

AN EXAMINATION OF PSYCHOPHYSIOLOGICAL MEASURES OF SEXUAL  
AROUSAL

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Bachelor of Arts (Honours), University of Saskatchewan, 2004

A Thesis  
Submitted to the School of Graduate Studies  
of the University of Lethbridge  
in Partial Fulfillment of the  
Requirements for the Degree

MASTER OF SCIENCE  
(Psychology)

Department of Psychology  
University of Lethbridge  
LETHBRIDGE, ALBERTA, CANADA

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## **ABSTRACT**

### **An Examination of Psychophysiological Measures of Sexual Arousal.**

The scientific study of sex has developed significantly since the inception of psychophysiological methods to assess sexual arousal. Sexual psychophysiology involves assessing the physiological activation of the sexual response system, in addition to mental, behavioral, and emotional processes or experiences (Rosen & Beck, 1988). Measures of sexual arousal are reviewed in Chapter One. Chapter Two describes a study testing the validity of the most commonly used measure of genital arousal in women, vaginal photoplethysmography. Results indicate that vaginal photoplethysmography is sensitive to sexual arousal only, and that there are important sex differences in patterns of physiological arousal to sexual stimuli. Directions for future research are discussed.

## ACKNOWLEDGMENTS

This thesis could not have been completed without the help of many other people, to whom I am thankful.

To Dr. Martin Lalumière, your guidance and support over the past year and a half have been immeasurable. Thank you for letting me choose a topic to study that certainly has more than its share of “red lights”; despite a pesky back catcher or two in the final inning, I’ve “crossed home plate”, and I’m looking forward to hitting more home runs. I feel truly honored to have been supervised by you and look forward to continue learning from you.

To Dr. Meredith Chivers, for sharing your expertise and time. The realm of female sexuality is clearly a complex domain and I thank you for giving me the opportunity to study it.

To Drs. Jean Choi, Rob Williams, and Paul Vasey for your helpful comments and assistance throughout the completion of this project.

To Dr. Lorin Elias, for opening my eyes to the joy of research. Your encouragement led me to pursue graduate training, and without that, I’m not sure where I’d be. I will always be thankful to you for that.

To everyone in the Lalumière lab who has assisted me throughout the project – Jen Arthur for data entry, Ashley Jespersen, and Annabree Simpson for general assistance, Krista Kuehn for data entry and finger measurement, and Sandeep Mishra for technical assistance, and all of the above for putting up with me during my crazy busy days.

To Tyler Buttle and Brad Hannah of Limestone Technology, whose almost daily assistance led directly to the completion of data collection and analysis. I'm sure you thought I'd never leave you alone.

To the participants – those men and women who volunteered their time to allow me to further the scientific study of sexual arousal.

To my friends, for your continued support and encouragement: Jacqueline Abrahamson, Lana Allen, Chelsea Banadyga, Jen Burkitt-Hiebert, Cheryl Cooper, Michelle Corcoran, Kim Côté, Shannon Digweed, Jen Faryon, Graham Herbert, Avril Keller, Joanna Kraft, David Logue, Christine Michell, Sandeep Mishra, Julie-Vanessa Muñoz, Dave Petrie, Aaron Puhl, Christine Reinhart, Doug VanderLaan, and Sarah Wheatley.

To my family, for your love and assistance. Throughout the course of this thesis and my life in general, you have always supported me. A special thanks goes out to my dad, for helping me set up the lab and the furniture.

To Chris Sargent – your patience and understanding has been greatly appreciated during this hectic time. Words cannot express how important your belief in me has been.

Lastly, I must thank the Social Sciences and Humanities Research Council of Canada (CGS Scholarship and Doctoral Scholarship) and the University of Lethbridge (Teaching Assistantships and Admission Scholarships) for their continued financial assistance.

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## **CHAPTER ONE**

### **Sexual Psychophysiology: A Brief Review**

#### **ABSTRACT**

The scientific study of sex has involved several forms of data collection methods, including surveys, case studies, and observations. Most recently, researchers have developed sexual psychophysiology, a distinct branch of sex research that employs a variety of tools to objectively assess sexual arousal and response patterns. Sexual psychophysiology involves directly measuring physiological, cognitive, behavioral, and affective processes and experiences (Rosen & Beck, 1988). The physiological aspects of sexual arousal in men and women are briefly discussed. Several genital and extra-genital measures of sexual arousal for men and women are described, including phallometry, vaginal photoplethysmography, clitoral ultrasonography, genital temperature, intra-anal blood pressure and volume, thermography, brain imaging, heart rate, blood pressure, skin conductance, pupil dilation, viewing time, and self-report. Only a few of these appear promising as measures of sexual arousal exclusively.

## **INTRODUCTION**

The scientific study of sex has grown significantly since its inception. Less than 150 years ago, such early researchers as Richard von Krafft-Ebbing, Havelock Ellis, and Sigmund Freud acknowledged the importance of sexuality and its impact on human behavior through case studies and clinical work. More recently, Alfred Kinsey, William Masters, and Virginia Johnson emphasized understanding sexual behavior and arousal through the use of both interviews and direct laboratory observation of sexual activities. Today, the study of sex has been enhanced by sexual psychophysiology, a distinct branch of sex research that employs a variety of tools to objectively assess sexual arousal and response patterns.

This chapter provides a review of the sexual psychophysiological tools that have been used in the past 50 years or so to enhance researchers' knowledge of sexual arousal in humans. First, the physiological aspects of sexual arousal are briefly discussed. Second, the methods that have been used to assess sexual arousal in men and women, including both genital and extra-genital measures, are discussed. Finally, recommendations are made regarding the most appropriate and promising measures for assessing sexual arousal.

## **ANATOMY OF SEXUAL AROUSAL**

Sexual psychophysiological methods involve assessing the physiological activation of the sexual response system, in concert with cognitive, behavioral, and affective (i.e., emotional) processes and experiences (Rosen & Beck, 1988). Many of the tools

developed to assess sexual arousal directly measure the physiological processes that occur at various stages during sexual arousal.

### **Male Sexual Arousal**

The external male sex organs consist of the penis and the scrotum, which contains the sperm-producing testes. Within the penis are three cylindrical spongelike bodies of erectile tissue (Geer & Janssen, 2000). One of these cylinders, the corpus spongiosum, surrounds the urethra (LeVay & Valente, 2006). The urethra serves an excretory function by carrying urine and ejaculate to the glans (i.e., the head of the penis). The remaining two cylinders of erectile tissue, the corpora cavernosa, fill with blood to create an erection. Blood is pumped into the penis under great pressure and a series of valves prevents the outflow of blood in order to maintain the erection. With the development of an erection the penis increases in circumference (i.e., width) and length, and experiences changes in surface temperature.

### **Female Sexual Arousal**

In comparison to males, females do not have obvious external cues of their sexual arousal. The external genitalia of the female, termed the vulva, include the mons, labia majora, labia minora, fourchette (i.e., the location at which the left and right labia minora meet), clitoral prepuce (i.e., clitoral hood), and clitoris. The internal sex organs consist of the vagina, cervix, uterus, ovaries, and fallopian tubes (LeVay & Valente, 2006). Vaginal vasocongestion, similar to penile vasocongestion, is the result of an increased inflow of blood that is not matched by a similar outflow. Vaginal lubrication occurs alongside

vasocongestion. The engorgement of the vagina increases pressure within the capillaries and causes an increased amount of fluid to pass through the pores of the vaginal epithelium (Geer & Janssen, 2000). The fluid flows onto the surface as sweat-like droplets that eventually combine to produce a lubricative film that covers the vaginal wall (Levin, 1992). In addition to lubrication, changes in surface temperature are also observed.

Physiological changes are also present in the clitoris during sexual arousal. The clitoris is considered to be the erectile organ of the female reproductive system. It consists of the clitoral shaft, the glans or head of the clitoris (i.e., the visible part of the clitoris), and erectile tissue (two cylinders of corpora cavernosa are located within the clitoral shaft and one corpus spongiosum is located within the glans). The glans is covered by the clitoral prepuce or clitoral hood. During sexual arousal, the corpora cavernosa become stiff, causing the clitoral shaft to become fairly rigid; the corpus spongiosum expands but remains soft to the touch (LeVay & Valente, 2006).

To summarize, sexual arousal in both men and women is related to genital vasocongestion, or the increase of blood in the genital tissues, as well as changes in temperature. The next sections provide a review of various methods of directly measuring sexual arousal in men and women.

## **MEASURES OF MALE GENITAL AROUSAL**

### **Penile Plethysmography or Phallometry (PPG)**

PPG refers to measuring changes in penile volume or size caused by changes in blood volume (Pearsall, 1999). As noted in the previous section, erection in men is due to increased blood flow to the penis and decreased outflow of blood. There are two different forms of PPG, volumetric and circumferential. Each are discussed and compared in detail below.

**Volumetric PPG.** Volumetric PPG was first introduced by Freund (1957, as cited by Freund, 1963) in order to determine the sexual orientation of men in the Czechoslovakian army. The device consists of several components. An experimenter first places a sponge-rubber ring on the penis, which is followed by a plastic ring with an inflatable cuff. A glass cylinder with a funnel at the top is then fitted over the other components. A tube attached to the top of the funnel is connected to a pressure transducer. The cuff is then inflated with air. Changes in the size of the penis result in air displacement which is detected by the pressure transducer.

Early work using volumetric PPG was conducted primarily by Freund (1963, 1965) and McConaghy (1967). For example, Freund (1963) used volumetric PPG to determine sexual interest in males by presenting pictures of males and females of different age groups. Participants were heterosexual and homosexual males with various age preferences. Among the 77 participants whose erectile responses were marked (i.e., those men who had experienced changes in penile volume of 40 ml or more), only one individual was misclassified in terms of sexual orientation. Participants who experienced lesser changes in penile volume were less likely to be classified correctly. Freund (1965)

presented pedophilic and non-pedophilic heterosexual men with images of males and females of varying degrees of maturity (i.e., young children, adolescents, and young adults) while changes in penile volume were assessed. The results indicated that 19 of the 20 pedophilic men and 17 of the 20 non-pedophilic men were correctly classified based on their genital responses.

Freund, Langevin, Cibiri, and Zajac (1973) conducted a more detailed comparison study of heterosexual and homosexual men. Participants were tested over two sessions: During the first session they were presented with six colour slides of nude males and females from four age categories (i.e., 5-8 year-old children, 9-11 year-old children, adolescents, and adults) and during the second session they were presented with short film clips of 14 to 28 seconds in length depicting the same age and gender categories as in the first session. Overall, both groups of men exhibited similar levels of genital response. Homosexual men exhibited their greatest response to stimuli depicting adult males, followed by adolescent males, older male children, and youngest male children. All responses to male stimuli were greater than responses to any female stimuli. Heterosexual men's responses to female stimuli followed the same pattern (i.e., greatest arousal was in response to adult female stimuli, with responses decreasing as age of females depicted decreased). All female stimuli elicited greater response than any male stimuli.

McConaghy (1967) developed a simpler transducer to measure penile volume change in response to visual presentations of nude males and females in heterosexual and homosexual men. Pictures of nude males and females engaging in non-sexual activities

(e.g., combing one's hair) were inserted into a travel video. Penile volume changes were measured continuously throughout the film. Among the 19 homosexual men with reliable data (the plethysmograph was not functioning appropriately for three of the testing sessions), 14 were classified correctly as homosexual, with 10 exhibiting significantly different responses than heterosexual men. Among the 11 heterosexual men, all showed a heterosexual pattern of arousal (i.e., their responses were highest to stimuli depicting women) and were therefore correctly classified as heterosexual. The responses for ten of the heterosexual men were significantly different from the responses of the homosexual men.

More recent studies have investigated the usefulness of the volumetric PPG in assessing sexual interests among sexual offenders (e.g., Freund & Watson, 1991; Seto, Lalumière, & Kuban, 1999; Seto, Lalumière, & Blanchard, 2000). For example, Seto et al. (2000) used volumetric PPG to assess whether or not volumetric PPG could detect pedophilic interests (i.e., a sexual preference for children over adults) among adolescent sex offenders. They compared the penile responses of adolescent sex offenders who had offended against children, young adult sex offenders who had offended against children, and non-sex offending young adult men. Adolescent sex offenders with only male victims responded relatively more to children than non-sex offenders, but showed a preference for adult females. Clear pedophilic interest could be detected among adolescent sex offenders with child victims of both sexes. Using a conservative cut-score (one that minimized false-positives), 50% of adolescent sex offenders with child victims of both sexes were classified as displaying pedophilic interests. Similar results have been

obtained among adult samples (e.g., Freund & Watson, 1991).

**Circumferential PPG.** Changes in penile circumference were first measured by Fisher, Gross, and Zuch (1965) in a study of the relationship between stages of sleep and penile erection. They fashioned a mercury strain gauge that consisted of an elastic silicon plastic tube approximately 1 mm in diameter filled with mercury and sealed with platinum electrodes at both ends to form a loop. The electrodes were attached to a bridge circuit connected to a polygraph. As the tubing stretched or shortened as a result of penile tumescence, the cross-sectional area of the column of mercury within the tubing changed. The resistance of the mercury in the tubing varied directly with the cross-sectional area, which reflects changes in penile circumference.

Various forms of the mercury-in-rubber (MR) strain gauge exist and are used for a variety of purposes. For example, indium/gallium (IG) has been substituted for mercury in some instances (e.g., Janssen, Vissenberg, Visser, & Everaerd, 1997). The uses of circumferential measures of PPG are quite similar to those of volumetric PPG. For example, Bancroft, Jones, and Pullan (1966) devised a MR device to treat a man with pedophilic tendencies using aversion therapy. If the man responded to stimuli depicting children, he was given electrical shocks to his arm. More recently, Lalumière, Quinsey, Harris, Rice, and Trautrimas (2003) investigated whether or not rapists are aroused by depictions of violent, non-consensual sex. Participants listened to various audio-taped stories while their penile responses were recorded using a MR strain gauge. Rapists showed higher responses to rape than consensual stimuli, while the reverse was true for

non-rapists.

Another tool has been developed to measure penile circumference changes. Barlow, Becker, Leitenberg, and Agras (1970) developed the electromechanical (EM) penile strain gauge. The EM gauge is made of two arcs of surgical spring material joined with two mechanical strain gauges. The strain gauges contract when the penis changes in circumference, resulting in changes in resistance. The changes in resistance are linked to a polygraph or computer using a bridge circuit. Laws and Bow (1976) redesigned the original EM strain gauge by doubling the thickness of the spring, using larger strain gauges, and using a different method of protecting the gauge assembly (i.e., part of the gauge was covered in silicone rubber sealant and then covered in Tygon, a protective coating that had prevented the original EM gauge from returning to its original shape after expansion). The modifications have made the redesigned model more durable than the original.

Abel, Barlow, Blanchard, and Mavissakalian (1975) used EM gauges to assess the influence of stimulus modality (e.g., film, audio-tapes, and photographs) and instructions. For example, participants were asked to either: imagine themselves in the situations being described and allow themselves to become aroused (i.e., imagined involvement) or imagine themselves in the situations but suppress their sexual arousal (i.e., imagined involvement with suppression). Participants were 20 homosexual men. Stimuli consisted of the following: two 2-minute black and white film clips depicting homosexual sexual activity, two erotic photographs previously selected by the participant depicting content

ranging from a single nude male to male homosexual sexual activity, and two 2-minute audio-tapes describing homosexual sexual activities. Participants were tested during three separate sessions, with stimulus modality varying across sessions. Overall, the films elicited the highest level of genital response; the photographs produced higher levels of response than the audio-tapes. Films were the least susceptible modality to be influenced by the instruction to suppress arousal.

