped to minimize potential bias, there were two specific reasons why this type of methodology was not used. First, the study followed the protocol of Kukkonen et al. (2007), which randomly assigned participants to one of three film conditions (erotic, humour, or neutral). Therefore, to be

consistent for data comparisons in the future, participants were randomized to one of four films in the present study. Second, the time requirement for each participant in the current protocol was quite lengthy (approximately two hours); therefore, it was decided that participants would only view three films (two neutral, one randomly assigned experimental film). Future studies should incorporate crossover through more complex study designs, if acceptable for participants.

The participants in the current study were young, non-married, and in good health, which limits the generalizability of the findings to the general population. For example, future studies that include women over the age of 30, who had given birth, or who had experienced significant changes in hormone levels (e.g., due to ovariectomies or menopause) may result in different findings. In addition, previous research has suggested that individuals who volunteer for sexual psychophysiological studies do not represent the general population (e.g., Morokoff, 1986, Wolchik et al., 1985). For example, women who participate in sexual psychophysiological studies have been found to have longer histories with and more frequent exposure to commercialized erotica, and are less likely to object to viewing sexually explicit films than non-volunteers (Wolchik, Spencer, & Lisi, 1983). However, it should be noted that this limitation is common to all studies pertaining to sexual psychophysiology, and that the demographic composition of the current sample is consistent with previous research (e.g., Kukkonen et al., 2007; Styles et al., 2006); therefore, the findings from this study are valid within the context of female sexual psychophysiology research.

A final limitation of the study was the use of hormonal contraceptives by the majority of participants. It is understood that different hormone combinations may have

differing effects on sexual functioning (Seal, Brotto, & Gorzalka, 2005), and that women taking hormonal contraceptives do not have the same menstrual phases as women who are not taking hormonal contraceptives. However, to ensure that the protocol was standardized for all participants, it was decided that participants would be tested between days 7-11 of their cycle, following the start of menstruation. This procedure has been used in similar research (e.g., Kukkonen et al., 2007). In addition, there were no differences found in the types of hormonal contraceptives used among participants in the four conditions, as well as no significant differences in blood flow change for participants in the erotic condition regardless of contraceptive use.

Clinical Implications and Future Research Assessing Sexual Dysfunction

The results of this study have implications for future research exploring female sexual dysfunctions, namely female sexual arousal disorder (FSAD). FSAD refers to an inhibition of the “vasocongestion-lubrication response” to sexual stimulation during the arousal phase of the sexual response cycle (Bartlik & Goldberg, 2000; DSM-IV, 1994). However, studies have shown that women with FSAD do indeed show the automatic vasocongestive response as measured by VPP (Laan, van Driel, & van Lunsen, 2003), meaning that women who meet DSM-IV criteria of “lack of lubrication/swelling” are objectively showing an increase in their vaginal vasocongestion that is comparable to women without lubrication/swelling difficulties (e.g., Brotto, Basson, & Gorzalka, 2004; van Lunsen & Laan, 2004).

In another study, Laan et al. (2003) examined genital responsiveness to visual stimuli in women with and without FSAD using the VPP. Women with FSAD were diagnosed using DSM-IV criteria and matched to sexually healthy women. No significant

differences were found for mean and maximum genital response between the two groups of women, and there was no significant difference found for latency of genital response. Therefore, the authors concluded that women with FSAD were no less genitally responsive to the visual sexual stimuli than the age- and menopausal status-matched women without FSAD, even though they were diagnosed using the DSM-IV criteria of impaired genital responsiveness. Furthermore, although genital responsiveness did not differ between groups, subjective ratings of sexual arousal and affect did. Women with FSAD reported lower subjective sexual arousal and perceived genital sensations during viewing of visual sexual stimuli, as well as more negative affect.

Similarly, research by Brotto et al. (2004) demonstrated that although there were no physiological or subjective sexual arousal differences for women with FSAD as compared to a control group of sexually healthy women, significant differences emerged when the FSAD group was broken down into subtypes of arousal problems. Specifically, women who were classified as having “Genital Arousal Disorder”, as compared to women classified as having “Subjective Sexual Arousal Disorder” and “Combined Genital and Subjective Sexual Arousal Disorder” significantly differed from the control group with respect to physiological sexual arousal. LDI would be useful in measuring and comparing the genital responses of women with and without FSAD (or FSAD subtypes) while viewing erotic stimuli, as well as their subjective ratings of sexual arousal in order to replicate and expand on the previous findings. These results may lend further support to the current literature (e.g., Brotto et al., 2004; Laan et al, 2003), and further challenge the DSM-IV’s conceptualization of FSAD.

Although the findings from the current study extend directly to the study of FSAD, LDI measuring genital blood flow within other female sexual dysfunctions should also be considered. For example, Bohm-Starke et al. (2001) used LDI to evaluate vascular changes in women with provoked vestibulodynia (PVD; pain that is localized to the vestibule [i.e., the vaginal opening], and is provoked by pressure to the area) and found that women with PVD had increased blood flow in the posterior parts of the vestibular mucosa. Additionally, newer studies are currently examining differences in blood flow between women with and without PVD, and how blood flow changes may be related to vestibular pain thresholds (Boyer, Pukall, & Chamberlain, ongoing). Additionally, LDI would be very useful for measuring genital blood flow in women characterized as having Persistent Genital Arousal Disorder (PGAD) who describe the following symptoms: involuntary genital and clitoral arousal persisting for extended periods of time, genital arousal that is unrelated to subjective sexual desire, and genital arousal that is not alleviated with orgasm (Leiblum, Brown, Wan, & Rawlinson, 2005). A comparison of genital blood flow and subjective sexual arousal between sexually healthy women and women presenting with PGAD would be helpful in gaining a more thorough understanding of biological and psychological factors involved in the development and maintenance of PGAD.

In order to help women understand the complexities of female sexual functioning, it will be helpful to address the various biopsychosocial components that can be affected. For example, women with sexual arousal difficulties may gain more insight into the sources of their problems, including biological (i.e., factors affecting blood flow and lubrication), psychological (i.e., anxiety), and social factors (i.e., relationship distress or

dissatisfaction, low sexual satisfaction) when LDI and subjective questionnaires are employed in assessment and treatment of sexual dysfunction. Furthermore, the results from the moderation analyses may be useful in identifying potential targets for treatment. For instance, women who have difficulties with sexual arousal, including those who do not necessarily meet a diagnosis for FSAD, may need to target issues pertaining to their relationship functioning, sexual compatibility, and sexual communication to help strengthen the association between their subjective and physiological experience of sexual arousal. Therapeutic techniques may include working on establishing a greater awareness of the impact that negative thoughts, feelings, and behaviors can have on sexual functioning, improving sexual communication within the dyad, and sexual skills training to improve sexual satisfaction (Kaplan, 1995). Couples therapy may also be an important direction for treatment given the significant moderating effect that relationship satisfaction and adjustment, as well as couple sexual satisfaction, had on the association between subjective and physiological sexual arousal. Within couples therapy, it will be important to educate partners as to their contributing role in their partners' sexual arousal, highlighting the need for effective and open sexual and relationship communication.

Future Research using LDI

Given the novelty of LDI for examining sexual arousal, there are several areas for future research that will expand on the findings from the current study, and continue to contribute to our understanding of female sexual arousal. First, the current study only included women who were on days 7-11 of their menstrual cycles. Future research should test women at each phase of their menstrual cycle to investigate potential cyclical changes in blood flow and subjective sexual arousal. For example, Slob et al. (1991)

reported greater sexual arousal, as measured by temperature changes in participants' labia minora, when participants were tested during their follicular phases. Marginal increases were also noted in subjective sexual arousal during this phase. In contrast, Styles et al. (2006) observed women at two phases of their menstrual cycles, including the follicular phase for some women, to assess for differences in blood flow. The authors did not find any variation in blood flow according to the phase of the menstrual cycle. Future studies will help clarify the potential for cyclic changes in sexual arousal, and whether these changes are specific to one aspect of sexual arousal (e.g., genital temperature, blood flow) or whether they are related to all aspects of sexual arousal (e.g., genital temperature, blood flow, lubrication, subjective sexual arousal).