Three comparisons have been conducted on the measurement characteristics of the classic MR/IG strain gauge and the EM strain gauge (Janssen et al., 1997; Laws, 1977; Richards, Bridger, Wood, Kalucy, & Marshall, 1985). Laws presented a 3-minute erotic film to one male participant whose penile responses were simultaneously measured with a redesigned EM strain gauge (Laws & Bow, 1976) and a MR strain gauge. There was no significant difference in the percentage of erection measured by each device. Laws concluded that the MR strain gauge is more appropriate because it is affordable, available in many sizes, easier to handle, and is rarely noticed by participants. In comparison, the EM gauge has been known to pinch participants and to slip during the initial detumescence that occurs during the onset of stimulus presentation in many participants (McConaghy, 1974).

Richards et al. (1985) compared an IG strain gauge with an EM strain gauge by placing each on a calibration device and measuring the output simultaneously. The gauges were then simultaneously heated gradually and then cooled. The procedure was repeated five times with the diameter of the gauges ranging from 30 mm to 38 mm. Both strain gauges

produced linear outputs, but the EM gauge was slightly less stable over time, likely due to mechanical stiffness near the springs. Both gauges were sensitive to temperature changes, but the IG gauge was more affected. Richards et al. suggested that the EM strain gauge was slightly superior to the IG gauge, because the EM strain gauge is usable over a wider range of circumferences and is easier to calibrate than the IG strain gauge.

Janssen et al. (1997) presented participants with a 15-minute heterosexual erotic film while their penile responses were being assessed simultaneously by an IG strain gauge and an EM strain gauge. Two different calibration methods were also tested. Calibration of strain gauges typically involves using a graduated circular cone, such that various levels of the cone produce different levels of stretch in the gauge. The oval calibration device consists of two identical halves of a plastic cone that are mounted on a micrometer gauge. When the micrometer gauge is in the zero position, the two halves of the cone connect, forming a circle; increasing the distance between the two halves results in changing the circular shape into an oval.

Janssen et al. (1997) found that both the EM and IG gauges were prone to being affected by the shape of the calibration cone, with the oval-shaped cone producing fewer problems. The EM gauge produced higher responses when calibrated with the circular cone than with the oval-shaped device, suggesting that the cross-sectional area of the penis is more similar in shape to an oval than a circle. The EM gauge also appeared to be more sensitive during initial stages of erection. The authors recommended both gauges for experiments using high intensity stimuli, because both devices show equal sensitivity

at higher levels of arousal.

**Volumetric Versus Circumferential PPG.** Few comparison studies have been conducted in order to determine which measure of PPG is more accurate. To date, only four studies have been conducted, three of which have methodological problems. The first study was conducted by Freund, Langevin, and Barlow (1974). Participants' penile responses to colour slides of neutral images (e.g., landscapes) and males and females of different ages were assessed simultaneously by volumetric PPG (Freund, 1965) and an EM strain gauge (Barlow et al., 1970). Volume and circumference changes were largest for adult females, then to younger females. In terms of standardized scores, volume changes varied as a function of the age of female stimuli (i.e., with higher responses to older female stimuli), but circumference changes did not. On the basis of these results, Freund et al. concluded that volumetric PPG is the superior measure. Unfortunately, the vast majority of the participants' data (34 out of 48 participants, or 71%) was excluded from analysis because it had not been possible to apply the volumetric and circumferential measurement devices together. Thus, the authors' conclusion must be considered premature.

McConaghy (1974) compared his version of the volumetric penile plethysmograph to a MR strain gauge by presenting a film interrupted by 10-second slides of male and female nudes. McConaghy noted that in many instances the responses from the two devices paralleled each other, but that sometimes they were in complete opposition to each other (i.e., one would show an increase in response while the other would show a decrease in

response). The latency of the response was longer for the MR strain gauge and responses recorded by the volumetric device were not always apparent in the MR strain gauge recordings. McConaghy suggested that this was likely a result of individual differences between participants with respect to changes in blood flow and penis length. There are many limitations to McConaghy's study, however, because he failed to include any form of statistical analyses in his comparison, and his sample was quite small ( $N = 3$ ).

The third comparison study was conducted by Wheeler and Rubin (1987). Six male participants were tested simultaneously with a volumetric device and a MR strain gauge. Participants attached the MR strain gauge first, watched part of an erotic film, and then placed the volumetric device on their penises during a state of partial arousal. The experimental film, a 10-minute erotic film depicting heterosexual and lesbian activities, was then presented three times. Correlations between the measures were fairly consistent and high, but not perfect. In most participants the volumetric device did not indicate change in penile size before the MR strain gauge did and it did not record all of the subtle changes recorded by the MR strain gauge. The major limitations with Wheeler and Rubin's study are the procedure that was employed and the small sample size. As noted by McConaghy (1989), volumetric changes in the penis often occur within seconds of stimulus onset, and the stimuli presented are typically short in duration (e.g., slides). Wheeler and Rubin, however, presented films that were quite lengthy (i.e., 10 minutes). As noted above, participants placed the volumetric device on their penises when they were already somewhat aroused; because volumetric PPG is extremely sensitive to *initial* changes in the penis, it is likely that the procedure employed by Wheeler and Rubin

reduced the likelihood that volumetric PPG would detect changes in the penis because the initial changes in penile response had already occurred.

The most recent and most methodologically sophisticated comparison study was conducted by Kuban, Barbaree, and Blanchard (1999). Forty-two heterosexual men were assessed with both devices simultaneously. Participants were presented with four slides from each of seven categories of stimuli, including nude male and female adults (approximately 20 to 25 years of age), early pubescents (approximately 12 years of age), and children (approximately six to ten years of age), as well as neutral stimuli depicting landscapes. Narratives describing sexual interactions between the participant and a person of the same gender and age as the individual in the slides accompanied each slide. The test was chosen based on recommendations from past research that had produced the most accurate responses for assessing age and gender preferences while minimizing the likelihood that participants would respond to characteristics of individual trials (e.g., attractiveness of individual depicted; Lalumière & Harris, 1998). Based on level of response using both devices, participants were divided into the following groups: high responders (i.e., participants with high responses using both devices), low responders (i.e., participants with low responses using both devices), and mismatched responders (i.e., participants who responded high or low using one device, and the opposite with the other device). Correlations between the devices were extremely high for those participants who achieved high levels of response ( $r = .98$ ), but were strikingly lower for those participants who did not achieve high levels of response ( $r = -.15$ ). The results from Kuban et al.'s study indicate that when participants achieve approximately 10% of a full

erection, volumetric PPG and circumferential PPG are equally accurate. When penile responses are quite low, however, volumetric PPG is the more appropriate measure, because low responders exhibited higher levels of response to stimuli depicting adult females in comparison to all other stimuli using volumetric PPG; low responders did not differentiate between adult or adolescent females and any other category of stimuli using circumferential PPG.

### **Temperature Measurements**

Changes in skin temperature as measurements of male sexual arousal were first discussed by Fisher et al. (1965). As noted above, the researchers were interested in examining the relationship between sleep cycles and erection. Continuous recordings of penile skin temperature were obtained by attaching a small thermistor to the penis. Penis and groin temperature decreased at the onset of sleep, but penile temperature increased by as much as 3°F during erections.

Webster and Hammer (1983) examined the usefulness of temperature changes in assessing sexual arousal. They compared a thermistor with an EM strain gauge in eight heterosexual men by presenting them with three 3-minute erotic films. The two measures were highly positively correlated with each other and self-report. The EM strain gauge, however, detected decreases in arousal more quickly and was more strongly correlated to self-report. Another problem with the thermistor is the fact that it exhibited longer response latency in comparison to PPG. The strain gauge reached its highest response point before the film ended but the thermistor always peaked after stimulus offset.

Rosen and Keefe (1978) suggested that the decision regarding which type of measure to use must depend on the measurement characteristics of the device and the goals of the particular study in which the device will be used. Based on the evidence available thus far, it appears that circumferential measures may be most appropriate for measuring sexual arousal in community samples, as the device is easy to use, inexpensive, fairly sensitive, and not noticeable by the participants (when using a MR strain gauge). When the research question entails clinical assessment or the need for information about minute changes in penile response, volumetric measures may be more appropriate. Due to the slow transition exhibited, for both increases and decreases in sexual arousal (Webster & Hammer, 1983), the thermistor is a sub-optimal method to use when measuring sexual arousal across a variety of stimuli of short durations.

## **MEASURES OF FEMALE GENITAL AROUSAL**

### **Vaginal Photoplethysmography (VPP)**

The most commonly used measure of female sexual arousal is VPP. The device was originally developed by Sintchak and Geer (1975). It consists of a clear tampon-shaped acrylic-plastic cylinder that contains both a light source (originally an incandescent light, but now an infrared light-emitting diode or LED; Hoon, Wincze, & Hoon, 1976) and a polygraph device (now a computer) that records the responses. The light source is used to illuminate the capillary bed of the vaginal wall and the blood circulating within it. The amount of backscattered light serves as an indirect measurement of vasocongestion, as the amount of reflected light varies in relation to the transparency of the vaginal tissue.

The probe is approximately 5 cm in length and 1.2 cm in diameter. A cord is attached to the blunt end of the probe and connects to the data acquisition system. A placement device made of flexible acrylic plastic can be placed on the cable in order to standardize the depth and orientation of the probe (Laan, Everaerd, & Evers, 1995).

Two signals are produced by VPP. The first signal is vaginal blood volume (VBV), which is produced when the signal from the vaginal photoplethysmograph is coupled with a Direct Current (DC) amplifier. VBV is believed to provide an index of the total amount of blood in the vaginal walls (Hatch, 1979). The second signal is vaginal pulse amplitude (VPA). VPA is produced when the signal from the vaginal photoplethysmograph is coupled with an Alternating Current (AC) amplifier. VPA reflects changes in vasocongestion with each heart beat. Higher amplitudes indicate higher levels of arousal (Geer, Morokoff, & Greenwood, 1974).

Surprisingly little research has been conducted on the validity of VPP. Hoon et al. (1976) conducted an experiment to determine which of several physiological measures could differentiate between sexual, neutral, and aversive stimuli. Female participants were shown a sexual film depicting foreplay, a control film depicting an oceanographic lecture, and an aversive film depicting Nazi war crimes. Compared to the other measures tested, which included heart rate, heart rate variability, skin conductance, forehead temperature, and blood pressure (both systolic and diastolic), VBV was the most sensitive measure in that it increased to the sexual film only, and decreased in response to the other films. VPA, however, was not assessed.

Heiman (1977) presented male and female participants with various erotic and non-erotic audio-tapes and asked the participants to rate how aroused they felt while listening to the tapes. Erotic tapes described heterosexual or solitary sexual acts (e.g., masturbation) and the enjoyment of the other person as a partner (when appropriate) with a focus on the sexual acts (erotic condition) or a combined focus on erotic and romantic elements (i.e., description of emotional relationship; erotic-romantic condition). Non-erotic tapes described romantic elements without sexual activities (romantic condition) or neither romantic nor erotic elements (control condition). Both VPA and VBV could differentiate between the erotic and non-erotic audio-tapes, with higher responses being exhibited in the erotic conditions than non-erotic conditions. VPA, however, correlated with self-report more highly than VBV did.

More recently, Laan et al. (1995) tested the sensitivity of VPA and VBV concurrently. Participants were presented with four different films, consisting of the following: a sexual film, a sexually threatening film, an anxiety-inducing film, and a neutral film. The correlation between VPA and VBV was fairly high, indicating that the two components measure a similar aspect of sexual arousal, but the degree of correlation was dependent on the film type. VPA responses were identical to self-reported measures of sexual arousal, in that VPA was highest during the sexual film, lower but still present during the sexually threatening film, and non-existent during the neutral and anxiety-inducing films. VBV, however, did not reflect the participants' self-reports. Although the work by Laan et al. supports past research by indicating that VPA is the superior method in assessing

female sexual arousal, a limitation to their methodology is the fact that non-sexual emotional stimuli of a positive valence were not presented to participants. More recent uses of VPP will be discussed in Chapter 2.

### **Clitoral Ultrasonography**

Recently, clitoral ultrasonography has been examined as an alternative to VPP. Clitoral ultrasonography involves assessing clitoral blood flow with Doppler ultrasonography, in which sound waves are converted into an image. The Doppler principle is that sound pitch increases as the source (e.g., blood) moves toward the listener and decreases as it moves away. A transducer sends a series of short sound pulses into the clitoris and pauses between each pulse to detect the returning sounds (Stonely, 2002). The direction and depth of each sound that is returned is determined, which is then converted into a point of light on a television monitor. Thousands of these pulses are computed and displayed every second to produce an image of the clitoris, allowing experimenters to see blood flowing to the clitoris.

Three standard Doppler blood flow measures are typically assessed (Connolly, Borirakchanyavat, & Lue, 1996). Arterial dilation reflects the increase in diameter of cavernous arteries during increased blood flow. Total blood flow is dependent on arterial diameter and blood flow velocity; peak blood flow velocity reflects the highest speed at which blood is flowing. The third measure is blood flow acceleration, which assesses the speed at which blood flow increases.

Khalifé, Binik, Cohen, and Amsel (2000) tested the reliability of the device by measuring

clitoral blood flow in 23 women. Two experimenters scanned each participant's clitoris using an ATL 5000 ultrasound machine and a 10 MHz linear probe (i.e., transducer). To assess clitoral blood flow, the linear probe was held against each participant's clitoral artery by an experimenter.<sup>1</sup> The correlations between experimenters' ratings were high for the three standard Doppler blood flow measures, including maximum velocity.

A more recent study conducted by Kukkonen, Paterson, Binik, Amsel, Bouvier, and Khalifé (2006) tested the convergent and discriminant validity of clitoral ultrasonography by presenting 63 pre-menopausal women with a neutral baseline film (a travel video on the Amazon) and either a sexually arousing film (a film clip used to induce sexual arousal in women at the Kinsey Institute; Janssen, Carpenter, & Graham, 2003), a humorous film (excerpts from *The Best Bits of Mr. Bean*), or a neutral video (a travel video of Madagascar). Significant differences were found in response to the neutral and the sexually arousing film, in that blood flowed faster to the clitoris during the sexually arousing film. There were no significant differences in blood flow to the sexually arousing and the humorous films. Likewise, there were no significant correlations between clitoral blood flow and subjective sexual arousal. The inability to differentiate between the humorous and sexual films may be a result of increased blood flow to the clitoris that was caused by the process of pressing the linear probe against the clitoris in order to find the clitoral artery, coupled by the presence of a film meant to induce a positive mood (T. M. Kukkonen, personal communication September 4, 2006). Based on the evidence cited above, it seems that clitoral ultrasonography is not a good measure of

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<sup>1</sup> The angle at which the linear probe is held can influence the results obtained. At this time, there is no standardized method for attaching the linear probe to the genitalia, eliminating individual differences in the positioning of the probe by different experimenters (T. M. Kukkonen, personal communication, November 2, 2006).

female sexual arousal.

### **Temperature Measurements**

As noted above, temperature changes occur in the female genitalia as a result of increased vasocongestion. Several researchers have attempted to measure female sexual arousal in terms of temperature changes, by measuring changes in both vaginal temperature and labial temperature.

**Vaginal Temperature Measurements.** Fugl-Meyer, Sjögren, and Johansson (1984) developed a radiotelemetric method for measuring vaginal temperature during the night. Radiotelemetry involves gathering and transmitting data over great distances. The radiotelemetric system consisted of a battery-powered transducer built onto a device similar to a vaginal diaphragm ring, a receiver with a time-measuring circuit and D/A converter, and a recorder. The diaphragm ring forms the emitting antenna loop, while the circular or receiving antenna is placed under the bed and connected to the receiver by a cable. Two heterosexual women participated in their own homes. Participants inserted the device before going to sleep. Upon getting into bed, the participants were asked to relax while reading sexually neutral literature or listening to the radio. Participants were then asked to read sexually arousing literature, to fantasize, or to masturbate. Participants could also engage in sexual intercourse with their partner if they desired to do so. A rapid decrease in vaginal temperature was observed in both participants almost immediately after going to bed. Any stimulus meant to elicit sexual arousal produced the opposite effect in that vaginal wall temperature continued to decrease; in fact, the lowest temperature was recorded during orgasm. Although the device has advantages in that

movement artifacts (i.e., disturbances in the output) are not an issue (because vaginal temperature does not appear to be influenced by sudden movements or genital contractions; e.g., Gillian & Brindley, 1979) and it can be used in natural settings, it does not appear that any other corroborating research using the device has been conducted.

**Labial Temperature Measurements.** A more common device used to measure temperature changes is the labial thermistor (Henson, Rubin, Henson, & Williams, 1977). Henson et al. developed the labial thermistor using three surface temperature thermistors. One of the thermistors monitors ambient room temperature, while the other two are used to monitor changes in surface skin temperature. One of the thermistors measuring skin temperature is attached to the labia minora using a brass clip and the other is attached to an extra-genital site (e.g., the chest) to provide a reference temperature. Participants were presented with two 10-minute films, an erotic heterosexual film and a nature film. They were asked to rate their sexual arousal once before the film and several times after the film.

The results indicated that changes in reference temperature were not significantly different between the two films. Labial temperature, the more interesting measure, increased for nine of the ten participants during the erotic film, with seven of the changes being quite large (i.e., 0.50°C higher than baseline temperature). Increases in labial temperature were somewhat slow to develop after the erotic film began, as noticeable changes did not occur until approximately two minutes after the onset of the film. Maximum temperature change was achieved before the end of the film in eight of the ten

participants. The peak change between the erotic and neutral films was significantly different, with the highest change in temperature occurring in the erotic film. Subjective self-report ratings were also significantly correlated with changes in labial temperature during the erotic film, but not with the reference temperature. Following the presentation of the film, labial temperature and self-reported arousal were not as highly correlated, because subjective levels of arousal returned to baseline significantly faster than labial temperature did.

**Comparison Between Vaginal Blood Flow and Temperature Measures of Sexual Arousal.** Two studies conducted by Henson and colleagues (Henson, Rubin, & Henson, 1979a, b) compared female sexual arousal to erotic films using both VPP and a labial thermistor. In both studies, the participants watched an 11-minute erotic film. Participants were asked to report their subjective level of arousal once before the film presentation and several times after the film had ended. In the first study, both genital measures showed changes for most participants, and were highly correlated with each other. Following the film, however, there were smaller correlations between labial temperature changes, VBV, and VPA, and the measures rarely returned to baseline levels of arousal. Subjective arousal was correlated best with VPA and labial temperature during the film ( $r = 0.756$  and  $r = 0.815$ , respectively), but not after the film, likely because subjective arousal decreased faster than genital arousal did.

In the second study, Henson et al. (1979b) attempted to determine the consistency of genital measures of arousal across testing sessions. Participants were tested in two similar

sessions that were separated by at least seven days. Due to technical difficulties, the data for VBV from both sessions were available for only four of the eight participants. There was no significant correlation for mean responses across sessions for VBV or VPA, but there was a significant correlation for labial temperature changes ( $r = 0.91$ ). Subjective arousal was significantly correlated with both VPA and labial temperature, but not with VBV.

Based on the analysis provided by Henson and colleagues (1979a, b), one might assume that measuring labial temperature is the best method of measuring sexual arousal in women. It is important to remember that each method has limitations. VPP, for example, is subject to movement artifacts that can distort the results. VPP also measures output in terms of relative change, in that a difference from baseline is simply a change from baseline in arbitrary units. The thermistor measures output in terms of absolute change; changes in arousal detected by the thermistor are changes in temperature in degrees (i.e., known units). As such, the values obtained from VPP are dependent on the electronic circuitry and the level of amplification used. The labial thermistor has its limitations, as well. When compared to VPA, labial temperature takes quite a bit more time to return to baseline levels. This could prove to be a problem when attempting to expose participants to repeated trials, which is an important aspect of conducting sexual psychophysiological studies. Likewise, the accuracy of the measurements obtained from the labial thermistor is dependent on the positioning of the participant being tested, such that any ambient heat resulting from closed legs or a blanket must be avoided (Payne & Binik, 2006). Little, if any, research has been conducted on whether the placement of the thermistor itself can

influence the results obtained. Placement differences across participants using VPP are minimized through the use of a placement device used to standardize the orientation of the probe and the depth to which it is inserted. Thus, as with male measures of sexual arousal, it is important for researchers to choose the measure of sexual arousal most suitable for the experiment at hand.

### **CROSS-SEX MEASUREMENT DEVICES**

Several devices have been developed with the intention of allowing direct comparison of the sexual arousal of males and females. As noted by Geer and Janssen (2000), however, simply developing a device that assesses the same location in both men and women does not solve the problem. Men and women's genital arousal, although based on the same principle of vasocongestion, appears to follow a different time course. For example, Geer and Quartararo (1976) found that vaginal blood flow continues well after masturbatory-induced orgasms. Seven female participants masturbated in the lab while their genital responses were recorded by a vaginal photoplethysmograph. Both VBV and VPA showed increased levels of response during the masturbation and post-orgasm periods. Responses in the orgasm stage could not be assessed due to the high frequency of movement artifacts. Both VBV and VPA showed response levels significantly higher than baseline throughout the post-orgasmic period, indicating that vaginal blood flow is still quite high following an orgasm. In men, however, detumescence begins fairly quickly after orgasm. As such, measuring genital vasocongestion in both sexes with the same device may not produce comparable results.

### **Intra-Anal Pressure and Blood Volume**

Bohlen and Held (1979) developed an anal probe to measure changes in blood volume and muscle tension in both men and women. The anal probe consists of an LED-transistor photoplethysmograph and a pressure transducer encased within a small structure of silicone rubber tubing, with electrical signals from the probe being sent directly to a recording device. The researchers claim that movement artifacts are diminished and that the probe allows cross-sex comparisons of the same site, but reported no details on comparisons between men and women. Carmichael, Warburton, Dixen, and Davidson (1994) used the anal probe, as well as systolic blood pressure, blood hormone levels, and anal electromyography to assess arousal in men and women. Participants' responses were recorded for six minutes prior to self-stimulation through to five minutes after orgasm. The researchers found that men and women did not differ in anal muscle tone during baseline levels of arousal, but women had higher levels of blood flow. Both men and women experienced increased blood flow during orgasm compared to the baseline assessment. Men, however, had significantly higher levels of anal blood flow and muscle activity during arousal and orgasm, indicating that there are potential sex differences in anal blood flow during sexual arousal. Despite the fact that anal photoplethysmography appears to have the potential to assess sexual arousal in both sexes, research using the device is scarce, which limits the conclusions one can make about the validity of the device.

### **Thermography**

As discussed above, many researchers have used temperature to assess sexual arousal in

men and women. Because thermistor measurements are taken from different genital regions in men and women, comparisons of sexual arousal between the sexes have not been conducted using these measurements. Thermography, however, has been used in cross-sex comparisons by Seeley, Abramson, Perry, Rothblatt, and Masters-Seeley (1980). Thermography involves measuring heat in various body regions and transforming the measures into signals that can be recorded. By analyzing the pictures of heat patterns in a given region, one can assess minute elevations in temperature caused by cellular and metabolic changes (Geer & Janssen, 2000). Seeley et al. used thermography to assess sexual arousal in men and women while they masturbated. One male and one female had their genitals scanned by a thermal imaging system that contained an infrared scanner, electronic equipment, and high-resolution display of the images. Seeley et al. found that the changes in temperature detected by thermography did reflect sexual arousal. In the female, labial and vaginal temperature was the coolest during the initial phase of testing. In the male, the scrotum remained the coolest genital area throughout the experimental session, despite the occurrence of increasing penile temperature. The head of the penis was cooler than the shaft of the penis, likely due to the fact that there are more veins in the shaft than the head (Seeley et al.).

Only one other study has examined the usefulness of thermography. Kukkonen, Binik, Amsel, and Carrier (in press) presented men and women with a neutral film of a Canadian countryside, and then a film with either the same content, erotic content, humorous content, or scary content. The only film that produced an increase in temperature in the genital region was the erotic film. The time required to reach

maximum arousal, approximately 10 minutes, was not significantly different between the sexes. The extended amount of time required to produce maximum temperature changes mirrors a problem associated with the use of thermistor measurements of arousal in both sexes, in that increases in temperature are often slow in development and even slower in returning to baseline (e.g., Henson et al., 1979a, b).

### **Brain Imaging**

The brain is often touted as the most important sex organ in humans (e.g., Dennis, 2004). Recent advances in technology have allowed researchers to examine similarities and differences in men and women's brain activity in response to sexual stimuli.

Some research has suggested a sex difference with respect to processing affective stimuli. Sabatinelli, Flaisch, Bradley, Fitzsimmons, and Lang (2004) assessed possible gender differences in visual cortex activity (i.e., the part of the brain that is responsible for processing visual stimuli) by using functional magnetic resonance imaging (fMRI) in 14 men and 14 women while they viewed 56 pictures from the following categories: erotic couples, families, household objects, neutral faces, angry faces, physical threat, and human injury or mutilation. Men and women both showed greater visual cortical activity in response to both pleasant and unpleasant images compared to neutral images; men, however, showed greater extrastriate activity in response to erotic images in comparison to women. Activity in the extrastriate cortex is typically influenced by attention and reward expectation, indicating that perhaps men were more attentive to erotic stimuli than women.

Likewise, Hamann, Herman, Nolan, and Wallen (2004) used fMRI to assess possible sex differences in limbic system activation in response to sexual and non-sexual stimuli. The limbic system contains brain structures associated with emotion, motivation, and emotional association with memory. Fourteen men and 14 women viewed photographs from four stimulus categories (erotic couple stimuli, attractive opposite-sex nude stimuli, neutral stimuli depicting non-sexual male-female interactions, and a visual fixation cross) for 3,750 ms each. Participants were also asked to rate the attractiveness of each stimulus and how physically arousing it was. Results indicate that both sexes reported the erotic couple stimuli were most attractive and more arousing than the opposite sex stimuli. Men had greater neural responses in the amygdala and hypothalamus than women when presented with the couple stimuli. No other sex differences in neural response were found.

Redouté et al. (2000) used Positron Emission Tomography (PET) to assess regional cerebral blood flow in response to neutral, humorous, and sexually explicit films and a series of photographs of varying levels of intensity depicting women (i.e., non-sexually arousing, moderately arousing, and highly arousing) in nine men. Results indicated that there was greater cerebral blood flow to the right orbitofrontal cortex in response to stimuli depicting women than all other types of stimuli. Other areas that showed increased blood flow were the claustrum, paralimbic areas, striatum, and hypothalamus.

A more recent study by Anokhin, Golosheykin, Sirevaag, Kristjansson, Rohrbaugh, and

Heath (2006) suggests that sex differences in brain activity in response to sexual stimuli may vary as a function of the type of brain imaging used. Anokhin et al. presented 264 women with various emotional images, as well as erotic images while measuring event-related potentials (i.e., brain responses that directly result from thoughts or perceptions). Overall, similar to findings in men reported above (e.g., Hamann et al., 2004; Redouté et al., 2000), women responded more to emotionally arousing images than neutral images. Interestingly, women responded to erotic stimuli faster than non-erotic stimuli, regardless of emotional content.

The research described above suggests that brain imaging research may elucidate interesting and important results relevant to sexual arousal and interest, although it is somewhat troublesome that each study identifies unique brain regions. This may be due to the nature of various techniques used and each technique's ability to detect brain regions with varying degrees of specificity. As such, one must take into consideration the type of imaging technique that is being used. Also, the equipment involved in brain imaging is typically extremely expensive.

### **Imaging of Genitals**

Although it is typically used to assess brain structures, researchers have recently used fMRI techniques to better understand the anatomy of male and female genitalia during intercourse. Weijmar Schultz, van Andel, Sabelis, and Mooyaart (1999) asked heterosexual couples and single women to participate in an fMRI study. A woman was asked to lie on her back while the first image was taken, and then remain in the same

position while engaging in face-to-face intercourse with her partner (if she was in a relationship) for the second image. The third image was taken once the man had left the fMRI tube while the woman was stimulating her clitoris manually; a fourth image was taken 20 minutes after the woman achieved an orgasm during masturbation. The images revealed that changes occur in the vaginal wall as a result of the uterus being raised due to penile penetration and gradual filling of the bladder. The penis takes on the shape of a boomerang, in that the shaft of the penis moved upwards at an angle of approximately 120° to the base of the penis. Although using fMRI to obtain images of the genitals during sexual intercourse can provide a wealth of information regarding genital structure, it is extremely difficult to accomplish this task successfully, due to the small size of the fMRI tube and difficulties in maintaining arousal in such conditions.

### **OTHER MEASURES OF SEXUAL AROUSAL**

Although directly measuring genital responses provides a wealth of data regarding sexual arousal, the generalizability of the data has been questioned in the past. Volunteer biases have been well-documented in sexual psychophysiological research (e.g., Bogaert, 1996; Strassberg & Lowe, 1995; Wolchik, Braver, & Jensen, 1985). Wolchik et al. assessed volunteer bias by presenting students who had volunteered for an experiment on sexuality and personality with a written description of four different experiments varying in level of intrusiveness (e.g., watching an erotic film versus watching an erotic film while having genital responses assessed) and asking them which (if any) they would like to volunteer for. Males volunteered more often than females overall, and there was a significant difference between participants who volunteered for experiments that required

participants to undress and the participants that did not volunteer. Both males and females who volunteered for the more intrusive experiments were more sexually experienced, less worried about their sexual performance, and reported more exposure to erotic materials than non-volunteers.

Chivers, Rieger, Latty, and Bailey (2004) noted, however, that even though volunteers differ from non-volunteers with respect to personality traits and sexual experience, volunteers may still be representative of the general population with respect to their patterns of sexual arousal. To assess whether or not differences between volunteers and non-volunteers influence patterns of sexual arousal, Chivers et al. investigated the differences between female volunteers and non-volunteers and then correlated these variables with the sexual arousal patterns of the volunteers of a study of genital arousal. Few significant correlations were found between variables related to willingness to participate and genital responses, suggesting that volunteer biases may not influence the observed sexual arousal patterns.

Although it is unlikely that individual differences in willingness to participate influence patterns of genital responses, many researchers have attempted to assess sexual arousal using less invasive techniques based on physiological changes associated with general arousal. These changes include changes in heart rate, blood pressure, skin conductance (i.e., changes in the electrical properties of the skin due to emotional arousal), and pupil dilation. A relatively new technique of assessing sexual interest, viewing time, has also been used. Researchers frequently ask participants to report their levels of arousal during

experiments, as well. Although these techniques are less invasive, the vast majority of them are not specific enough and do not measure sexual arousal but, if anything, general arousal.

### **Heart Rate**

Several researchers have included measures of heart rate in their study of the physiological correlates of sexual arousal. Wenger, Averill, and Smith (1968) measured several physiological responses in men while they read sexually stimulating and neutral material. Wenger et al. found that there were no significant differences in heart rate during the sexual and neutral conditions. Likewise, Bancroft and Mathews (1971) measured changes in penile tumescence, heart rate, skin conductance, and forearm blood flow in male participants viewing slides of women and neutral images and fantasizing about sexual interactions. They found that only changes in penile erection were elicited by the different stimuli.