Second, given the relatively young age of the participants in the study, it will be beneficial for future research to examine blood flow changes and subjective sexual arousal in older women, particularly women who are peri-menopausal, menopausal, and post-menopausal. This research would expand our understanding of the physiology of sexual arousal and the association between subjective and physiological sexual arousal as one ages, and it would provide more comprehensive knowledge of the role(s) that psychosocial variables play with respect to physiological and subjective sexual arousal (as both moderators and mediators).

Third, although a visual inspection of the data provided information on the rather immediate physiological response, specific information was not obtained on the rate of onset of physiological sexual arousal or return to baseline levels of blood flow. It will be important to acquire a more accurate timeline of sexual arousal in future studies to ascertain a more precise experience of sexual arousal from beginning to end. As more

advanced technologies are developed, continuous measurement of genital blood flow baseline levels through peak sexual arousal and a return to baseline is warranted. Given the findings from thermal imaging studies indicating a slower return to baseline as compared to the VPP, LDI is likely to show similar patterns to the thermal imager, and therefore, may not be as useful for multi-trial studies. However, this hypothesis remains to be tested.

Fourth, on account of some of the concerns previously noted regarding internally-placed instruments for measuring female sexual arousal (e.g., VPP), it is recommended that future psychophysical studies directly compare the VPP to an externally-placed instrument, such as the LDI. Given the internal placement of the VPP and the non-direct contact required by the LDI, the two instruments would be able to be used simultaneously to measure female sexual arousal. A direct comparison may help resolve some of the differences in findings, namely the lower or non-significant correlations between subjective and physiological sexual arousal often reported in studies using the VPP. It is likely that by incorporating measurements of both internal and external responses, in addition to an individual's subjective experience, a more complete picture of the female sexual arousal will be generated.

Finally, although the sample size of the current study was sufficient to detect group differences, larger samples of participants viewing the erotic film would allow for further exploration of the roles that psychosocial variables play in moderating the complex relationship between subjective and physiological sexual arousal. In addition, future studies should consider the design of the experiment in order to maximize power with respect to sample size. The current study included 80 participants, but only 20

participants were randomized to the erotic film condition; therefore, most of the analyses were conducted with these 20 participants. Moreover, including additional psychological variables such as stress and body image would further add to our understanding of the association between subjective and physiological sexual arousal in sexually healthy women. Additionally, given the self-reported impact that genital filming had on participants' sexual arousal, relaxation, and humour, it will be important for future sexual physiological studies to identify factors that impact the experience of having one's genitals monitored, and how these factors may influence the results. This research would help to improve study methodology by minimizing the influence of these factors on sexual arousal and personal comfort.

Conclusions

This research contributes to the study and understanding of female sexual arousal. The main conclusions that can be drawn from the results of this study are: 1) LDI is a valid instrument for measuring physiological sexual arousal (i.e., genital blood flow) in women. The increase in blood flow during the sexual arousal response is specific to the genitals. 2) LDI offers advantages over other instruments, such as assessing blood flow in the external genitals without requiring direct contact. 3) Subjective reports of sexual arousal (retrospective and simultaneous) are significantly and positively associated with physiological sexual arousal. 4) Several psychosocial variables, including sexual satisfaction, sexual communication, and relationship satisfaction, significantly moderated the relationship between subjective and physiological sexual arousal. General mental health was also a significant moderator of physiological sexual arousal on subjective sexual arousal. In addition, variables pertaining to the self-report of genital sensations,

including lubrication, perceptions of genital change, and tingling, mediated the relationship between physiological and subjective sexual arousal. 5) There is a need for future research to adapt the current protocol to the study of women with and without female sexual arousal disorder, and to larger samples.

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Appendix A
Advertisements

Feeling Aroused?



Queen's University Department of Psychology needs healthy women aged 18-30 to participate in a research

Study Procedures:

- ❖ Interview and questionnaires pertaining to mental health, sexual functioning and relationship adjustment
- ❖ Blood flow imaging of the genital region while watching one of 4 different films

Participation will take approximately 2 hours and all information is strictly confidential

*****Nominal Compensation Provided *****

Interested?

For more information, please contact the
Sexual Health Research Lab
(613) 533-3276
SHRL@queensu.ca

Investigators: Samantha Waxman, MA & Caroline Pukall, Ph.D.





Queen's University's Department of Psychology needs women to participate in a research study about female sexual arousal. Participation involves the completion of an interview and questionnaires on sexual, relationship, and psychological functioning, and a blood flow imaging session to measure genital blood flow during film presentation.

If you are a woman who is:

- Between 18 and 30 years of age
- Sexually healthy
- A non-smoker

Please contact the Sexual Health Research Laboratory (SHRL) if you are interested.
613-533-3276
SHRL@queensu.ca

* Nominal compensation provided*

Appendix B
Telephone Screen

Telephone Screen

Ph.D. Study for Samantha Waxman

Telephone screening interview

Date of call: _____ Called participant: _____ Participant called: _____

RA name: _____

1) How did you hear about this study?

1) Newspaper ad: Which one? _____

2) Poster: Where? _____

3) Word of mouth

4) Physician's office

5) Other: How? _____

Study information

I am just going to tell you a bit about why this research is being done and then explain in detail exactly what your participation entails. Please interrupt if you have any questions. Also, please be advised that this telephone screening is quite long and contains some questions of a sensitive nature. Would you like to continue at this time with the screening?

*YES NO (if prefer a different time, record date and time for next call:
_____)

* Sexual arousal refers to one's feeling of sexual excitement and pleasure and is a very important aspect of sexual functioning. There are two main goals of this study. The first goal is to investigate the usefulness of Laser Doppler Imaging, or LDI, for measuring sexual arousal in sexually healthy women. LDI is a new technique for measuring female sexual arousal and has shown some promising results in one other study. However, LDI requires further validation. The second goal is to examine which psychosocial variables, including mood, sexual, and relationship functioning, predict physiological and subjective arousal in sexually healthy women.

Your participation in this study involves one appointment at the Sexual Health Research Laboratory in the Department of Psychology at Queen's University. Your appointment consists of two parts. The first part involves an interview and the completion of questionnaires, and should take approximately 1 hour. The second part involves Laser Doppler Imaging of your genitals while you watch different films. This should take approximately 1 hour to complete as well.

The interview will be conducted by a trained female researcher. The interview will cover information such as sociodemographics, medical and gynecological history, and relationship and sexual history. There will also be questionnaires on a computer asking

about mood, health, and sexual and relationship functioning. You are under no obligation to answer any questions that you feel uncomfortable answering.

The LDI portion will be set up by the same researcher from the interview. You will be asked to remove your clothing from the waist down and be seated on a gynecological examination table in the gynecological examination position with your legs in stirrups. The researcher will place the LDI machine close to, but without touching, your genitals. You will be given a pair of goggles that will be used to watch three films. Two films will involve nature scenes. The other film will be either a third nature film, an anxiety film, a humour film, or an erotic film. Each film is approximately 15 minutes in length. Both before and after each film, you will be asked to verbally answer questions that appear on the screen, and during the film, you will be asked to rate your level of sexual arousal.

Although some discomfort may be experienced during this testing, no health risks are posed, and the discomfort should not last for very long. You are able to stop or control the session at any time. For your time and convenience, you will be reimbursed \$25.00 upon completion of all parts of the study.

Do you have any questions?

Are you interested in seeing if you are eligible for participating in the study?

Yes 1 Thank them and ask for their full name: _____

No 2 Thank them for their time, and ask them to feel free to call back if they change their mind. End the screening interview.

2) How old are you? _____

If under 18 years →Cannot participate: “I am sorry, but in order to participate in this study, you must be 18 years of age or older in order for us to obtain legal consent. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

If over 30 years →Cannot participate: “I am sorry, but in order to participate in this study, you must be under 30 years of age. Unfortunately, you are not eligible to participate in this study. As this is a new area of research for our lab, we will be expanding to include women over 30 in future studies. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

DOES NOT WANT TO SAY – “Unfortunately, to determine whether you are eligible to participate in the study, we must obtain this information. Please take some time to think about this, and if you decide you would like to give me this information,

feel free to call me back and we will continue with the questions. Thank you for your time. Have a nice day/evening.” *End call.*

3) Are you fluent in English?

Yes 1
No 2*

* If not fluent in English → “I am sorry, but in order to participate in this study, you must be fluent in English. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

4) Do you mind answering some questions about your medical and sexual history to determine if you are eligible for the study?

Yes 1 *
No 2

* Explain that we need to ask these questions to determine their eligibility for the study. If they are still hesitant, ask them to think about it and call back.

5) Are you currently experiencing menopause?

Yes 1 *
No 2

* If participant is currently experiencing menopause → “I am sorry, but in order to participate in this study, you must not be experiencing menopause. Unfortunately, you are not eligible to participate in this study. As this is a new area of research for our lab, we will be expanding to include women who are menopausal. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

6) Do you smoke (e.g., cigarettes, cigars, pipes)?

Yes 1 *
No 2

* If participant smokes → “I am sorry, but in order to participate in this study, you must be a non-smoker. Because this study is examining blood flow and smoking can alter an individual’s blood flow, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

7) Do you have a history of drug and/or alcohol abuse?

Yes 1 *
No 2

* If participant has history of drug and/or alcohol abuse → “I am sorry, but in order to participate in this study, you must not have a history of drug/alcohol abuse. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

8) Do you have any genital piercings?

Yes 1 *
No 2

* If participant has genital piercings → “I am sorry, but in order to participate in this study, you must not have genital piercings. Because the study uses laser Doppler imaging, genital piercings interfere with the imaging. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

9) Do you consider yourself to be heterosexual?

Yes 1
No 2 *

* If she does not consider herself to be heterosexual → “I am sorry but in order to participate in this study, you must be heterosexual. The questionnaires that we will be using have only been validated for heterosexual relationships, and the erotic film we present depicts heterosexual sexual activities. As this is a new area of research for our lab, we will be expanding to include same-sex oriented women in future studies. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

10) Are you currently in a sexual relationship?

Yes 1
No 2

11) Have you had penetrative vaginal intercourse?

Yes 1
No 2

12) I am now going to ask you questions about your level of sexual experience.

Administer DSFI

*If participant scores below 15 on the DSFI Experiences scale, she is not eligible for participation. Say: → “I am sorry, but in order to participate in this study, you must have had a certain amount of sexual experience. Unfortunately, you are not eligible to participate in this study at this time. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

DSFI – Experiences Subscale

	YES	NO
1. Male lying prone on female (clothed)		
2. Stroking and petting your sexual partner’s genitals		
3. Erotic embrace (clothed)		
4. Intercourse-vaginal entry from rear		
5. Having genitals caressed by your sexual partner		
6. Mutual oral stimulation of genitals		
7. Oral stimulation of your partner’s genitals		
8. Intercourse side-by-side		
9. Kissing of sensitive (non-genital) areas of the body		
10. Intercourse – sitting position		
11. Masturbating alone		
12. Male kissing female’s nude breasts		
13. Having your anal area caressed		
14. Breast petting (clothed)		
15. Caressing your partner’s anal area		
16. Intercourse – female supine position		
17. Mutual petting of genitals to orgasm		
18. Having your genitals orally stimulated		
19. Mutual undressing of each other		
20. Deep kissing		
21. Intercourse – male superior position		
22. Anal intercourse		
23. Kissing on the lips		
24. Breast petting (nude)		

13) Are you currently suffering from a medical, chronic pain, or psychiatric condition?

Yes 1 *

No 2

* If yes, what condition(s) have you been diagnosed with? _____

→ Are you taking any medications for this/these conditions?

Yes 1 *

No 2

→ If **yes**, which one(s)? _____

→ Are you receiving any other treatment for this/these conditions?

Yes 1

No 2

→ If **yes**, which one(s)? _____

→ Have you previously taken any medication or received any other treatment for this/these conditions?

Yes 1

No 2

→ If **yes**, which one(s)? _____

→ Does this condition interfere significantly with your daily and sexual functioning?

Yes 1

No 2

* If the woman's response includes depression, use of antidepressants or other medication known to affect sexual functioning, diseases of vascular system and other diseases such as diabetes, thyroid disorder, cardiovascular disease, neurological disease, stroke, then say "I am sorry, but in order to participate in this study, you must have free from any medical or psychiatric conditions that can impair sexual functioning. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!" *End call.*

14) Have you ever been diagnosed with a sexual dysfunction?

Yes 1

No 2

→ If **yes**, which one(s)? _____

→ Who diagnosed you? _____

→ Are you taking any medications for this/these conditions?

Yes 1

No 2

* If **yes**, which one(s)? _____

→ Are you receiving any other treatment for this/these conditions?

Yes 1

No 2

* If **yes**, which one(s)? _____

15) Are you currently taking hormonal contraceptives?

Yes 1 *

No 2

* If **yes**, what kind? _____

16) Have you ever given birth?

Yes 1 *

No 2

* If she has had a child, say “I am sorry, but in order to participate in this study, you must be nulliparous, which means that you have not given birth. The reason behind this is that childbirth can change the colour of the labia, which may alter the laser Doppler portion of the testing. Therefore, you are not eligible to participate in this study. As this is a new area of research for our lab, we will be expanding to include women who have given birth in future studies. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!”
End call.

17) Is there any possibility that you might currently be pregnant?

Yes 1 *

No 2

* If she believes she may be pregnant, say “I am sorry, but in order to participate in this study, you can not currently be pregnant. Therefore, at this time, you are not eligible to participate in this study. However, if you are not pregnant and would still like to participate in the study, we would be happy to continue screening you for participation. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

18) When did your last menstrual period start? _____

19) When was your last gynecological exam? _____ (month/year) * must be within the last 18 months

20) Do you currently experience pain in your vulvar/genital region upon vaginal penetration?

Yes 1 *

No 2

* If she has pain in her vulva during vaginal penetration → “I am sorry, but in order to participate in this study, you must be free from vulvar pain. Unfortunately, you are not eligible to participate in this study. However, there are other studies in the lab that assess women with vulvar pain and I can give you information about these if you’d like.”

If interested in other studies → There is a study on vulvodynia and relationships currently ongoing in our lab. This study requires a gynecological examination by a gynecologist affiliated with the study, sensory testing of genital and non-genital sites, as well as an interview and questionnaires. There is also a treatment study looking at pelvic floor physiotherapy for women with vulvar pain. This study requires a gynecological examination by a gynecologist affiliated with the study, sensory testing of the genitals, and pelvic floor physiotherapy. Finally, there is an online study that does not require a gynecological exam or testing sessions. You are free to complete the survey from your home computer. If you have a partner, there are also questionnaires that he is able to complete that assess aspects of your sexual and relationship functioning. If you are interested in any of these studies, I can pass on your contact information to the principal investigator and she will call you back with more details.

YES* NO

* Pass onto participant’s name and phone number for the study/studies she is interested in.

Do you have any other questions for me at this time? Thank you again for your interest in our study. Have a great day/night!” *End call.*

21) Do you currently experience low sexual desire? This may include symptoms such as no sexual thoughts or fantasies.

Yes 1 *

No 2

→ Does this low sexual desire cause you or your partner to feel distressed?

Yes 1

No 2

22) Do you experience persistent extreme aversion or avoidance of sexual contact from a partner because of feelings such as panic, anxiety, disgust or nausea?

Yes 1 *

No 2

→ Does this aversion or avoidance cause you or your partner to feel distressed?

Yes 1

No 2

23) Do you find it difficult to have an orgasm, even after what you consider to be sufficient stimulation?

Yes 1 *

No 2

→ Does this difficulty to have an orgasm cause you or your partner to feel distressed?

Yes 1

No 2

24) Do you have difficulty getting sexually aroused during solitary masturbation?

Yes 1 *

No 2

N/A 3

→ Does this difficulty to become aroused cause you to feel distressed?

Yes 1

No 2

25) Do you have difficulty getting sexually aroused with a partner?

Yes 1 *

No 2

→ Does this difficulty to become aroused cause you or your partner to feel distressed?

Yes 1

No 2

26) Are you concerned about your ability to get sexually aroused?

Yes 1
No 2

27) Have you ever been unable to complete sexual activity due to lack of vaginal lubrication?

Yes 1 *
No 2

→ Does this inability cause you or your partner to feel distressed?

Yes 1
No 2

28) Have you experienced a persistent lack of vaginal lubrication during sexual activity over the past six months?

Yes 1 *
No 2

→ Has this lack of lubrication caused you or your partner to feel distressed?