Studies of females have not produced more promising results. Hoon et al. (1976) measured heart rate, blood pressure, skin conductance, and vaginal blood volume while presenting a variety of films to female participants and found that the most accurate measures were vaginal blood volume and skin conductance. Heart rate did not show significant increases during the sexual stimulus. A more recent study conducted by Polan et al. (2003) assessed vaginal blood flow, heart rate, blood pressure, and skin conductance while female participants viewed a film with a variety of erotic (couples engaging in a variety of sexual activities and intercourse) and non-erotic segments

(excerpts from relaxation films that featured nature scenes depicting flowers, mountains, and oceans accompanied by gentle instrumental music). Again, vaginal blood flow was significantly higher during the erotic stimuli but heart rate was not. As such, heart rate does not appear to be a promising alternative measure of sexual arousal.

### **Blood Pressure**

Blood pressure has been measured to assess changes in sexual arousal in both sexes. For example, Wenger et al. (1968) found that blood pressure increased during presentation of sexual stories and decreased during presentation of neutral stories. Hoon et al. (1976) also found that blood pressure increased in females watching a sexual film but decreased during an aversive film and a neutral film. Sarlo, Palomba, Buodo, Minghetti, and Stegagno (2005) found that men and women's blood pressure increased significantly more to erotic stimuli than all other stimuli (e.g., threat, neutral), but that men exhibited greater increases in blood pressure to the erotic stimuli than women. These results suggest the blood pressure may be a good measure of sexual arousal in both sexes, although absolute level of change may differ across sexes.

### **Skin Conductance**

Skin conductance refers to changes in the electrical properties of the skin due to emotional arousal. It is typically measured by electrodes attached to an individual's fingers that record changes in electrodermal conductance. Similar to many other extra-genital measures, the results regarding skin conductance are inconsistent. Bancroft and Mathews (1971) found that skin conductance did not change when participants were

viewing slides of women or neutral images. Davis and Buchwald (1957) presented male and female participants with a variety of slides. Skin conductance significantly differed in response to erotic and non-erotic slides for males, but not for females. Likewise, Polan et al. (2003) reported that skin conductance did not significantly differ between erotic and non-erotic film segments in their female participants. Sarlo et al. (2005) reported that there was no difference in skin conductance levels between men and women when they viewed a variety of different slides meant to elicit emotional responses.

### **Pupil Dilation**

Pupil dilation can result from either a decrease in illumination or exposure to emotional stimuli (Zuckerman, 1971). Hess and Polt (1960) were among the first researchers to attempt to assess sexual arousal with pupillary responses. They presented male and female participants with pictures of a baby, a mother and baby, a nude male, a nude female, and a landscape. Females' pupil responses indicated greater arousal or interest in the pictures of the baby, the baby and its mother, and the nude male. The males responded with more interest in the nude female picture. A more recent study by Aboyoun and Dabbs (1998) found somewhat similar results. Males and females were presented images of clothed and nude males and females. Both sexes responded more to nude images than clothed images, regardless of sex of the target image or participant. Based on these results, it appears that although pupil dilation occurs in response to sexual stimuli, the measure is not specific enough to measure sexual arousal or actual interest.

### **Viewing Time**

Viewing time refers to the duration of time spent looking at an image or object. Quinsey, Rice, Harris, and Reid (1993) asked male and female participants to rate images of nude males and females of different age groups (i.e., infants, children, adolescents, and adults) while covertly measuring viewing time. Differences in viewing time of preferred versus non-preferred gender stimuli were not significant for male or female participants. Viewing time also did not correlate highly with subjective reports of sexual attractiveness of the stimuli.

More recent studies suggest a more optimistic conclusion. Harris, Rice, Quinsey, and Chaplin (1996) presented a group of child molesters and a group of heterosexual volunteers with slides of males and females of different ages (i.e., children, adolescents, and adults) while viewing time and phallometric responses were assessed. Viewing times correlated strongly with self-reported ratings of sexual attractiveness of the slides for both the control group ( $r = 0.91$ ) and child molester group ( $r = 0.46$ ), although the correlation was significantly higher for the control group. When comparing child molesters who had only assaulted female victims with the control group, viewing time patterns showed significant differences, as well. Quinsey, Ketsetzis, Earls, and Karamanoukian (1996) also found that viewing time correlated quite highly with ratings of sexual attractiveness for both non-sex offending men and women.

Letourneau (2002) found that male sex offenders who committed crimes against boys looked longer at images of young males and male sex offenders who committed crimes against adolescent girls looked longer at images of adolescent girls. Letourneau, however,

did not find that viewing time could accurately identify sex offenders against young girls or adult women, possibly because the group of men who had assaulted female children was composed mainly of incest offenders. Past research has suggested that incest offenders' arousal patterns are difficult to distinguish from both non-offenders (for a review see O'Donohue & Letourneau, 1992) and other offenders' patterns of arousal (e.g., Seto et al., 1999). The group of participants who had offended against adult women was quite small ( $n = 8$ ), and the viewing time task used had not been designed to identify rapists but sadomasochistic men that use excessive force during sexual assaults.

The results of the studies described above suggest that viewing time may be a promising tool for assessing sexual arousal when the correct stimuli are used and participants are clearly identified (e.g., comparing a group of child molesters who offend against victims of one sex with other offender groups may produce more accurate results than comparing child molesters with victims of both sexes with other offenders).

### **Self Report Measures**

One might assume that the easiest way to assess whether or not an individual is sexually aroused is to simply ask him or her. Although this approach has been employed by many researchers in several different ways, the answers are not always easy to interpret. For example, genital responses to sexually arousing stimuli do not always correspond to subjective or self-reported sexual arousal. The low level of concordance is particularly true for women, as indicated by a recent meta-analysis (Chivers, Seto, Lalumière, Laan, & Grimbos, 2005; see also Chapter 2), and for sex offenders (e.g., Quinsey, Steinman,

Bergersen, & Holmes, 1975).

Another issue related to self-report measures of arousal is how to actually assess subjective arousal. Two different methods have been used, the static and continuous response methods. In static response methods, participants are asked to report their subjective level of arousal once, or repeatedly at different intervals (e.g., Henson et al., 1977) in order to avoid distracting participants from the stimuli (e.g., Wincze, Venditti, Barlow, & Mavissakalian, 1980). The continuous response method requires participants to assess their arousal levels throughout the entire stimulus presentation, so as to avoid relying on participants' memories of how they felt. Participants can be asked to assess subjective sexual arousal by moving a joystick-like lever into various positions (e.g., a 180° arc, where 0° corresponds with no arousal being present and 180° corresponds with maximum arousal; Chivers et al., 2004) or through a button press that causes an electronic representation of a gauge, such as a bar, to increase or decrease; Chivers & Blanchard, 2006). Both static and continuous methods face the risk of participants lying about their arousal to various stimuli for fear of admitting responding to something they or others may consider to be socially unacceptable (e.g., McConaghy, 1974). Sex offenders against children, for example, typically report high arousal to pictures of adult women and no arousal to pictures of children, but their genital arousal suggests otherwise (Quinsey et al., 1975).

## **CONCLUSION**

The field of sex research has been greatly enhanced by the development of sexual

psychophysiological measures. Sexual physiological measures of arousal provide a wealth of information in comparison to extra-genital measures of sexual arousal, as they appear to be fairly valid (i.e., accurate), reliable (i.e., consistent), and less subject to participant influences (e.g., lying). At the moment, it appears that the best measure available for assessing sexual arousal in men is phallometry. Circumferential phallometry using mercury-in-rubber strain gauges in particular seems to be the most useful measure of arousal, when testing healthy men from community samples. For women, the best measure is possibly vaginal pulse amplitude assessed by vaginal photoplethysmography, as it has the potential to be specific to sexual stimuli in a similar fashion to phallometry, can allow for the presentation of multiple stimuli in a single experimental session, and can easily be used by participants. Other promising measures include thermography, brain imaging techniques, blood pressure, and viewing time.

## CHAPTER TWO

### **Female Sexual Arousal: Validation of Vaginal Photoplethysmography**

#### **ABSTRACT**

Intriguing sex differences in patterns of sexual arousal have been reported recently, including differences in degree of category-specificity and concordance. These sex differences could be due to the difficulty in measuring female genital arousal. The most commonly used measure of female sexual arousal, vaginal photoplethysmography, has not been fully validated and may not measure sexual arousal specifically. Alternatively, these sex differences may be caused by sex differences in psychosexual development through the action of masculinizing hormones. Twenty men and twenty women were presented with various sexual and emotionally-laden but non-sexual short film clips while their genital and subjective arousal were measured. Results suggest that vaginal photoplethysmography is a measure of sexual arousal exclusively: Women's genital responses were highest during sexual stimuli and absent during non-sexual stimuli. Sex differences in degree of category-specificity and concordance were replicated. Degree of masculinity showed no clear relationship with patterns of genital arousal in women.

## **INTRODUCTION**

The scientific study of sex has recently benefited from the development of sexual psychophysiology, a distinct branch of sex research that employs a variety of tools to objectively assess sexual arousal and response patterns. Researchers have most often focused their attention on men, using phallometry to assess genital responses to a variety of sexual stimuli. Much of the male research has focused on forensic applications, such as identifying the sexual preferences of sex offenders (e.g., Blanchard, Klassen, Dickey, Kuban, & Black, 2001; Freund & Blanchard, 1989; Lalumière et al., 2003; Seto et al., 2000) and determining the likelihood of recidivism in sex offender populations (e.g., Rice, Harris, & Quinsey, 1990; Rice, Quinsey, & Harris, 1991). As noted by several researchers, phallometry has been well-validated as an objective measure of sexual arousal and interests (for reviews see Geer & Janssen, 2000; Rosen & Beck, 1988).

The most commonly used objective measure of female sexual arousal is vaginal photoplethysmography (Geer & Janssen, 2000). The VPP is a small, tampon-shaped acrylic device designed to assess sexual arousal by measuring the amount of blood circulating in the vaginal tissues. As detailed in Chapter One, the VPP contains both a light source that is used to illuminate the capillary bed of the vaginal wall and the blood circulating within it, and a photosensitive light detector. The amount of light reflected back to the detector serves as an indirect measure of vasoengorgement, because the amount of light varies in relation to the transparency of the vaginal tissue (Sintchak & Geer, 1975).

Recent research with phallometry and VPP suggests that there are several interesting sex differences in patterns of arousal. One such sex difference pertains to the nature of stimuli that elicit genital and subjective arousal (i.e., feelings of sexual arousal). Men's arousal patterns, both genital and subjective, are category-specific, such that men show a high level of arousal to stimuli involving their declared preferred sex partners and preferred sexual activities. For example, men who identify themselves as homosexual typically show the highest genital and subjective arousal to gay erotica and little arousal to stimuli involving women, whereas heterosexual men typically show the highest genital arousal to stimuli involving women and little arousal to gay erotica (e.g., Freund et al., 1973).

In comparison, women's patterns of genital arousal appear to be quite different. Chivers et al. (2004) presented heterosexual and homosexual men and women and post-operative male-to-female transsexuals with a variety of sexual films. Films featured different types of couples (e.g., male-male, female-female, and male-female) and different types of sexual activities (i.e., intercourse and oral sex). Circumferential phallometry was used to assess genital responses in men and vaginal photoplethysmography was used to assess women and male-to-female transsexuals' genital responses. The films that elicited the greatest genital and subjective responses from men and transsexuals matched their self-described sexual orientation. For women, a different pattern of genital arousal was observed. A substantial proportion of women (37%) exhibited their highest responses to films that did not match their self-described sexual orientation. As a result, the correlation between self-reported sexual orientation and genital arousal was significantly lower for

women than for both men and transsexuals. Subjectively, however, women responded similarly to the men and transsexuals, in that they reported their highest level of subjective arousal to the films that corresponded with their self-reported sexual orientation.

The lack of category-specificity of genital arousal in women was replicated in another study by Chivers and Bailey (2005). Heterosexual men and women were presented with the same sexual stimuli from Chivers et al. (2004), as well as a non-human sexual stimulus depicting male and female bonobo chimpanzees engaging in repeated penile-vaginal intercourse. Non-sexual stimuli—films depicting landscapes and non-human primates engaging in non-sexual behavior—were also presented. Men did not respond genitally or subjectively to the non-human sexual stimulus, and responded the most both genitally and subjectively to the female-female and male-female stimuli. Women's genital responses indicated that they were significantly more aroused to the non-human sexual stimulus than the neutral stimuli, but did not report feeling as such. Likewise, women showed the highest and equal genital responses to all three forms of human sexual stimuli (i.e., male-male, female-female, and male-female), but their highest subjective responses indicated arousal to the male-female stimuli only.

It is possible that not all women show a lack of category-specificity. Chivers and Blanchard (2006) presented heterosexual and homosexual men and women with stimuli depicting neutral, non-human primate sexual activity, nude female non-sexual activity (i.e., solitary exercise in the nude), solitary female masturbation, female-female sexual

activity, nude male non-sexual activity (i.e., solitary exercise in the nude), solitary male masturbation, male-male sexual activity, and male-female sexual activity. The heterosexual and homosexual men responded the highest to stimulus categories depicting sexual activity involving their preferred sex partners (i.e., lesbian/heterosexual and gay sexual activity, respectively). Overall, women exhibited their highest genital arousal to stimuli involving explicit partnered sexual activity; lower levels of genital response were exhibited for solitary sexual activity, non-human sexual activity, and nude exercise. With respect to stimuli of lower intensity (e.g., solitary nude exercise and masturbation), sexual orientation did have an effect on genital responses: Lesbian women showed greater genital responses to female stimuli than male stimuli, whereas heterosexual women showed equal levels of genital arousal to stimuli depicting both sexes. These results suggest that lesbian women may be more category-specific than heterosexual women.

A second, and related, sex difference in arousal patterns concerns the concordance between genital and subjective reports of sexual arousal. Men show high concordance between genital and subjective sexual arousal, but women do not. A recent meta-analysis of all studies reporting a correlation between genital and subjective arousal in men and women indicated a positive and significant association in both sexes, but a higher association in men ( $r = 0.58$  and  $r = 0.32$ , respectively; Chivers et al., 2005).

The sex difference in concordance is observed when participants are presented with multiple categories of stimuli (e.g., Chivers et al., 2004; Chivers & Bailey, 2005), and also when men and women are presented with a single category of stimuli or even a

single stimulus. For example, Wincze et al. (1980) presented men and women with a low intensity and a high intensity heterosexual film. As a group, women did not show a strong correlation between subjective and genital arousal ( $r = 0.15$ ), but men did ( $r = 0.69$ ). Likewise, Heiman (1977) presented men and women with different recorded sexual stories while measuring genital and subjective arousal. Only 58% of the women reported at least some sexual arousal while they were experiencing their highest genital response. All of the men, however, reported at least some sexual arousal while experiencing their highest genital response.

Although some research suggests that asking participants to pay attention to bodily cues of arousal when assessing subjective arousal can increase the correlation between subjective and genital arousal (e.g., Korff & Geer, 1983), Chivers et al.'s meta-analysis does not completely support this suggestion; the correlation between genital responses and perception of genital arousal (i.e., awareness of genital sensations) is very high in men and very low in women ( $r = 0.82$  and  $r = 0.10$ , respectively). In the subset of studies that asked participants to rate both their perception of genital arousal and their subjective arousal (i.e., how sexually aroused they felt), the sex difference in the correlation between objectively-measured genital and subjective arousal remained (men:  $r = .67$ ; women:  $r = .13$ ), suggesting that even when women are asked to report their perception of genital arousal, concordance between genital (i.e., the physiological response) and subjective sexual arousal remains low.

There are two possible explanations for the sex differences in arousal patterns noted

above. One plausible explanation is that VPP may simply not be as accurate a measure of genital arousal as phallometry. In an extensive review of measures of sexual arousal, Rosen and Beck (1988) stated that measures of penile response are both reliable and valid, but that the reliability and validity of VPP had not been satisfactorily established; unfortunately, not much has changed since that review was published. If VPP is not as valid a measure as phallometry, the lack of category-specificity of genital arousal and the poor concordance between genital and subjective measures in women may simply be an artifact of the lack of validity of the female measure. It is clear that phallometric responses are specific to sexual stimuli, because penile responses only occur in response to stimuli involving sexual images or activity (for a review, see Zuckerman, 1971). It is unclear, however, if the same is true for VPP. Perhaps VPP shows little category-specificity or concordance with subjective arousal because subjectively non-preferred sexual stimuli generate a non-sexual physiological response (i.e., increase in blood flow) that is detected by VPP.