Yes 1
No 2

***** If YES is provided for questions #21-28 say:** “I am sorry, but in order to participate in this study, you must be free from sexual difficulties. Unfortunately, you are not eligible to participate in this study at this time. Do you have any questions for me about this? Thank you again for your interest in our study. Have a great day/night!” *End call.*

***** If NO is provided for question #21-28, say:**

“The erotic video you may be viewing in this study consist of scenes depicting consenting adults engaged in a variety of sexual activities including kissing, masturbation, mutual oral sex, and penetration. There is no talking or storyline in the video and the scenes are quite explicit.”

29) Have you ever watched sexually explicit movies or videos?

Yes 1
No 2 *

30) Do you feel uncomfortable about or object to the idea of watching a sexually explicit movie or video?

Yes 1
No 2 *

* If the caller has never watched a sexually explicit movie or feels uncomfortable watching them, say → “I am sorry, but in order to participate in this study, you must have experience watching sexually explicit movies and feel comfortable doing so as this is part of the study’s procedure. Therefore, you are not eligible to participate in the current study. However, if you change your mind, please feel free to call the lab back and we can continue with screening. Thank you again for your interest in the study. Have a great day/night! *End call.*

31) Do you have any difficulty getting aroused at sexually explicit videos or movies?

Yes 1 *
No 2

* Please describe the difficulties you have: _____

Thank you for answering all of those questions!

END OF SCREENING - **Initial Decision:**

NOT ELIGIBLE _____ * (If they are not eligible, explain to them why and thank them for their time.)

NOT SURE _____ (If not sure, tell them that you will call them back after discussing it with your supervisor.)

ELIGIBLE _____ † (Tell them that they are eligible for the study; see below.)

† Are you interested in participating in the study?

Yes 1
No 2
Not sure 3

→ If **no/not sure**, thank them for their time and ask them to call back if they change their minds. Answer any questions they might have, especially if they are not sure.

→ If yes, say: **“The interview and laser Doppler imaging must be conducted during the luteal phase (days 7-11) of your menstrual cycle. You said the date**

of your last menstrual cycle was _____ (take from previous part of screen). Looking at a calendar, it looks like the next available week for testing would be _____. Do you have free time during this week to participate?

YES schedule appointment

NO schedule for next available luteal phase

Interview and Imaging date/time booked: _____

Graduate Student booked: _____

→ What is the best way to contact you in order to confirm the appointment?
(Circle one response)

NOTE: Inform them that if we leave a message, we would leave only our name and number and that we are calling from Queen's University

A) Home :

B) Work:

C) Cell:

D) Email:

*****“There are a few things that we request before you come in to participate. The first is that you must abstain from alcohol or caffeine, including coffee, tea, chocolate, or soft drinks, for at least four hours before testing. You also must abstain from sexual intercourse for 24 hours before testing. These two requests are to ensure that blood flow in the genitals is at normal, non-aroused levels. I am also going to ask that you trim excess pubic hair before coming to the session, as dense hair can detract from the resolution of the scan. If you wax your pubic hair, this is also an acceptable way of removing dense hair. Although we’d like you to trim as much pubic hair as possible, please be very careful when trimming excess hair.**

One the day of testing, please go to the entrance of Humphrey Hall. There will be a door on your left. Please ring the doorbell that reads “Sexual Health Research Lab”. The graduate student will come and greet you.”***

Provide the participant with directions to the university if needed.

Do you have any questions for me?

Appendix C

Letter of Information and Consent Form

Letter of Information

TITLE OF PROJECT:

An Examination of the Psychosocial Predictors of Female Sexual Arousal.

INVESTIGATORS:

Samantha Waxman, MA

Caroline Pukall, PhD

PURPOSE OF THE STUDY:

Female sexual arousal is an important, yet difficult, phenomenon to investigate. Most of the existing research has focused on the physiological (or biological) component of female sexual arousal by measuring the swelling of genitals with blood (Kukkonen et al., 2007). Although these physiological changes are a necessary component of sexual arousal in healthy women, psychological and/or social factors that relate to sexual arousal have received little scientific study. To highlight the importance of studying female sexual arousal, it has been found that as many as 19% of women between the ages of 18-59 report problems with vaginal lubrication (Laumann et al., 1994).

This study will be the first to examine the impact of women's psychological, sexual, and relationship functioning in predicting physiological sexual arousal. This study has the potential to inform researchers and clinicians of the factors that play important roles in sexual arousal for healthy women and women with arousal difficulties.

You are being invited to participate in a research study sponsored by the Department of Psychology at Queen's University, and directed by Samantha Waxman and Dr. Caroline Pukall. The goals of this study are to investigate psychological, sexual and relationship functioning in sexually healthy women, to examine the usefulness of Laser Doppler Imaging (LDI) for measuring female sexual arousal, and to assess the relationship between the psychosocial variables and sexual arousal as measured via the LDI. A trained graduate student will read through this form with you, describe the study procedures in detail, and answer any questions you may have. This study has been reviewed for ethical compliance by the Queen's University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board.

DETAILS OF THE STUDY:

You will not be considered for this study if you: 1) report a current lack of sexual activity (i.e., are not currently in a sexual relationship), 2) have limited sexual experience, 3) regularly use antidepressant or other medication known to affect sexual functioning or interfere with blood flow, 4) have a psychiatric or psychological diagnosis known to interfere with sexual functioning, 5) have any genital piercings, 6) smoke cigarettes, 7) report current or past alcohol and/or drug abuse, 8) have any type of cardiovascular disease and/or neurological condition (e.g., epilepsy, diabetes), 9) are of peri-, pre- or menopausal status, 10) have given birth, and 11) have received diagnosis of sexual dysfunction. In addition, you must consider yourself to be heterosexual, as the measures being used are specific to heterosexual relationships.

Your participation in this study involves undergoing the following procedures: 1) a structured interview and the completion of questionnaires; and 2) an LDI session. The interview, questionnaires, and LDI session will take place at the Sexual Health Research Laboratory, Department of Psychology, Queen's University.

Interview and questionnaires: The interview will take approximately 30 minutes to complete and will cover sociodemographic information (e.g., age, level of education), medical and gynecological history, and sexual and relationship history. Following the interview, you will be asked to complete a battery of questionnaires on a computer that should take 30-45 minutes. The questionnaires will address your current psychological, sexual, and relationship functioning.

LDI: The LDI session will take approximately 1 hour and will be carried out by a trained graduate student. You will be asked to undress from the waist down and lie down on an examination table with your legs in stirrups in order to expose the external genitals (i.e., vulva) for scanning. During this session, blood flow to your vulva will be measured using a laser Doppler Imager (LDI) while you are watching different films. The measurement of blood flow will not require any direct physical contact with your genitals. This session will begin with the presentation of two nature films (each 15 minutes long) to help you get used to the testing situation and to obtain your baseline (or typical) level of blood flow. Once you acclimatize to the environment, you will be asked to verbally rate your current levels of relaxation, anxiety, and arousal, as well as to answer questions pertaining to your current desire for intercourse with a partner and masturbation. The graduate student will be behind a curtain and will record your answers to these questions. You will then be randomly assigned to one of four experimental film conditions: neutral, anxiety, humour, or erotic. The process of assigning you to one of four videos will be conducted using a random number table. Each participant will be assigned one number from the table, and each number is associated with one of the four types of films. Special goggles will be used to show you the films in a private manner. You will be instructed to place the goggles on your face. Prior to the film presentation, you will be asked to rate your level of relaxation, emotion, and sexual arousal. During the presentation of this film, you will be asked to monitor your sexual arousal levels by clicking on a mouse button to increase or decrease your ratings. Immediately following the end of the video, you will be asked to provide emotion/arousal ratings.

FREEDOM TO WITHDRAW:

Your participation in this study is completely voluntary and you may withdraw from this study at any time without any consequence. If any questions or concerns arise during the course of testing, please feel free to speak with one of the investigators. Please remember that if you decide that you would like to discontinue your participation, all activities will cease immediately.

COMPENSATION:

Upon completion of the study, you will receive \$25.00 as compensation for your time and inconvenience. If the study has to be terminated for scientific reasons (e.g., no longer

meeting the requirements mentioned in “Details of the Study”) or if you choose to withdraw from the study, compensation will be adjusted according to the fraction of the study completed.

BENEFITS OF PARTICIPATION:

The information obtained from this study will potentially help our understanding of the processes involved in female sexual arousal. While you may not benefit directly from this study, results from this study may benefit women with arousal difficulties by increasing our understanding of what psychosocial factors contribute to female sexual arousal.

RISKS OF PARTICIPATION:

There are no known risks from participating in this study. However, it is possible that you may experience some discomfort during the LDI session as you will be sitting in the lithotomy position (i.e., knees in stirrups) for approximately 1 hour. In addition, some of the questions asked during the interview/questionnaire session cover sensitive topics, such as depression and sexual functioning. As such, you may experience some discomfort answering some of the items. You are not required to answer any questions that you feel uncomfortable answering. In the case that you do experience distress from answering some of the questions, we provide you (and all participants) with a mental health resource sheet that has contact information for various mental health agencies in the community.

CONFIDENTIALITY AND PARTICIPANT RIGHTS:

All information obtained during the course of this study is strictly confidential and your anonymity will be protected at all times. Coded (ID) numbers will replace all names and you will be identified only by this number. There will be one password-protected file linking your name and contact information with your ID number; that password will be available only to Samantha Waxman and Dr. Caroline Pukall. Data (where identifiers have been removed) will be stored in locked files and will only be available to the investigators and research assistants directly involved in this project. You will not be identified in any publication or reports of the study; data will be aggregated in all reports of this study.

SUBJECT STATEMENT AND SIGNATURE SECTION:

I, _____ (please print name), have read and understood the information/consent form for this study. I have had the purposes and procedures of this study explained to me by a trained graduate student and I understand what is required for participation in this study. I understand that my participation is voluntary and that I can withdraw my participation at this time. I have been given sufficient time to consider the above information and have had the opportunity to ask questions which have been answered to my satisfaction. I understand the potential benefits and risks associated with participating in this study and understand that my confidentiality will be protected throughout the study. I am voluntarily signing this form. I will retain a copy of this consent form for my information.

Should I have further questions, I understand that I can contact any of the following individuals:

- Samantha Waxman, Principal Investigator (533-3276; 4sew@queensu.ca), PhD student in the Department of Psychology at Queen’s University
- Dr. Caroline Pukall (533-3200; caroline.pukall@queensu.ca), Assistant Professor in the Department of Psychology at Queen’s University and co-investigator of this study
- Dr. Vern Quinsey (533-2492; psyhead@post.queensu.ca), Head of the Department of Psychology at Queen’s University
- Dr. Albert Clark (533-6081), Chair of the Queen’s University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board

By signing this consent form, I am indicating that I agree to participate in this study

_____	_____	_____
Participant’s name	Participant’s signature	Date
_____	_____	_____
Witness’ name	Witness’ signature	Date

Please check **ONE** of the following boxes:

- I would like any identifying information destroyed once the thesis is completed, and I would like to remain anonymous.**
- I agree to let the researchers keep my identifying information on file in the secure lab, and to contact me for participation in future research projects.**

STATEMENT OF INVESTIGATOR:

I have carefully explained to the participant the nature of the above research study. I certify that, to the best of my knowledge, the participant understands clearly the nature of the study and demands, benefits, and risks involved to participate in this study.

_____	_____
Signature of Principal Investigator	Date

Sexual Health Research Lab

62 Arch Street, Kingston, ON, K7L 3N6

Email: SHRL@queensu.ca

Phone: (613) 533-3276

Limits of Confidentiality

All information disclosed during your participation in this research study is confidential and **will not** be disclosed to anyone with your written and informed consent **except** where reporting is required by law, that is –

1. where there is suspicion that a child or children (that is, an individual who is PRESENTLY under the age of 16) has been or is being abused,
2. where the research participant is likely to harm herself or himself unless protective measures are taken,
3. where the research participant presents a serious danger of violence to others, and
4. if the research participant reveals that she has been sexually abused by a healthcare provider (for example, a psychologist or physician) covered by the Regulated Health Professionals Act, it is necessary by law to report the name of the perpetrator to his/her governing body.

IF YOU HAVE ANY CONCERNS ABOUT THESE MATTERS, OR ABOUT THIS FORM, PLEASE DISCUSS THESE WITH ME.

PLEASE SIGN THE ACKNOWLEDGEMENTS BELOW TO INDICATE THAT YOU
HAVE READ THIS INFORMATION ABOUT CONFIDENTIALITY

I acknowledge the circumstances that limit confidentiality and I accept them.

Participant's name

Participant's signature

Date

Witness' name

Witness' signature

Date

Appendix D
Psychosocial Interview

Psychosocial Interview

Ph.D Study for Samantha E. Waxman

Subject Number _____

Interviewer _____

Date of Interview _____

PART A: Socio-Demographic Information

I'd like to start by asking you some general questions.

1) What is your date of birth? _____ / _____ / _____
Age _____

2) What is your place of birth?

- | | | | | | |
|---------------------|--------------------------|---|----------------|--------------------------|----|
| Canada | <input type="checkbox"/> | 1 | Eastern Europe | <input type="checkbox"/> | 6 |
| United States | <input type="checkbox"/> | 2 | Western Europe | <input type="checkbox"/> | 7 |
| Latin/South America | <input type="checkbox"/> | 3 | Middle East | <input type="checkbox"/> | 8 |
| Caribbean | <input type="checkbox"/> | 4 | Africa | <input type="checkbox"/> | 9 |
| Australia/Oceania | <input type="checkbox"/> | 5 | Asia | <input type="checkbox"/> | 10 |

3) How do you define your ethnocultural heritage?

4) What is your mother tongue?

- | | | |
|---------|--------------------------|---------|
| English | <input type="checkbox"/> | 1 |
| French | <input type="checkbox"/> | 2 |
| Other | <input type="checkbox"/> | 3 _____ |

5) Do you identify with any religious community?

- | | | |
|-----|--------------------------|--------------------|
| Yes | <input type="checkbox"/> | 1 Which one? _____ |
| No | <input type="checkbox"/> | 2 → go to #7 |

6) Does your religious identity play an important role in your life?

- | | | |
|-----|--------------------------|---|
| Yes | <input type="checkbox"/> | 1 |
| No | <input type="checkbox"/> | 2 |

7) What is the highest level of formal education you have received?

- | | | |
|---|--------------------------|---|
| Some high school | <input type="checkbox"/> | 1 |
| High school graduate | <input type="checkbox"/> | 2 |
| Some trade school | <input type="checkbox"/> | 3 |
| Trade school graduate | <input type="checkbox"/> | 4 |
| Some college or undergraduate degree | <input type="checkbox"/> | 5 |
| College or undergraduate graduate | <input type="checkbox"/> | 6 |
| Some graduate school or professional training | <input type="checkbox"/> | 7 |
| Graduate or professional school degree | <input type="checkbox"/> | 8 |

Other

9

8) How many years of schooling has that included? _____

9) What is your current employment status?

Employed full-time 1

Employed part-time 2

Student 3

Retired 4

Unemployed 5

On disability 6

Full-time parenting 7

Other 8

10) What is your approximate total annual income of your household?

\$0 - \$9,999 1

\$10,000 - \$19,999 2

\$20,000 - \$29,000 3

\$30,000 - \$39,999 4

\$40,000 - \$49,000 5

\$50,000 - \$59,000 6

\$60,000 and over 7

Notes:

PART B: Gynecological and Medical History

I am now going to ask you some questions regarding your medical and gynecological history. Please feel free to ask any questions you may have.

1) Have you ever experienced childbirth?

- Yes 1 * If yes, remind participants that in order to participate, you must be nulliparous. Therefore, they are no longer eligible for the study.
No 2

2) Since the time of the screening, have there been any changes with your

a) medical health

- Yes 1
No 2

If yes, please explain. _____

b) daily functioning

- Yes 1
No 2

If yes, please explain. _____

c) psychiatric/psychological status

- Yes 1
No 2

If yes, please explain. _____

d) sexual health/functioning

- Yes 1
No 2

If yes, please explain. _____

3) Are you currently taking any medication?

- Yes 1
No 2

If yes, why?

For how long?

4) Do you menstruate regularly (approximately once a month)?

Yes 1

No 2 Why not?

5) At what age did you first start to menstruate? _____

6) What was the start date of your last menstrual period? _____ / _____ / _____
mo day year

7) If has current partner: Do you and/or your partner use any method(s) of contraception?

Yes 1

No 2

If no current partner: Did you and/or your past partners use any method(s) of contraception?