The first study relevant to this question was conducted by Geer et al. (1974). Fourteen women were presented with two 8-minute films, one erotic film depicting a heterosexual couple involved in a sexual interaction that included undressing, oral sex, and penile-vaginal intercourse, and the other a non-erotic film depicting battles and court life scenes from the Crusades. Compared to baseline levels of genital response, both films elicited significant increases in vaginal pulse amplitude (VPA), which reflects short-term changes in vaginal engorgement due to the amount of blood present in vaginal tissue during each heart beat, and vaginal blood volume (VBV), which reflects slow changes in the pooling

of vaginal blood (Hatch, 1979). The erotic film produced significantly higher responses in VBV and VPA compared to the non-erotic film.

Hoon et al. (1976) assessed several physiological measures of arousal using a sexually explicit film depicting heterosexual foreplay and control films. Control films included a neutral film of an oceanographic lecture and a dysphoric film depicting Nazi war crimes with intense sequences of dismembered bodies. The physiological measures were heart rate, heart rate variability, skin conductance, forehead temperature, blood pressure (both systolic and diastolic), finger blood pulse amplitude, and vaginal blood volume (but not vaginal pulse amplitude). Participants were also asked to report levels of subjective sexual arousal and anxiety in response to all films. The results indicated that VBV, systolic blood pressure, diastolic blood pressure, skin conductance, and forehead temperature were all significantly influenced by stimulus category. VBV, diastolic blood pressure, and forehead temperature exhibited the greatest increases during the sexual film, and no change in response to the two non-sexual films. Changes in systolic blood pressure and skin conductance varied by stimulus type, such that the sexual film elicited the highest change, followed by the dysphoric film, followed by the neutral film. Self-reported emotions corresponded with the content of the films: The sexual film produced the most subjective sexual arousal and the dysphoric film produced the most anxiety.

The most recent research on the validity of vaginal photoplethysmography was conducted by Laan et al. (1995). Laan et al. presented 49 women with four film clips including: a sexual clip depicting petting, cunnilingus, and intercourse; a sexually threatening clip

depicting a man chasing a woman up a set of stairs and kissing her and caressing her against her will; a non-sexual anxiety-inducing clip depicting a woman being chased by a rabid dog; and a neutral clip depicting old buildings from a Dutch village. Vaginal blood volume, vaginal pulse amplitude, skin conductance, heart rate, and self-reported arousal were assessed. Participants rated themselves as most sexually aroused during the sexual film clip, somewhat aroused during the sexually threatening film, and not at all aroused during the non-sexual films. Both VPA and VBV showed the highest level of response to the sexual stimuli, but VBV did not differentiate between the neutral stimulus and the sexually threatening stimulus. VPA did not increase at all in response to the neutral or the non-sexual anxiety-inducing film clip, but VBV increased slightly to the neutral film clip. VPA and VBV were both significantly correlated with subjective sexual arousal during the sexual and sexually threatening stimuli. VBV, however, was also related to other emotions, including anxiety and threat.

The studies discussed above share the same methodological limitation: an extremely narrow range of non-sexual stimuli that serve as control stimuli. One problem associated with the use of only negative non-sexual stimuli is that the emotional responses elicited by negative non-sexual films do not resemble the responses women experience during sexual arousal. Heiman (1980) assessed the affective responses that occur in relation to sexual arousal in 55 women. The participants were asked to fantasize about a sexual encounter and were also presented with erotic films and audio-tapes while their genital arousal was measured using VPP. Following each type of stimulus (i.e., film, audio-tape, or fantasy), each participant rated her subjective reaction to the stimulus and the degree to

which she experienced a variety of positive and negative affective responses, including interest, like, enjoyment, disgust, embarrassment, boredom, guilt, and anxiety. The results are not surprising; self-reported arousal was positively and significantly correlated with positive affective responses (like, enjoyment, and interest). VPA responses were also significantly correlated with positive affective responses. Because women typically experience positive affective responses during sexual arousal, a better test of the validity of VPP would be to compare women's responses to sexual stimuli with responses to non-sexual stimuli of a positive valence, instead of or in addition to non-sexual stimuli of a negative valence, in order to elicit emotional responses that typically occur during sexual arousal.

A related problem involves the stimuli that have been previously used to assess category-specificity. As noted by Chivers et al. (2004), explicit sexual stimuli (i.e., stimuli depicting two men having sex) may be unusual or abhorrent to some people. These stimuli may produce a negative emotional response, such as anxiety or disgust. This possibility was somewhat addressed by early validation studies in that anxiety-inducing (Laan et al., 1995) or dysphoric films (Hoon et al., 1976) did not elicit genital responses in women. It is possible, however, that the heterosexual women watching homosexual sexual interactions are not reacting in a negative manner, but rather with amusement or other positive emotions. A recent study conducted by Kukkonen et al. (2006) using clitoral ultrasonography found that women who were presented with a humorous film did not experience differences in clitoral blood flow compared to women who were presented with a sexual film. It is possible, then, that women are simply experiencing a

physiological response related to amusement or humor when viewing homosexual films, which results in increased blood flow to the genital area, and thus to lesser category-specificity and concordance.

The second plausible explanation is that the difference observed in arousal patterns is due to a true sex difference. Perhaps men and women's sexual psychophysiology is designed differently, such that men's physiological arousal determines their subjective arousal (assuming that the former precedes the latter), whereas women's physiological arousal does not. Symons's (1979) notion that women's reproductive interests would not be served by a psychology that is subordinate to physiology provides a possible ultimate function for such a sex difference.

The notions of minimal parental investment and maximal reproductive rate help explain why men and women have different reproductive strategies. Men and women have always had different minimal parental investment, defined as the minimum amount of resources or time necessary to produce an offspring. Over evolutionary history, men's minimal investment has consisted of a single ejaculate, whereas women's minimal investment consisted of the production of an egg, nine months of gestation, and child birth. These fundamental differences in parental investment resulted in men having much higher potential reproductive rates than women (Clutton-Brock & Vincent, 1991).

Based on these differences, there was greater selection pressure on men than on women to increase the *quantity* of their sex partners, and greater selection pressure on women

than men to increase the *quality* of their sex partners. To increase *quantity* of sexual partners, men would have benefited by being easily aroused at the sight of women with good reproductive value. To increase *quality* of sexual partners, women would have benefited from being judicious in their selection of potential mates. In fact, increasing *quantity* would have had little benefits for women, but potentially great costs. As such, selection would have likely favored women whose psychological responses were less tied to their physiological responses, at least in terms of sexual arousal, in an attempt to promote greater control over mate choice. Lesser concordance between genital and subjective arousal may have led to better decision-making in the context of mate choice. This theory is silent on the ultimate causes of low genital category-specificity in women.

Regardless of ultimate functions, sex differences in patterns of arousal, if real, would likely be caused proximally by hormonal sex differences in sexual development. Androgens, such as testosterone, are present in both sexes but to varying degrees. Men have higher levels of testosterone in comparison to women. Of relevance, testosterone has known influences on women's sexual behavior and preferences, in addition to other personality traits. For example, Money, Schwartz, and Lewis (1984) studied women who were exposed to high levels of androgens prenatally due to the genetic disorder congenital adrenal hyperplasia (CAH) and men with androgen insensitivity syndrome (AIS), a condition in which a genetically male fetus possesses a genetic error that prevents his body from responding to androgens, causing female-like genitalia to develop. Money et al. found that women with CAH were more likely to report being bisexual or homosexual, in comparison to individuals with AIS. A more recent study by

Hines, Brook, and Conway (2004) found similar results, in that women with CAH reported a less exclusively heterosexual sexual orientation both in the 12 months before testing and across their lifetime than women without CAH.

Other studies of women exposed in utero to unusual amounts of androgens tend to show elevated levels of “masculine” tendencies. Berenbaum and Resnick (1997) assessed the level of aggression (a sexually dimorphic trait) present in adolescent and adult males and females without CAH and adolescent and adult females with CAH. Control participants were relatives of female participants with CAH who were unaffected by the disorder. Results indicated that control males exhibited higher levels of aggression than control females, and the females with CAH reported higher levels of aggression than control females. Similarly, Berenbaum (1999) found that adolescent girls with CAH preferred male over female typical activities and occupations, in comparison to their female relatives who did not have CAH.

The effect of androgens on female mating behavior is seen in different species, as well. McGlothlin, Neudorf, Casto, Nolan, and Ketterson (2004) assessed the influence of testosterone on female interest in males in a common species of songbirds (*Junco hyemalis*). Typically, male juncos are less choosy than female juncos, with respect to mates. In a counter-balanced experiment, McGlothlin et al. implanted male and female juncos with tubes of either testosterone or nothing (i.e., some juncos received the testosterone first then the empty tube and others received the treatment in reverse). A control and testosterone-enhanced male matched for size and age were each placed in one

end of a Y-shaped enclosure. Individual female juncos were placed at the long end of the enclosure, and then released. Females who received the testosterone implants were less choosy than those who received the empty implants, such that those females with increased testosterone spent approximately the same amount of time next to the control and testosterone-enhanced male junco, whereas control females spent more time next to the control male. Females who received testosterone were thus masculinized with respect to this aspect of mating behavior.

Because of the link between androgens, mating behavior, and masculinity, one would expect that women who have been exposed to higher levels of prenatal androgens and are therefore more “masculinized” will exhibit more male-typical arousal patterns, that is, more category-specific responses and higher degrees of concordance between subjective and genital arousal.

The purpose of the current study was threefold. The first objective of the study was to determine whether vaginal photoplethysmography, the most commonly used measure of female sexual arousal, is a measure of sexual arousal or a measure of general arousal, by exposing women to sexual and non-sexual stimuli of a positive and negative valence. The second objective was to attempt to replicate past research describing differences in arousal patterns between men and women (category-specificity and concordance between genital and subjective arousal). The third objective was to examine whether degree of masculinity is associated with more masculinized patterns of arousal among women. More specifically, it was hypothesized that if VPP is an accurate and valid measure of

sexual arousal:

- (I) only sexual stimuli will produce a genital response,
- (II) women will show less category-specificity and lower concordance than men,  
and
- (III) degree of masculinity will correlate with degree of category-specificity and  
concordance in women.

## **OVERVIEW OF THE STUDY**

Twenty men and 20 women were presented with 20 sexual and non-sexual film clips of a positive and negative emotional valence while their genital responses and subjective sexual arousal were monitored. Changes in finger blood volume were also assessed. Participants also completed several questionnaires, completed a mental rotation task, and had their hands electronically scanned in order to assess their degree of masculinity.

## **METHODS**

### **Participants**

Twenty-three men and 23 women were initially recruited from the University of Lethbridge and the community of Lethbridge using newspaper advertisements, posters (Appendix 1), and visits to university classes. To be invited to participate in the study, participants had to meet the following inclusion criteria: 18 to 28 years old; self-identification as predominantly or exclusively attracted to members of the opposite sex; involved in an intimate or dating relationship for six months or longer; no history of mental illness, substance abuse, chronic sexual arousal problems, or sexually transmitted

diseases; not using any medication to treat mental illnesses or high blood pressure; no children; able to read and write English fluently; and sexually experienced (i.e., participants must have had sexual intercourse and have been exposed to sexually explicit materials). Also, women must have had a regular menstrual cycle and could not be pregnant or menstruating at the time of testing.

These inclusion criteria were used to ensure a certain degree of homogeneity of participants, especially for characteristics that have been shown to affect sexual arousal (e.g., age, sexual experience); to ensure that participants were capable of completing the different experimental tasks (e.g., English fluency, no sexual arousal problems); and to ensure participants would be comfortable during the experiment (e.g., previous exposure to erotica, previous sexual intercourse experience).

Data from two women were excluded because their questionnaire responses suggested a bisexual sexual orientation. Data from another woman were excluded because she did not respond more to any stimulus category (i.e., sexual or non-sexual) than the neutral stimulus category. Data from two men were excluded because their questionnaire responses suggested they were not in any form of relationship.<sup>2</sup> Data from another man were excluded due to equipment failure during the experiment.

The mean ages of the 20 men and 20 women with valid data was 22.0 ( $SD = 2.5$ ) and

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<sup>2</sup> Three participants did not fully meet one of the inclusion criteria but their data were used for analyses. One man reported having a history of mental illness but was not on medication at the time of testing. One man reported being in a relationship for less than six months, but the relationship was monogamous. One woman reported using medication to treat a minor mental illness, but she had been on the same low dose of medication for a very long period of time.

21.9 ( $SD = 3.0$ ) years, respectively. Most men and women reported being in a dating relationship (85% and 80%, respectively), with the remainder reporting being engaged (10% and 5% respectively) or in a common-law relationship (5% and 15%, respectively). On average, women reported being in slightly longer relationships ( $M = 21.9$  months,  $SD = 17.7$  months) than men ( $M = 19.4$  months,  $SD = 15.0$  months). The majority of men and women were Caucasian (85% and 100%, respectively) and most of the men and women tested had completed or were completing post-secondary education at the time of testing (80% of both men and women). There were no statistically significant sex differences on any of these biographic factors. Slightly more than half of the women reported using hormonal contraceptives ( $n = 12$ ).

Both men and women were classified as predominantly or exclusively heterosexual using the Kinsey Scale (Kinsey, Pomeroy, & Martin, 1948; Kinsey, Pomeroy, Martin, & Gebhard, 1953). Women's scores, however, appeared to be more variable than men's scores. The Kinsey Scale ranks individuals from 0 to 6, with 0 indicating exclusive interest in women, 3 indicating equal interest in men and women, and 6 indicating exclusive interest in men. Most men and women reported that their romantic attractions were exclusively to members of the opposite sex ( $n = 19$  for both men and women). Reports for sexual attractions and sexual fantasies were somewhat different: The vast majority of men reported that their sexual attractions and sexual fantasies were directed toward women only ( $n = 19$  for both items), but fewer women reported sexual attractions and fantasies toward men only ( $n = 12$  and  $n = 7$ , respectively), indicating that a fair proportion of the women tested had either been attracted to or fantasized about other

women at least occasionally ( $n = 8$  and  $n = 13$ , respectively). Women who reported some sexual attractions or fantasies involving other women (i.e., those who scored a 4 or 5 on the relevant Kinsey Scale items) are hereafter referred to as predominantly heterosexual women; women who reported no sexual attractions or fantasies involving other women (i.e., those who scored 6 on the relevant Kinsey Scale items) are hereafter referred to as exclusively heterosexual women. It is important to note that none of the women who reported having sexual attractions or fantasies toward women stated that these were more frequent than attractions or fantasies toward men.

### **Measures and Materials**

**Audiovisual Stimuli.** Audiovisual presentations were used because past research has indicated that they elicit the highest genital and subjective responses, in comparison to other forms of media, such as slides or audio-tapes (e.g., Heiman, 1980; Abel et al., 1975). Past research has indicated that various emotions can produce differential cardiovascular responses, including joy or happiness, sadness, fear or threat, and physical action or exhilaration (e.g., Sinha, Lovallo, & Parsons, 1992), as well as sexual arousal (e.g., Sarlo et al., 2005). Specific film clips were selected based on the results obtained from a pilot study that was conducted to ensure that the clips elicited the intended emotional responses. Film clips were all approximately 90 seconds long and focused on a female character, when appropriate.