Yes 1

No 2

If yes to either question, which one(s)? _____

How long have you been using this form of contraception? _____

If using hormonal contraceptive, which brand? _____

How long have you been using the hormonal contraceptives? _____

8) Have you ever had a yeast infection?

Yes 1 How many? _____

No 2

If yes, have you suffered from repeated yeast infections?

Yes 1 Since what age? _____

No 2

DK 3

N/A 4

If yes, how were the yeast infections diagnosed?

Clinical plus positive culture 1 Number of times _____

Clinical only
Self-diagnosed

2 Number of times _____
3 Number of times _____

9) What gynecological problems have you had? Please answer yes or no.

- | | | | |
|---|----------------------------|----------------------------|-----------------------------|
| Chlamydia | <input type="checkbox"/> 1 | Trichomoniasis | <input type="checkbox"/> 8 |
| Gardnerella vaginalis/
Bacterial vaginosis | <input type="checkbox"/> 2 | Bladder/urinary infections | <input type="checkbox"/> 9 |
| Genital Warts or HPV | <input type="checkbox"/> 3 | Interstitial cystitis | <input type="checkbox"/> 10 |
| Gonorrhea | <input type="checkbox"/> 4 | PID | <input type="checkbox"/> 11 |
| Genital herpes | <input type="checkbox"/> 5 | Endometriosis | <input type="checkbox"/> 12 |
| HIV | <input type="checkbox"/> 6 | Other _____ | <input type="checkbox"/> 13 |
| Syphilis | <input type="checkbox"/> 7 | None _____ | <input type="checkbox"/> 14 |

10) What kind of gynecological interventions have you had? Please answer yes or no

- | | | | |
|----------------|----------------------------|-------------|----------------------------|
| Hysterectomy | <input type="checkbox"/> 1 | Curettage | <input type="checkbox"/> 5 |
| Laparoscopy | <input type="checkbox"/> 2 | Abortion | <input type="checkbox"/> 6 |
| Ovariectomy | <input type="checkbox"/> 3 | Other _____ | <input type="checkbox"/> 7 |
| Tubal Ligation | <input type="checkbox"/> 4 | None _____ | <input type="checkbox"/> 8 |

11) What was the date of your last gynecological exam?

_____/_____
Month Year

Notes:

PART C: Relationship and Sexual History

Now I am going to ask you some questions about your sexuality and about your relationship history. If you are currently involved in a relationship or are dating, you will be asked questions about your partner. If you are in an open or non-monogamous relationship, the questions referring to 'your partner' refer to your main partner.

1) Are you currently in a relationship?

- Yes 1
No 2 *If no, skip to question 3

2) What is the sex of your current partner?

- Male 1
Female 2
Other 3 _____

* Note: Participant must consider herself heterosexual to be eligible for the study.

3) How would you describe your current relationship status or situation?

- Single, not dating 1
Casual sex with one consistent partner 2
Casual sex with multiple partners 3
Dating one partner regularly 4
Dating one partner regularly—long distance 5
Living with a partner 6
Married 7
Common-law 8
Separated 9
Divorced 10
Widowed 11
Other 12

4) How long have you been in this situation? _____years _____months

5) ** If checked single, casual, or dating: You said that you are _____ and therefore, do not consider yourself involved in a committed relationship. Please indicate when your most recent committed relationship ended: _____

6) How many long-term (i.e., lasting 3 months or longer) committed relationships have you been in? _____

7) How many casual dating (i.e., relationships that you did not consider yourself committed to) relationships have you been in? _____

- 8) At what age did you first have penetrative intercourse? In terms of a heterosexual experience, this refers to penis-in-vagina intercourse. _____
- 9) Some women report experiencing pain during their first experience of penetrative intercourse.
- a) On a scale from 0 to 10, please rate the intensity (how strong the pain felt) of the pain you might have felt _____
- b) On a scale from 0 to 10, please rate the unpleasantness (how much the pain bothered you) of the pain _____
- 10) With how many partners have you had penetrative intercourse? _____
- 11) Many people engage in masturbation and sexual activities with partners. I am going to list various sexual activities and I'd like you to say how often you have engaged in the sexual activity in the last month, and how arousing this activity was on a scale from 0 to 10, with 0 being not arousing at all to 10 being most aroused you've ever been?

Sexual Activity	Frequency (# of times)	Level of Arousal (0 = not arousing at all; 10 = most aroused I've ever been)
Masturbation		
Manual stimulation of partner's genitals		
Partner's manual stimulation of your genitals		
Oral stimulation of partner's genitals		
Partner's oral stimulation of your genitals		
Penetrative vaginal intercourse on you		
Penetrative vaginal intercourse on partner		
Manual stimulation of partner's anus		
Partner's manual stimulation of your anus		
Oral stimulation of partner's anus		
Partner's oral stimulation of your anus		
Penetrative anal intercourse on		

you		
Penetrative anal intercourse on partner		
Penetrative sex-toy play on partner		
Penetrative sex-toy play on you		

I am now going to ask you questions about your sexual functioning.

12) Do you experience pain in your vulva region?

- Yes 1
 No 2

13) Do you ever experience decreased levels of desire?

- Yes 1
 No 2

14) Do you ever have difficulty obtaining or have a complete absence of orgasm, following what you consider to be sufficient sexual stimulation?

- Yes 1
 No 2

15) If you are engaging in vaginal penetration with a penis or a sex-toy, do you feel that you are sufficiently lubricated at the time of insertion such that no artificial lubrication is needed for your comfort?

- Yes 1
 No 2 *

If no, what do you believe is the reason for this?

16) Do you find you have difficulty attaining or maintaining sexual excitement or arousal during a sexual act?

- Yes 1*
 No 2

22) If you have intercourse, how long does it last on average from beginning of thrusting until thrusting stops? _____

23) When you have intercourse, how often do you reach orgasm, with/without simultaneous clitoral stimulation?

Almost always 1

Most of the time 2

Often 3

Sometimes 4

Never have 5

24) Over the past 6 months, approximately how many times have you had penetrative intercourse? _____

25) Typically, what percentage of penetrative intercourse occasions have you experienced arousal difficulties? _____

26) Can you describe to me the process of sexual arousal? How does it start? What do you notice? When do you notice you are no longer aroused? What changes occur during this period of arousal?

Appendix E
Questionnaires

Female Sexual Functioning Index

INSTRUCTIONS: These questions ask about your sexual feelings and responses during the past 4 weeks. Please answer the following questions as honestly and clearly as possible. Your responses will be kept completely confidential. In answering these questions the following definitions apply:

Sexual activity can include caressing, foreplay, masturbation, and vaginal intercourse.

Sexual intercourse is defined as penile penetration (entry) of the vagina.

Sexual stimulation includes situations like foreplay with a partner, self-stimulation (masturbation), or sexual fantasy.

CHECK ONLY ONE BOX PER QUESTION.

Sexual desire or interest is a feeling that includes wanting to have a sexual experience, feeling receptive to a partner's sexual initiation, and thinking or fantasizing about having sex.

1. Over the past 4 weeks, how **often** did you feel sexual desire or interest?

- Almost always or always
- Most times (more than half the time)
- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

2. Over the past 4 weeks, how would you rate your **level** (degree) of sexual desire or interest?

- Very high
- High
- Moderate
- Low
- Very low or none at all

Sexual arousal is a feeling that includes both physical and mental aspects of sexual excitement. It may include feelings of warmth or tingling in the genitals, lubrication (wetness), or muscle contractions.

3. Over the past 4 weeks, how **often** did you feel sexually aroused (“turned on”) during sexual activity or intercourse?

- No sexual activity
- Almost always or always

- Most times (more than half the time)
- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

4. Over the past 4 weeks, how would you rate your **level** of sexual arousal (“turn on”) during sexual activity or intercourse?

- No sexual activity
- Very high
- High
- Moderate
- Low
- Very low or none at all

5. Over the past 4 weeks, how **confident** were you about becoming sexually aroused during sexual activity or intercourse?

- No sexual activity
- Very high confidence
- High confidence
- Moderate confidence
- Low confidence
- Very low or no confidence

6. Over the past 4 weeks, how **often** have you been satisfied with your arousal (excitement) during sexual activity or intercourse?