There were ten stimulus categories: Non-sexual positive affect clips were categorized as exhilarating or happy, and non-sexual negative affect clips were categorized as anxiety-

inducing or sad. Sexual stimuli consisted of heterosexual (i.e., male-female), gay (i.e., male-male), and lesbian (i.e., female-female) explicit sexual interactions, as well as low intensity heterosexual sexual interactions, and heterosexual threatening sexual interactions (i.e., non-consensual heterosexual sexual interactions). Neutral stimuli were also included. Two film clips from each category were presented. An additional clip from the neutral and low intensity categories was used in the warm-up session.

The exhilarating film clips depicted a woman on a roller coaster (*Roller Coaster Expedition*) and a woman competing in a surfing competition (*Blue Crush*). The happy film clips showed a woman singing and dancing with her children (*Stepmom*) and a woman having a birthday party with children (*Raising Helen*). Anxiety-inducing film clips depicted a woman being chased through a forest by a man (*Kiss the Girls*) and a woman being chased by a rabid dog (*Cujo*). Sad film clips showed a woman being told her husband has been killed (*A League of Their Own*) and a woman being told she may lose custody of her adopted son (*Losing Isaiah*). The sexual stimuli depicted a variety of sexual activities: the heterosexual sexual stimuli depicted a man and woman engaging in cunnilingus, fellatio, and penile-vaginal intercourse (*Burning Lust*; *Caribbean Heat*); the male-male stimuli depicted two men engaging in fellatio or anal intercourse (*The Best of Jason Adonis*); the female-female stimuli depicted only kissing and cunnilingus (*A Guide to Eating Out*). The low intensity heterosexual sexual stimuli showed a man and woman kissing and caressing each other, with little nudity shown (*Caribbean Heat*; *Private Pleasures*; *Taste of Ambrosia*). The actors depicted in the low intensity stimuli were either fully clothed or semi-nude. The sexually threatening stimuli depicted a gang rape

scene (*The Accused*) and an acquaintance rape attack with partial nudity (*Thelma & Louise*). Lastly, the neutral scenes depicted a calm beach with waves lapping at the shore (*Waves – The Best Virgin Island Beaches*).

**Genital Measures.** All psychophysiological data were sampled using a Limestone Technologies Inc. (Kingston, ON) DataPac\_USB adapted for vaginal photoplethysmographic data acquisition and Prefest software, Version 10 (Limestone Technologies Inc.).

Women's genital arousal was assessed with changes in vaginal pulse amplitude (VPA) using a vaginal photoplethysmograph (Sintchak & Geer, 1975). Vaginal pulse amplitude reflects changes in vaginal engorgement with each heart beat. Higher amplitudes indicate higher blood flow and possibly higher levels of arousal. The photoplethysmograph signal was sampled at a rate of 10 samples/second, band-pass filtered (.5 Hz to 10 Hz), and digitized (40 Hz). A placement device made out of flexible acrylic plastic was attached to the cable of the vaginal gauge and placed at a distance of 5 cm from the photo transistor (i.e., light detector). The placement device was used to control the depth and the orientation of the gauge (Laan et al., 1995). Movement artifacts were detected through visual inspection of the waveforms and removed prior to data analysis.<sup>3</sup>

Men's genital arousal was measured using mercury-in-rubber strain gauges of three sizes (75mm, 80mm, and 85mm; D. M. Davis, New Jersey). The device consists of a mercury-

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<sup>3</sup> Removal of movement artifacts from all physiological data was conducted by the author, blind to stimulus categories.

filled hollow rubber tube that is sealed at the ends with platinum electrodes that are inserted into the mercury. Changes in the circumference of the penis cause the rubber tube to either stretch or shorten, changing the electrical resistance of the mercury. The signal was sampled at a rate of 10 samples/second, low-pass filtered (to .5 Hz), and digitized (40 Hz). The signal was transformed into millimeters of circumference change from baseline. Between each experimental session the gauges were calibrated over six 5-mm steps. Movement artifacts were detected through visual inspection of the waveforms and removed prior to data analysis.

**Blood Volume.** Changes in blood volume were assessed by using a finger cuff that was attached to the middle finger of a participant's left hand. The signal was sampled at a rate of 10 samples/second, but was not filtered or digitized. Movement artifacts were detected through visual inspection of the waveforms and removed prior to data analysis.

**Reprocessing (Disinfection) of Laboratory Equipment.** The vaginal gauge, placement device, and penile strain gauge were reprocessed after each use and subjected to high-level disinfection (i.e., cold sterilization) using a chemical solution (Cidex® OPA). The genital gauges and the placement device underwent a procedure identical to that used for plastic medical instruments (The College of Physicians and Surgeons of Ontario, 1995). Cidex® kills all mycobacteria in 12 minutes (Johnson & Johnson, 1999). Surfaces that participants came into contact with (e.g., recliner, response keypad, etc.) were also thoroughly cleaned using an alcohol solution after each use.

**Subjective Arousal.** During the presentation of the experimental stimuli, participants continuously rated their subjective arousal (i.e., how sexually aroused they felt) via a button press on a keypad. Participants saw their subjective ratings change throughout the film clip on the same monitor that showed the films (i.e., a vertical bar on the left side of the monitor). Increases in subjective arousal were indicated by an increase in the height of the bar and decreases in arousal were indicated by a decrease in the bar's height. Continuous subjective arousal was recorded as percentage of arousal, from 0 to 100.

**Post-Stimulus Questions.** After the presentation of each film, participants saw questions on the computer monitor. Participants were asked to rate how pleasant or unpleasant each film clip was, how much attention they paid to the film, the intensity of the film, and the extent to which they experienced various emotions (e.g., sexual arousal, happiness, sadness, exhilaration, anxiety, boredom, calmness) via a button press on a keypad. Participants were asked to respond to the questions using a scale of 1 to 9, with 1 being the lowest level of response (i.e., the emotion in question is definitely not present, or the film was not at all intense) and 9 being the highest level of response (i.e., the emotion was definitely present or the film was definitely intense). Questions were presented in fixed order, due to the nature of the software being used. The very first question was about sexual arousal.

**Questionnaires.** The questionnaire (Appendix 2) included biographic questions, as well as questions about sexual experiences, sexual interests, and relationship satisfaction (Relationship Assessment Scale; Hendrick, 1988). Other questions were included to

assess masculinity and femininity, including the Preference for Partner Variety and Casual Sex Scale (PVCS; Lalumière, Chalmers, Quinsey, & Seto, 1996), Bem Sex Role Inventory (BSRI; Bem, 1974), a brief version of the Lippa Occupation Survey (LOS; Lippa, recommendation to Paul Vasey, August, 2006), and Aggression Questionnaire (AQ; Buss & Perry, 1992). The PVCS is a 12-item questionnaire that assesses an individual's willingness to engage in uncommitted sexual relations. Men typically score higher than women (Dowsley, 1996). The BSRI consists of 20 masculine, 20 feminine, and 20 androgynous traits that participants rate themselves on. The masculine and feminine traits are used to classify individuals as psychologically masculine, feminine, androgynous, or undifferentiated. Men typically score higher on the masculine or instrumental traits (e.g., assertiveness, need to dominate) and women typically score higher on feminine or expressive traits (e.g., altruism, need to help others; Bem, 1974; Holt & Ellis, 1998; Oswald, 2004). The brief version of the LOS consists of 10 questions that assess one's interest in sex-typical occupations (e.g., car mechanic, carpenter, florist, or dance teacher). The AQ consists of 29 questions that assess four aspects of aggression: physical aggression, verbal aggression, hostility, and anger. Men and women differ in levels of aggression, with men being more physically aggressive, verbally aggressive, and hostile than women (Buss & Perry, 1992). All questionnaires were scored so that a higher score indicated greater masculinity.

**2D:4D Ratio.** Participants had the palm side of both of their hands electronically scanned twice. Vernier calipers (accurate to 0.01 mm) were used to measure the length of the index and ring finger (i.e., the second and fourth digit) of the scans of both hands. The

ratio of the length of the second to fourth finger (2D:4D) is an index of prenatal exposure to testosterone, with men typically having lower ratios than women (Manning, 2002). The 2D:4D ratios obtained from both scans were averaged for each hand. The correlation between the two ratios was high for both hands (right:  $r = .98, p < .001$ ; left:  $r = .95, p < .001$ ).

**Mental Rotation Task.** The mental rotation task (MROT) is a test that requires participants to rotate objects in their mind to determine if the objects match a target object (Vandenberg & Kuse, 1978). Participants are presented with a two dimensional line drawing of a three dimensional target object and asked to identify which two of four rotated two dimensional line drawings matched the target. Participants were given five minutes to complete 12 problems. Scores could range from 0 to 24. Research has consistently shown that men perform better on the task than women (Voyer, Voyer, & Bryden, 1995).

### **Procedure**

All experimental procedures discussed below were approved by the University of Lethbridge's Human Subject Research Committee.

**Screening.** Prospective participants responded to advertisements via telephone or e-mail and received preliminary information about the study (Appendix 3). To determine eligibility, a prospective participant was given a list of exclusion criteria and asked if any of the criteria applied to him or her. If none of the criteria applied, a more detailed

description of the experimental procedure was provided. If the individual was still interested, an appointment was scheduled. Women were scheduled such that they were participating when they were not menstruating. Because most research indicates that menstrual cycle phase does not influence sexual arousal in women (e.g., Morrell, Dixen, Carter, & Davidson, 1984), women were not tested during a specific phase of their menstrual cycle, although information regarding menstrual cycle was obtained from the questionnaire. Prior to testing, participants were asked to refrain from sexual activity of all types for 24 hours, physical exercise of all types for one hour as exercise results in sympathetic nervous system arousal that can influence genital responses (Meston & Gorzalka, 1996), and using alcohol, tobacco, caffeine, cold medications, and recreational drugs on the day of testing, because these substances may influence both physiological and psychological sexual arousal.

**Experimental Session.** Participants were greeted individually by the female experimenter (KDS) in the laboratory. Each participant was shown the experimenter room prior to entering the participant room. In the participant room, the experimenter reviewed the purpose of the experiment, outlined the experimental tasks, provided instructions on the application or insertion of the genital gauges, and answered any questions the participant had (Appendix 4). Participants signed an informed consent form if they agreed to participate (Appendix 5).<sup>4</sup>

Participants were given the opportunity to use the restroom prior to beginning the

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<sup>4</sup> One additional female did not feel comfortable with the reprocessing procedure used for the genital gauges, and did not participate.

experimental session. The experimenter attached the finger cuff to the middle finger of the participant's left hand. In order to ensure accurate measurements, the pressure on the cuff was raised to 120 mmHg then lowered to 60 mmHg. The experimenter then turned the overhead lights off and left the room. Once the participant was alone in the room, he or she undressed from the waist down. The participant inserted or attached the genital gauge while reclining in a comfortable linen-lined recliner. The participant was also provided with a light blanket to cover his or her legs. The temperature of the participant room was kept at approximately 25°C during the presentation of the film clips.

Using an intercom system, the participant informed the experimenter when he or she was ready to begin the experiment. Participants were instructed to attend to the films carefully and attempt to focus their attention solely on the events taking place in the films. Film clips were presented on a 17-inch monitor positioned at eye level approximately 5 feet from the participant. Participants were asked to respond to the films as naturally as possible, and to avoid contracting their genitals, manipulating their responses, touching themselves, moving, and talking during the films, as these activities could disrupt the measurements. The self-report keypad was on the right arm of the recliner and participants were allowed to position it as they desired. As mentioned earlier, participants used the keypad to continuously rate their subjective sexual arousal throughout each film, and respond to the questions assessing emotional responses after each film.

The first two films that were presented were used as warm up stimuli, in order to familiarize the participant with the testing session. Data collected during the two warm up

stimuli were not used in analyses reported below. The first warm up stimulus was a neutral film depicting a beach with waves reaching the shore. The second was a low intensity sexual interaction involving a man and a woman kissing and caressing each other. Following the two warm up stimuli, all participants were presented with the 20 film clips. The order of film presentation for the experimental stimuli was randomized for every participant, and one film from each category was presented in the first half of trials and the second film was presented in the second half of trials. At least one other film always separated films from the same category. Stimuli were separated by an interval of at least 30 seconds. Participants whose genital arousal levels did not return to baseline within a few minutes were instructed to complete a distracter task in an attempt to lower arousal levels (e.g., read out loud from a nature magazine or count out loud backwards from 100 in different multiples). If arousal did not return to baseline levels after a maximum of five minutes, the next stimulus was presented regardless. This did not occur often (19 out of 800 trials in total, 2.4%). Inter-stimulus interval was determined by genital response levels irrespective of blood volume level, meaning that if genital response levels were low and stable, the next stimulus was presented (after a minimum of 30 seconds), regardless of blood volume levels. This procedure was followed to avoid fatigue in participants, as the experimental procedure was quite lengthy.

After all experimental stimuli were presented, participants were asked to remove the finger cuff and genital gauge and place the genital gauge in a sealable plastic bag. Participants were asked to redress and open the door of the participant room when they were ready to begin the next part of the experiment. With the participant's permission,

the experimenter entered the room and offered the participant a break. The experimenter then asked the participant to complete the questionnaires in private. Upon completion of the questionnaires, the experimenter re-entered the room with the participant's permission and provided instructions on how to complete the mental rotation task. Once the participant had completed the mental rotation task, both the experimenter and the participant went to the experimenter room, where the experimenter took two electronic scans of each of the participant's hands. During the scanning process, the experimenter debriefed the participant (Appendix 6), thanked him or her for participating, and compensated the participant with \$50. The entire experimental session took approximately two and a half hours.

### **Data Analysis**

Peak minus baseline scores for each stimulus were calculated for genital responses and continuous subjective responses. The change in blood volume that produced the greatest difference (i.e., the greatest difference between a low and high point in the tracing) was also calculated for each stimulus. These scores were then standardized (i.e., transformed into z-scores) within-subjects for each type of response separately in order to eliminate any effect of individual variation in responsiveness (Harris, Rice, Quinsey, Chaplin, & Earls, 1992). The z-scores were then averaged to produce mean scores for each stimulus category (e.g., happy, sad, etc.). Post-stimulus responses to questions were averaged for each category and not standardized. The following outlines the statistical analyses that were used to test the hypotheses previously described:

- 1) To test whether vaginal photoplethysmography measures sexual arousal or

- general arousal, separate 2 (sex: male or female) X 10 (stimulus category: neutral, happy, sad, exhilarating, anxiety-inducing, sexually threatening, low intensity, male-male, female-female, male-female) ANOVAs were conducted for genital, continuous subjective, and blood volume responses. Planned contrasts were used to compare differences in responses to the sexual, non-sexual, and neutral stimuli.
- 2) An index of category-specificity (i.e., a contrast score) was computed separately for genital and subjective responses to test whether men exhibit more category-specific responses than women. The contrast score was computed by taking the highest response to a sexual stimulus category and then subtracting the average of all responses to other sexual categories. For example, if a male participant responded highest to the female-female stimuli, the average of his responses to the male-male, male-female, low intensity, and sexually threatening categories would then be subtracted from his response to the female-female stimulus category. Higher scores indicate greater category-specificity, such that one category captured more of the overall arousal output produced by participants. Note that this operationalization of category-specificity is slightly different than the definition used in the introduction. It refers to exclusivity of response rather than to the matching of highest genital response to self-reported sexual orientation. The sex difference was examined by comparing the average category-specificity indices for each sex using an independent samples t-test.
  - 3) Non-parametric correlations were used to test whether men exhibit higher concordance between genital and subjective responses than women. Each participant provided one correlation between genital and continuous subjective

arousal, and one correlation between genital and post-stimulus subjective arousal. These correlations were based on 20 pairs of data, one pair for each stimulus presentation. The sex difference was examined by comparing the average correlations for each sex using an independent samples t-test.