- No sexual activity
- Almost always or always
- Most times (more than half the time)
- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

7. Over the past 4 weeks, how **often** did you become lubricated (“wet”) during sexual activity or intercourse?

- No sexual activity
- Almost always or always
- Most times (more than half the time)
- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

8. Over the past 4 weeks, how **difficult** was it to become lubricated (“wet”) during sexual activity or intercourse?

- No sexual activity
- Extremely difficult or impossible
- Very difficult
- Difficult
- Slightly difficult
- Not difficult

9. Over the past 4 weeks, how often did you **maintain** your lubrication (“wetness”) until completion of sexual activity or intercourse?

- No sexual activity
- Almost always or always
- Most times (more than half the time)
- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

10. Over the past 4 weeks, how **difficult** was it to maintain your lubrication (“wetness”) until completion of sexual activity or intercourse?

- No sexual activity
- Extremely difficult or impossible
- Very difficult
- Difficult
- Slightly difficult
- Not difficult

11. Over the past 4 weeks, when you had sexual stimulation or intercourse, how **often** did you reach orgasm (climax)?

- No sexual activity
- Almost always or always
- Most times (more than half the time)
- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

12. Over the past 4 weeks, when you had sexual stimulation or intercourse, how **difficult** was it for you to reach orgasm (climax)?

- No sexual activity
- Extremely difficult or impossible
- Very difficult

- Difficult
- Slightly difficult
- Not difficult

13. Over the past 4 weeks, how **satisfied** were you with your ability to reach orgasm (climax) during sexual activity or intercourse?

- No sexual activity
- Very satisfied
- Moderately satisfied
- About equally satisfied and dissatisfied
- Moderately dissatisfied
- Very dissatisfied

14. Over the past 4 weeks, how **satisfied** have you been with the amount of emotional closeness during sexual activity between you and your partner?

- No sexual activity
- Very satisfied
- Moderately satisfied
- About equally satisfied and dissatisfied
- Moderately dissatisfied
- Very dissatisfied

15. Over the past 4 weeks, how **satisfied** have you been with your sexual relationship with your partner?

- Very satisfied
- Moderately satisfied
- About equally satisfied and dissatisfied
- Moderately dissatisfied
- Very dissatisfied

16. Over the past 4 weeks, how **satisfied** have you been with your overall sexual life?

- Very satisfied
- Moderately satisfied
- About equally satisfied and dissatisfied
- Moderately dissatisfied
- Very dissatisfied

17. Over the past 4 weeks, how **often** did you experience discomfort or pain during vaginal penetration?

- Did not attempt intercourse
- Almost always or always
- Most times (more than half the time)

- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

18. Over the past 4 weeks, how **often** did you experience discomfort or pain following vaginal penetration?

- Did not attempt intercourse
- Almost always or always
- Most times (more than half the time)
- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

19. Over the past 4 weeks, how would you rate your **level** (degree) of discomfort or pain during or following vaginal penetration?

- Did not attempt intercourse
- Very high
- Moderate
- Low
- Very low or none at all

Sexual Arousability Inventory

INSTRUCTIONS: The experiences in this inventory may or may not be sexually arousing to you. There are no right or wrong answers. Read each item carefully, and then circle the number which indicates how sexually aroused you feel when you have the described experience, or how sexually aroused you think you would feel if you actually experienced it. Be sure to answer every item. If you aren't certain about an item, circle the number that seems about right. Rate feelings of arousal according to the following scale:

- 1 Adversely affects arousal; unthinkable, repulsive, distracting
- 0 Doesn't affect sexual arousal
- 1 Possibly causes sexual arousal
- 2 Sometimes causes sexual arousal; slightly arousing
- 3 Usually causes sexual arousal; moderately arousing
- 4 Almost always sexually arousing; very arousing
- 5 Always causes sexual arousal; extremely arousing

1. When a partner simulates your genitals with mouth and tongue.	-1 0 1 2 3 4 5 N/A
2. When a partner fondles your breasts with his hands.	-1 0 1 2 3 4 5 N/A
3. When you see a partner nude.	-1 0 1 2 3 4 5 N/A
4. When a partner caresses you with his eyes.	-1 0 1 2 3 4 5 N/A
5. When a partner stimulates your genitals with his fingers.	-1 0 1 2 3 4 5 N/A
6. When you are touched or kissed on the inner thigh by a partner.	-1 0 1 2 3 4 5 N/A
7. When you caress a partner's genitals with your fingers.	-1 0 1 2 3 4 5 N/A
8. When you read a pornographic or "dirty" story.	-1 0 1 2 3 4 5 N/A
9. When a partner undresses you.	-1 0 1 2 3 4 5
10. When you dance with a partner.	-1 0 1 2 3 4 5
11. When you have intercourse with a partner.	-1 0 1 2 3 4 5 N/A
12. When a partner touches or kisses your nipples.	-1 0 1 2 3 4 5 N/A
13. When you caress a partner (other than his genitals).	-1 0 1 2 3 4 5 N/A
14. When you see pornographic pictures/slides/films.	-1 0 1 2 3 4 5 N/A
15. When you lie in bed with a partner.	-1 0 1 2 3 4 5 N/A

16. When a partner kisses you passionately.	-1 0 1 2 3 4 5 N/A
17. When you hear sounds of pleasure during sex.	-1 0 1 2 3 4 5 N/A
18. When a partner kisses you with an exploring tongue.	-1 0 1 2 3 4 5 N/A
19. When you read suggestive or pornographic poetry.	-1 0 1 2 3 4 5 N/A
20. When you see a strip show.	-1 0 1 2 3 4 5 N/A
21. When you stimulate your partner's genitals with your mouth and tongue.	-1 0 1 2 3 4 5 N/A
22. When a partner caresses you (other than your genitals).	-1 0 1 2 3 4 5 N/A
23. When you see a pornographic movie.	-1 0 1 2 3 4 5 N/A
24. When you undress your partner.	-1 0 1 2 3 4 5 N/A
25. When a partner fondles your breasts with mouth and tongue.	-1 0 1 2 3 4 5 N/A
26. When you have sexual intercourse in a new or unusual place.	-1 0 1 2 3 4 5 N/A
27. When you masturbate.	-1 0 1 2 3 4 5 N/A
28. When your partner has an orgasm.	-1 0 1 2 3 4 5 N/A

CES-D

Directions: Using the scale below, circle the number which best describes how often you felt or behaved this way-DURING THE PAST WEEK.

- 1 = Rarely or none of the time (less than 1 day)**
- 2 = Some or a little of the time (1-2 days)**
- 3 = Occasionally or a moderate amount of time (3-4 days)**
- 4 = Most or all of the time (5-7 days)**

DURING THE PAST WEEK:

- | | | | | | |
|-----|---|---|---|---|---|
| 1. | I was bothered by things that usually don't bother me. | 1 | 2 | 3 | 4 |
| 2. | I did not feel like eating; my appetite was poor. | 1 | 2 | 3 | 4 |
| 3. | I felt that I could not shake off the blues,
even with the help from my family or friends. | 1 | 2 | 3 | 4 |
| 4. | I felt that I was just as good as other people. | 1 | 2 | 3 | 4 |
| 5. | I had trouble keeping my mind on what I was doing. | 1 | 2 | 3 | 4 |
| 6. | I felt depressed. | 1 | 2 | 3 | 4 |
| 7. | I felt that everything I did was an effort. | 1 | 2 | 3 | 4 |
| 8. | I felt hopeful about the future. | 1 | 2 | 3 | 4 |
| 9. | I thought my life had been a failure. | 1 | 2 | 3 | 4 |
| 10. | I felt fearful. | 1 | 2 | 3 | 4 |
| 11. | My sleep was restless. | 1 | 2 | 3 | 4 |
| 12. | I was happy. | 1 | 2 | 3 | 4 |
| 13. | I talked less than usual. | 1 | 2 | 3 | 4 |
| 14. | I felt lonely. | 1 | 2 | 3 | 4 |
| 15. | People were unfriendly. | 1 | 2 | 3 | 4 |
| 16. | I enjoyed life. | 1 | 2 | 3 | 4 |
| 17. | I had crying spells. | 1 | 2 | 3 | 4 |
| 18. | I felt sad. | 1 | 2 | 3 | 4 |

19. I felt that people disliked me. 1 2 3 4
20. I could not get "going". 1 2 3 4

Quality of Marriage Index

Instructions: Please write the number in the space provided that best describes the degree of satisfaction you feel in various areas of your relationship.

- 1 = Very strongly disagree
- 2 = Strongly disagree
- 3 = Disagree
- 4 = Neither disagree nor agree
- 5 = Agree
- 6 = Strongly Agree
- 7 = Very strongly agree

1. We have a good relationship. _____
2. My relationship with my partner is very stable. _____
3. My relationship with my partner is strong. _____
4. My relationship with my partner makes me happy. _____
5. I really feel like part of a team with my partner. _____
6. All things considered, what degree of happiness best describes your relationship? (please circle the corresponding number)

1	2	3	4	5	6	7	8	9	10
Unhappy				Happy					Perfectly happy

AROUSAL QUESTIONNAIRE

PRE-FILM

Please indicate the number which best describes how you feel right now, that is, at this moment:

1. How relaxed do you feel?

0	1	2	3	4	5	6	7	8	9	10
not at all relaxed										the most relaxed I've ever been

2. How funny do you find this situation?

0	1	2	3	4	5	6	7	8	9	10
not at all										funniest situation ever

3. Overall, how anxious do you feel?

0	1	2	3	4	5	6	7	8	9	10
not at all										the most I've ever felt

4. Overall, how sexually aroused do you feel (both mentally and physically)?

0	1	2	3	4	5	6	7	8	9	10
not at all										the most sexually aroused I've ever been

a) How sexually aroused are you mentally?

0	1	2	3	4	5	6	7	8	9	10
not at all										the most mentally aroused I've ever been

b) How sexually aroused are you physically?

0	1	2	3	4	5	6	7	8	9	10
not at all										the most physically aroused I've ever been

5. Do you feel like having sex with a partner?

0	1	2	3	4	5	6	7	8	9	10
not at all										the most I've ever felt

6. Do you feel like masturbating?

0	1	2	3	4	5	6	7	8	9	10
not at all										the most I've ever felt

**AROUSAL QUESTIONNAIRE
POST-FILM**

Film: Humor Erotic Neutral Anxiety

Please indicate the number which best describes your experience:

1. Overall, how relaxed did you feel during this film?

0	1	2	3	4	5	6	7	8	9	10
not at all										the most relaxed I've ever been

2. Overall, how much did you enjoy the film?

0	1	2	3	4	5	6	7	8	9	10
not at all										the most enjoyable film I've ever seen

3. Overall, how funny did you find the film?

0	1	2	3	4	5	6	7	8	9	10
not at all funny										funniest film I've ever seen

4. Overall, how anxious did you become during this film?

0	1	2	3	4	5	6	7	8	9	10
not at all anxious										the most anxious I've ever been

5. Overall, how frightening was this film?

0	1	2	3	4	5	6	7	8	9	10
not at all frightening										most frightening film I've ever seen

6. Overall, how sexually aroused did you become during this film?

0 1 2 3 4 5 6 7 8 9 10
not sexually aroused at all the most sexually aroused I've ever been

7. At what point during the film would you say that you were most sexually aroused?

- Was not at all sexually aroused
- Within the first 5 minutes
- Between 5-10 minutes (middle of film)
- During the last 5 minutes
- Varied throughout (up and down during the film)
- Other; explain _____

8. How would you rate your peak sexual arousal during the film?

0 1 2 3 4 5 6 7 8 9 10
not at all sexually aroused the most sexually aroused I've ever been

Now I am going to ask you to consider your sexual arousal specifically in terms of mental and physical parts:

9. Overall, how sexually aroused were you **mentally** during the film?

0 1 2 3 4 5 6 7 8 9 10
not at all mentally aroused the most mentally aroused I've ever been

10. Did watching the video make you feel like having sex with a partner?

0 1 2 3 4 5 6 7 8 9 10
not at all the most I've ever felt

11. Did watching the video make you feel like masturbating?

0 1 2 3 4 5 6 7 8 9 10
not the most I've
at all ever felt

12. Overall, how sexually aroused were you **physically** during the film?

0 1 2 3 4 5 6 7 8 9 10
not the most
at all physically
aroused
I've ever been

13. How much genital change did you feel during the film?

0 1 2 3 4 5 6 7 8 9 10
no the most
genital genital change
change I've ever felt

14. How much lubrication (wetness) did you feel during the film?

0 1 2 3 4 5 6 7 8 9 10
no the most
lubrication lubrication
at all I've ever felt

15. How much genital tingling or fullness did you feel during the film?

0 1 2 3 4 5 6 7 8 9 10
no The most
genital genital
tingling/fullness tingling/fullness
I've ever felt

16. How sexually aroused did you feel during the film as compared to how sexually aroused you typically are with a partner?

-5 -4 -3 -2 -1 0 1 2 3 4 5
much less no
sexually sexually
aroused difference aroused

17. Did the process of having your genitals filmed affect you in any way?

YES NO

➤ If Yes, describe how: _____

A) To what extent did it increase or decrease your sexual arousal?

0 1 2 3 4 5 6 7 8 9 10
not the most
at all possible

B) To what extent did it increase or decrease how funny you thought the video was?

0 1 2 3 4 5 6 7 8 9 10
not the most
at all possible

C) To what extent did it increase or decrease how relaxed you were during the video?

0 1 2 3 4 5 6 7 8 9 10
not the most
at all possible

19. Is there anything else you would like to say about this film?

Appendix F

Debriefing Sheet and Mental Health Resources

Debriefing Sheet

Thank you for your participation in the study “An Examination of the Psychosocial Predictors of Female Sexual Arousal”. I sincerely appreciate the time and effort you contributed to helping with this project. The purposes of the study are 1) to validate a new instrument for measuring sexual arousal and 2) to investigate the influence of psychological and social factors on physiological arousal. Our hope is that by gaining a better understanding of the factors that contribute to normative sexual arousal, we may help identify particular variables of importance for women with arousal difficulties.

Just a reminder: All information is kept completely confidential in locked research cabinets and only members of the research team will have access to the information. At no time will you be identified as an individual as the data will be numerically coded to ensure confidentiality and anonymity. Only the group data will be reported in the research. However, if you would like a general summary of findings from this study, you may obtain them by contacting Samantha Waxman by e-mail at 4sew@queensu.ca.

If the discussion of your personal experiences leads you to feel distressed, you are encouraged to contact your family physician or mental health professional. Attached is a list of mental health resources in the Kingston and surrounding area, as well as a list of websites related to sexuality.

To thank you for your time and to compensate you for any inconveniences incurred from participating, we will be sending you a cheque for \$25 to your home.

Thank you again!
Sincerely,

Samantha Waxman, M.A.
Sexual Health Research Lab, Queen’s University

The references provided below are for further information regarding this topic:

- Basson, R. (2002). A model of women’s sexual arousal. *Journal of Sex & Marital Therapy*, 28, 1-10.
- Basson, R. (2007). Sexual desire/arousal disorders in women. In S. R. Leiblum (Ed.), *Principles and Practices of Sex Therapy* (4th ed.) (pp. 25-53). New York: The Guilford Press.
- Everaerd, W., Laan, E. T. M., Both, S., & van der Velde, J. (2000). Female Sexuality. In L. T. Szuchman & F. Muscarella (Eds). *Psychological Perspectives on Human Sexuality* (pp. 101-146). Toronto: John Wiley & Sons, Inc.
- Graham, C. A., Sander, S. A., Milhausen, R. R., & McBride, K. R. (2004). Turning on and turning off: A focus group study of the factors that affect women’s sexual arousal. *Archives of Sexual Behavior*, 33, 527-538.

Mental Health Resources

Belleville General Hospital.....(613) 969-5511

Brockville General Hospital.....(613) 345-5645

Kingston General Hospital.....(613) 548-2333

Frontenac Community Mental Health Services:

Information.....544-1356

24 Hour Crisis Line.....544-4229

Leeds and Grenville Rehabilitation and Counselling Services:

Toll Free.....1 800 267-4406

Delta.....(613) 928-3460

Gananoque.....(613) 382-4016

ext. 100

Kemptville.....(613) 258-7204

Prescott.....(613) 925-5940

Websites Related to Sexuality:

<http://www.sexualhealth.com/>

<http://www.teenwire.com/index.asp>

<http://www.plannedparenthood.org/>

<http://www.hars.ca>

<http://www.myams.org/shrc>

<http://www.myams.org/equip>