- 4) To test whether more masculine women exhibit patterns of arousal that are more similar to men (i.e., higher category-specificity and greater concordance between genital and subjective arousal), a factor analysis was conducted on all of the measures that were expected to elicit a sex difference to compute a masculinity index. Correlations were then computed between the masculinity factor score and indices of category-specificity and concordance. A second factor analysis was conducted using only the measures that produced a significant sex difference in this study, and this masculinity index was also correlated with indices of category-specificity and concordance.

## **RESULTS**

### **Manipulation Check**

To ensure that the film clips elicited the intended emotions, participants were asked questions regarding their emotional reactions following the presentation of each film clip. As indicated by Figures A.1 through A.11 (Appendix 7), the film clips elicited the intended emotional responses. The positive affect film clips were rated as pleasant and elicited higher reports of happiness and exhilaration than the negative affect clips. Likewise, the negative affect clips were rated as unpleasant and elicited higher reports of sadness and anxiety. Only sexual film clips elicited high levels of subjective sexual arousal.

## **The Influence of Stimulus Category on Genital Responses, Subjective Sexual Arousal, and Blood Volume**

**Genital Responses.** Figure 2.1 presents the standardized mean genital responses for men and women. The figure shows that men and women responded equally to the emotional non-sexual stimulus categories and the neutral stimuli, and responded much more to the sexual stimulus categories. A 2 (sex) X 10 (stimulus category) mixed ANOVA with repeated measures on the second factor confirmed this visual inspection. A main effect of stimulus category,  $F(9, 342) = 65.00, p < .001, \eta_p^2 = .63$ , was found. An interaction between sex and stimulus category was also found,  $F(9, 342) = 4.67, p < .001, \eta_p^2 = .11$ . No significant differences in overall genital responses were found between men and women because scores were standardized within subjects.

Simple effects were conducted for each sex. Stimulus category was significant for both men and women,  $F(9, 171) = 54.00, p < .001, \eta_p^2 = .74$  and  $F(9, 171) = 21.90, p < .001, \eta_p^2 = .54$ , respectively. Planned contrasts revealed that, for men, the sexual stimuli (i.e., sexual threat, low intensity, male-male, female-female, and male-female) produced greater genital responses compared to both the neutral stimuli,  $F(1, 171) = 16.12, p < .001$ , and the non-sexual stimuli (i.e., happy, sad, exhilarating, and anxiety-inducing),  $F(1, 171) = 96.87, p < .001$ . The non-sexual and neutral stimuli did not produce significantly different genital responses,  $F(1, 171) = .03, ns$ . Similarly, for women, planned contrasts revealed that the sexual stimuli produced greater genital responses compared to both the neutral stimuli,  $F(1, 171) = 8.51, p < .005$ , and the non-sexual

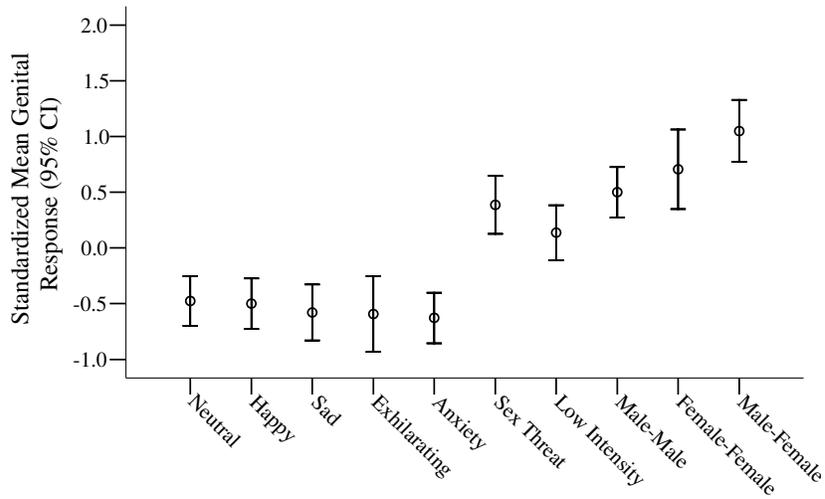
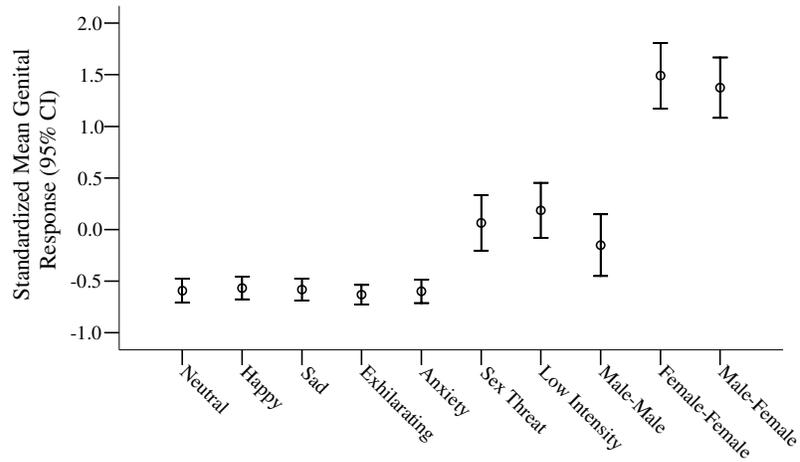


Figure 2.1 Standardized mean genital responses in men (top portion) and women (bottom portion) as a function of stimulus category

stimuli,  $F(1, 171) = 59.64, p < .001$ . Again, the non-sexual and neutral stimuli did not produce significantly different genital responses,  $F(1, 171) = 1.71, ns$ . The Greenhouse-Geisser correction was used when necessary (i.e., when the assumption of sphericity was not met), and yielded the same results.<sup>5</sup>

**Continuous Subjective Sexual Arousal.** Two participants (one man and one woman) did not report any changes in subjective sexual arousal during any film clip and data from a third participant (female) were missing due to technical failure during the experimental session. Data from these three participants were not included in analyses of continuous subjective sexual arousal (because z-scores could not be calculated). Figure 2.2 presents the standardized mean subjective sexual arousal responses for men and women. The figure suggests that both men and women reported their highest level of subjective arousal to the sexual stimuli. A 2 (sex) X 10 (stimulus category) ANOVA identical to the one described for genital responses revealed a main effect of stimulus category,  $F(9, 315) = 146.84, p < .001, \eta_p^2 = .81$ . A significant interaction between sex and stimulus category was also found,  $F(9, 315) = 8.17, p < .001, \eta_p^2 = .19$ . No significant sex difference was found because scores were standardized within subjects.

Simple effects were conducted for each sex and indicated a significant effect of stimulus category for both men,  $F(9, 162) = 72.50, p < .001, \eta_p^2 = .80$ , and women,  $F(9, 153) = 83.34, p < .001, \eta_p^2 = .83$ . Planned contrasts revealed that, for men, the sexual stimuli produced higher subjective sexual arousal than the neutral stimuli,  $F(1, 162) = 17.16, p < .001$ , and the non-sexual stimuli,  $F(1, 162) = 11.83, p < .001$ . Non-sexual and neutral

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<sup>5</sup> An examination of raw scores (peak minus baseline) shows that men and women exhibited near zero responses to all non-sexual stimuli.

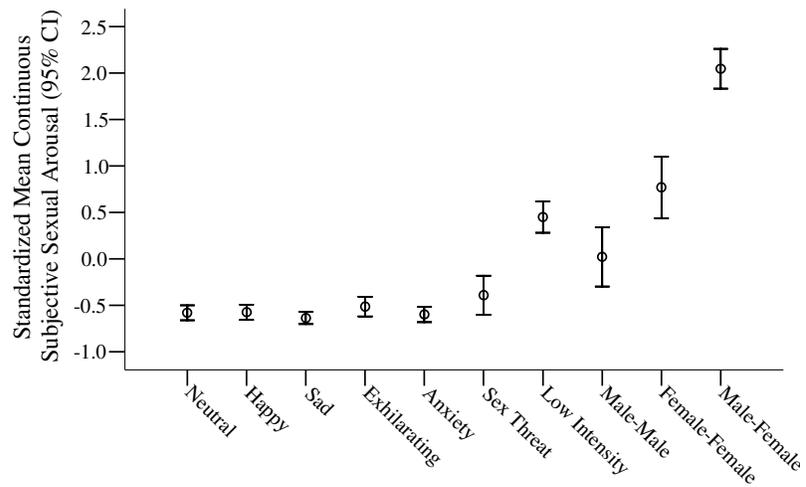
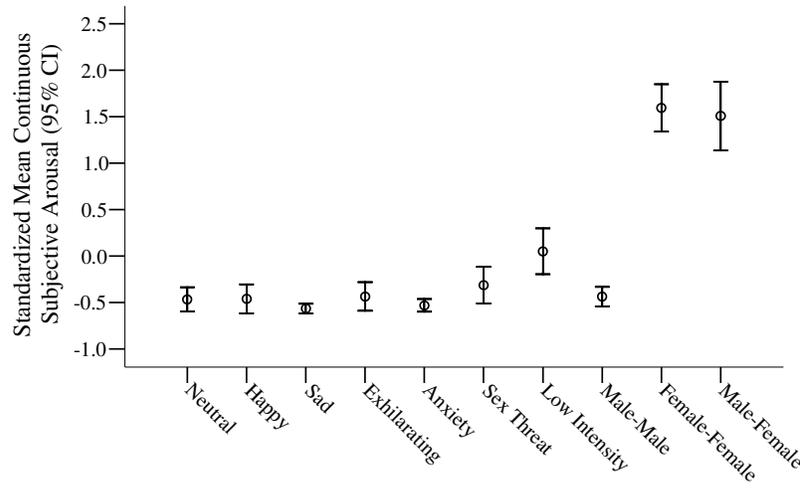


Figure 2.2 Standardized mean continuous subjective arousal responses in men (top portion) and women (bottom portion) as a function of stimulus category

stimulus categories did not produce significantly different subjective sexual arousal,  $F(1, 162) = .70, ns$ . Similarly, for women, planned contrasts revealed that the sexual stimuli produced higher subjective sexual arousal than the neutral stimuli,  $F(1, 153) = 23.58, p < .001$ , and the non-sexual stimuli,  $F(1, 153) = 15.74, p < .001$ . The non-sexual and neutral stimulus categories did not produce significantly different subjective sexual arousal,  $F(1, 153) = .03, ns$ . Similar to the data presented earlier for genital responses, the Greenhouse-Geisser correction was used when necessary, and yielded the same results.

**Blood Volume.** Figure 2.3 presents the standardized mean changes in blood volume for men and women. The figure shows that changes in blood volume did not vary in the expected direction. A 2 (sex) X 10 (stimulus category) ANOVA was conducted, and revealed a main effect of stimulus category  $F(9, 342) = 4.77, p < .001, \eta_p^2 = .11$ . A near significant interaction was also found between sex and stimulus category,  $F(9, 342) = 2.07, p = .05, \eta_p^2 = .05$ . Again, there was no significant sex difference, because the scores were standardized within subjects.

Simple effects were conducted for each sex and indicated a significant effect of stimulus category for both men,  $F(9, 171) = 3.25, p < .005, \eta_p^2 = .15$ , and women,  $F(9, 171) = 3.59, p < .001, \eta_p^2 = .16$ . For men, there were no significant differences in changes in blood volume between the sexual and non-sexual stimuli,  $F(1, 171) = 1.88, ns$ , the sexual

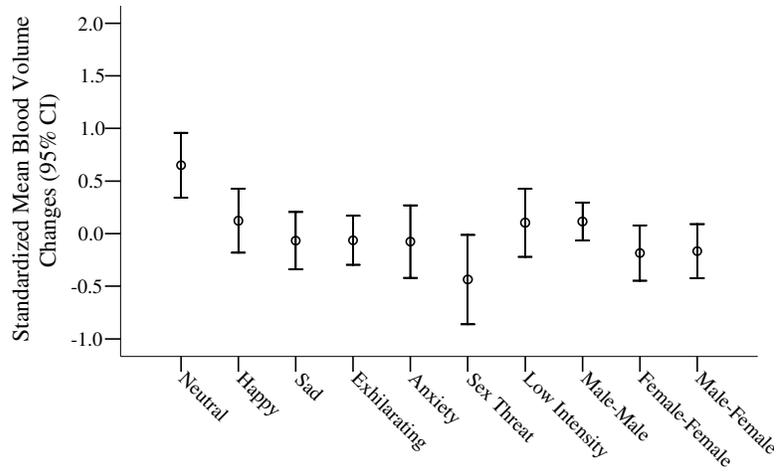
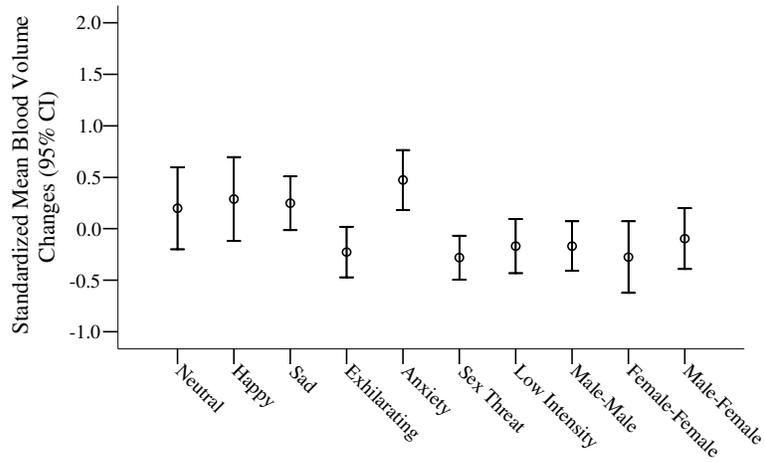


Figure 2.3 Standardized mean blood volume changes in men (top portion) and women (bottom portion) as a function of stimulus category

and neutral stimuli,  $F(1, 171) = 2.85$ , *ns*, and the non-sexual and neutral stimuli,  $F(1, 171) = .03$ , *ns*. Women showed significant differences in changes in blood volume between the neutral and non-sexual stimuli,  $F(1, 171) = 6.27$ ,  $p < .05$ , but not between the non-sexual and sexual stimuli,  $F(1, 171) = 1.02$ , *ns*. The difference in responses to the neutral versus the sexual stimuli approached significance,  $F(1, 171) = 3.70$ ,  $p = .06$ . All of these differences, however, were in the unexpected direction, in that the neutral stimuli produced the greatest change in blood volume overall.

The ANOVA described above for blood volume was conducted using the raw blood volume data to determine if there was a sex difference in overall blood volume responsiveness. The 2 (sex) X 10 (stimulus category) revealed a main effect of sex,  $F(1, 38) = 15.20$ ,  $p < .001$ ,  $\eta_p^2 = .29$ , and no interaction of sex by stimulus category,  $F(9, 342) = 1.04$ , *ns*. Overall, men experienced the greatest changes in blood volume in comparison to women.

### **Category-Specificity of Men and Women's Genital and Subjective Sexual Arousal**

The patterns of genital arousal shown in Figure 2.1 suggest a greater dispersion of responses among men compared to women. Men showed a clear preference for female-female and male-female stimuli, whereas women showed only a slight preference for these categories. In contrast, both men and women showed clear preferences with regard to subjective arousal (Figure 2.2). These patterns suggest that men were more category-specific with regard to their genital arousal, but not for subjective arousal.

As noted earlier, category-specificity scores were computed separately for the standardized genital and subjective sexual arousal responses for men and women. Higher scores indicate a higher degree of category-specificity (i.e., greater response to one category of sexual stimuli relative to all other sexual categories).

**Genital Arousal Category-Specificity.** An independent samples t-test was conducted to assess the sex differences in category-specificity for genital responses. The t-test revealed a significant sex difference,  $t(38) = 3.07, p < .005$ .<sup>6</sup> Overall, men had higher contrast scores in comparison to women ( $M = 1.53, SD = .62$  and  $M = 1.02, SD = .43$ , respectively), indicating that men responded more genitally to one category of stimuli than others, relative to women. Of relevance, most men experienced their highest genital responses to either the female-female stimuli (50%;  $n = 10$ ) or the male-female stimuli (40%;  $n = 8$ ). All men exhibited their highest response to only one stimulus category (i.e., no man had equally high responses to two stimulus categories). Women's genital responses were slightly more variable. Some women responded the most to either the female-female (25%;  $n = 5$ ) or male-female stimuli (45%;  $n = 9$ ), and the remaining women responded the highest to either the male-male stimuli (10%;  $n = 2$ ), the low intensity stimuli (5%;  $n = 1$ ), or the sexual threat stimuli (5%;  $n = 1$ ). Unlike men, two women (10%) showed equally high responses to two stimulus categories. Overall, 90% of men showed the highest arousal to a category that involved their stated preferred sexual partner. The corresponding value for women was 65%.

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<sup>6</sup> The assumption of equality of variance was examined for all t-tests reported in this study. The assumption was not met for only one test, and the result did not change when using the corrected t-value.

Because not all of the women who participated in the study reported sexual attractions or fantasies toward men exclusively, exploratory analyses were conducted to assess any differences in category-specificity for the two different groups of women, those who were predominantly heterosexual ( $n = 15$ ) and those who were exclusively heterosexual ( $n = 5$ ). No analyses were conducted for men because only one man reported any sexual attraction or fantasies directed toward men. Figure 2.4 presents the standardized mean genital sexual arousal responses for predominantly and exclusively heterosexual women, respectively. The figure suggests that predominantly heterosexual women exhibited a pattern of genital arousal that is more category-specific than exclusively heterosexual women. An independent samples t-test was conducted to determine whether predominantly heterosexual women had higher category-specific scores than exclusively heterosexual women. The t-test revealed a near significant difference between the two groups,  $t(18) = 2.10, p = .050$ , with predominantly heterosexual women exhibiting more category-specific genital responses ( $M = 1.12, SD = .41$ ) than exclusively heterosexual women ( $M = .70, SD = .32$ ).

**Subjective Arousal Category-Specificity.** An independent samples t-test was conducted to assess whether sex differences in category-specificity were present for continuous subjective sexual arousal. The t-test revealed no significant sex difference for category-specificity of subjective sexual arousal,  $t(35) = -1.01, ns$ . In contrast to the findings reported above, in which men's genital responses were more category-specific than women's, women's subjective sexual arousal ( $M = 1.91, SD = .46$ ) appeared to be

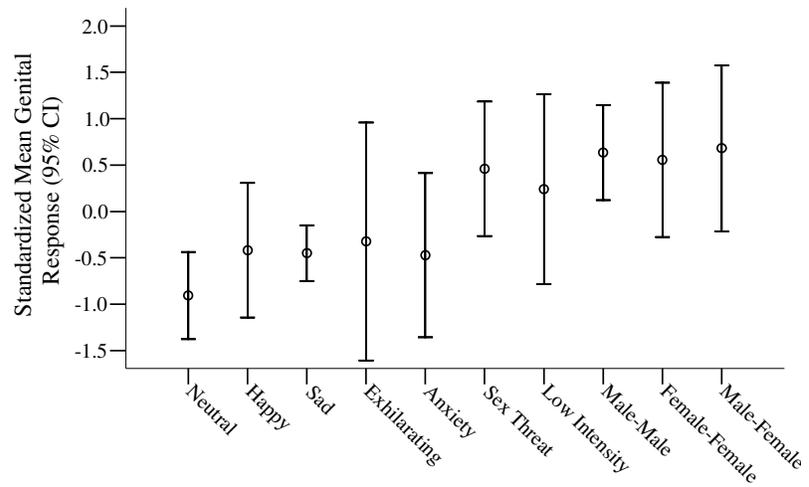
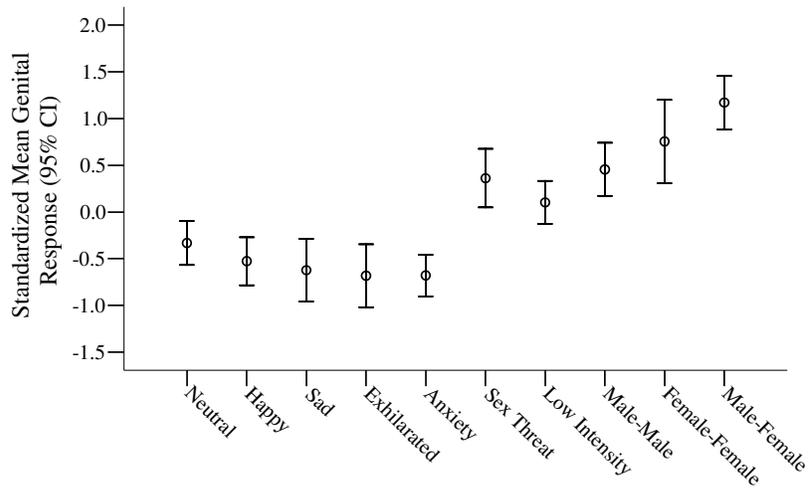


Figure 2.4 Standardized mean genital responses in predominantly heterosexual women (top portion) and exclusively heterosexual women (bottom portion) as a function of stimulus category

slightly more category-specific than men's ( $M = 1.77$ ,  $SD = .35$ ). This finding is likely the result of the nature of the specificity index used. On average, men reported high levels of subjective arousal to both the female-female and male-female stimuli and low levels of subjective arousal to the other sexual stimuli; women, however, reported their highest level of subjective arousal only during the male-female stimuli and lower levels of subjective arousal to all other sexual stimuli.

Similar to genital arousal category-specificity, exploratory analyses were conducted to assess differences in subjective sexual arousal category-specificity for the two groups of women (i.e., predominantly and exclusively heterosexual women). Figure 2.5 presents the standardized mean continuous subjective sexual arousal responses for these two groups. The figure suggests that overall, the two groups had a similar pattern of subjective sexual arousal, but that exclusively heterosexual women tended to respond more exclusively to the male-female category. An independent samples t-test was conducted to determine whether predominantly heterosexual women ( $n = 13$ ) were in fact less category-specific with respect to subjective arousal than exclusively heterosexual women ( $n = 5$ ). The t-test revealed a significant difference between the two groups,  $t(16) = 3.11$ ,  $p < .01$ , and in the direction opposite to what was reported for genital arousal: Predominantly heterosexual women exhibited *less* category-specific subjective arousal responses ( $M = 1.73$ ,  $SD = .33$ ) than exclusively heterosexual women ( $M = 2.35$ ,  $SD = .49$ ).

### **The Relationship Between Genital and Subjective Sexual Arousal**

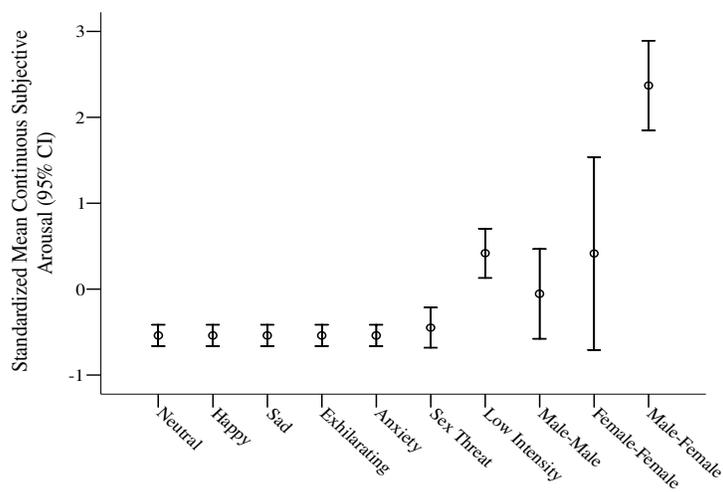
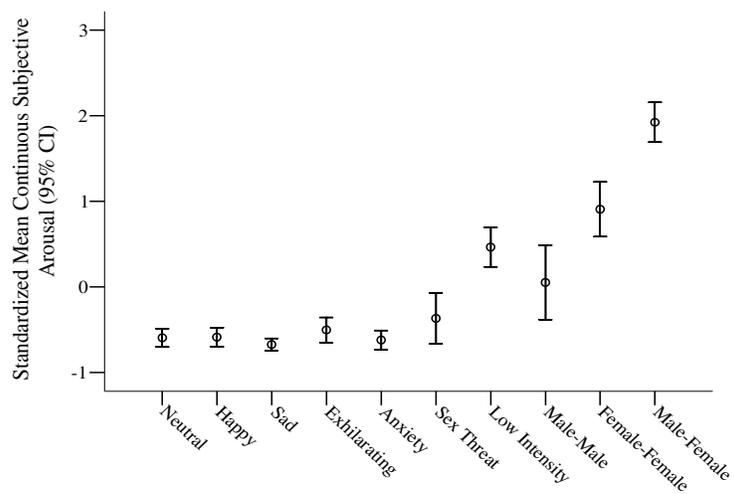


Figure 2.5 Standardized mean subjective arousal responses in predominantly heterosexual women (top portion) and exclusively heterosexual women (bottom portion) as a function of stimulus category

Three different within-subjects correlations were calculated to determine the presence of any sex differences in concordance between measures of sexual arousal. The first two correlations assessed the relationship between genital arousal and the two measures of subjective sexual arousal (i.e., continuous subjective sexual arousal and post-stimulus subjective sexual arousal). The third correlation assessed the relationship between the two subjective arousal measures, in order to determine if participants were responding in a similar manner to both types of subjective measures. The non-parametric correlations reported below are Spearman's rho.

The mean correlations across all stimuli for each sex are presented in Table 1 (top portion). Independent samples t-tests were used to assess the possibility of a sex difference in concordance. For correlations between genital responses and subjective responses, men were more concordant than women, but only the correlation between genital responses and post-stimulus subjective sexual arousal response showed a significant sex difference,  $t(37) = 2.04, p < .05$ . No significant sex difference was found for the correlation between the two measures of subjective sexual arousal, which showed very high concordance.

An independent t-test was conducted to assess any differences that might be present between predominantly heterosexual and exclusively heterosexual women. The exploratory analysis revealed that there were no significant differences for concordance between genital arousal and continuous subjective sexual arousal or genital arousal and post-stimulus subjective sexual arousal. There was a tendency for predominantly

Table 1. Mean correlations between genital and subjective measures of arousal for all stimuli (top portion) and sexual stimuli only (bottom portion)

All Stimulus Categories		
Type of Comparison	Men	Women
Genital-Continuous Subjective	0.534	0.480
Genital-Post Subjective	0.667	0.501
Post-Continuous Subjective	0.820	0.849

Only Sexual Stimuli		
Type of Comparison	Men	Women
Genital-Continuous Subjective	0.599	0.289
Genital-Post Subjective	0.722	0.320
Post-Continuous Subjective	0.848	0.851

heterosexual women ( $n = 13$ ) to be more concordant for both measures ( $M = .52$  and  $M = .54$ , respectively) than exclusively heterosexual women ( $n = 5$ ;  $M = .36$  and  $M = .40$ , respectively).

Because there was little genital and subjective sexual response to the non-sexual stimuli, it is possible that the low variance in genital and subjective responses to these stimuli could limit the size of the correlations between genital and subjective responses. Thus, correlations between genital and subjective responses to the sexual stimuli alone were also calculated. The means of these correlations are presented in Table 1 (lower portion). Results show that men were more concordant than women in their genital and continuous subjective arousal,  $t(35) = 2.53$ ,  $p < .05$ , and their genital and post-stimulus subjective arousal,  $t(36) = 4.03$ ,  $p < .001$ . Again, the correlation between the two measures of subjective sexual arousal was high and not different across the sexes. As indicated in Table 1, the men's average correlations increased slightly when considering only the correlations for sexual stimuli; for women, however, the average correlations dropped substantially, indicating that they were less concordant than men.

Regarding the two subgroups of women, the exploratory analysis revealed that the difference in concordance between genital arousal and both continuous subjective sexual arousal and post-stimulus subjective sexual arousal approached significance ( $p = .11$  and  $p = .07$ , respectively), even with such a small sample size. The predominantly heterosexual women ( $n = 13$ ) tended to be more concordant for both continuous and post-stimulus assessment ( $M = .38$  and  $M = .39$ , respectively) than exclusively heterosexual

women ( $n = 5$ ;  $M = .06$ , and  $M = .14$ , respectively).

### **Masculinity, Category-specificity, and Concordance in Women**

An index of masculinity was obtained by a factor analysis on all 40 participants of all of the measures that were expected to produce significant sex differences (i.e., PVCS; BSRI; LOS; physical aggression, verbal aggression, and hostility subscales of AQ; MROT; 2D:4D for left and right hands). The first and only clearly interpretable factor included the following measures: BSRI, physical aggression subscale of the AQ, verbal aggression subscale of the AQ, and the mean 2D:4D score for both the right and left hands (reverse-scored). These measures all had factor loadings higher than absolute 0.30. This factor explained 23% of the variance. An independent t-test revealed, as expected, a significant sex difference on the masculinity factor scores,  $t(38) = 2.12$ ,  $p < .05$ ; on average men had higher masculinity scores than women ( $M = .32$ ,  $SD = .96$  and  $M = -.32$ ,  $SD = .96$ , respectively).

The masculinity factor score was then correlated, among women, with the measures of category-specificity and concordance described above. The masculinity factor was not significantly correlated with any of the category-specificity or concordance indices. In general, however, the results indicated a positive relationship between masculinity and genital category-specificity,  $r = .25$ ,  $ns$ , but no relationship between masculinity and subjective category-specificity,  $r = -.05$ ,  $ns$ . Masculinity was negatively related to degree of concordance (ranging from  $r = -.41$  to  $r = -.29$ ). Non-parametric correlations

(Spearman's rho) revealed a significant negative relationship only between degree of masculinity and degree of concordance between genital and continuous subjective arousal,  $r = -.52, p < .05$ .

A second masculinity factor score was obtained using only the measures that produced a sex difference in this sample: the physical aggression subscale of the AQ,  $t(38) = 2.71, p = .05$ , the BSRI,  $t(38) = 2.10, p < .05$ , the LOS,  $t(38) = 3.81, p < .001$ , and the PVCS,  $t(38) = 1.71, p = .05$  (one tailed  $p$  values). A factor analysis was then conducted on these measures using all 40 participants. One clearly interpretable factor emerged. This factor accounted for 37% of the variance and included the BSRI, physical aggression subscale of the AQ, and PVCS (factor loadings above absolute 0.30). An independent t-test revealed a significant sex difference,  $t(38) = 4.25, p < .001$ ; on average men had higher factor scores than women ( $M = .56, SD = .76$  and  $M = -.56, SD = .90$ , respectively).

The masculinity factor score obtained from the second factor analysis was then correlated with measures of category-specificity and concordance among women. The masculinity factor was not significantly correlated with either genital arousal category-specificity,  $r = .08, ns$ , or subjective arousal category-specificity,  $r = -.03, ns$ . The masculinity factor was negatively and significantly correlated with degree of concordance between genital and continuous subjective sexual arousal for all stimulus categories,  $r = -.54, p < .05$ , and for only sexual stimulus categories,  $r = -.51, p < .05$ . A significant correlation was found between the masculinity factor and degree of concordance between genital arousal and post-stimulus subjective sexual arousal, but only when sexual stimulus categories were

considered,  $r = -.65$ ,  $p < .005$ . With the exception of the correlation between the masculinity factor and degree of concordance between genital arousal and continuous subjective sexual arousal, the correlations remained significant when using non-parametric analyses (Spearman's rho). Overall, women who were more masculine were not more category-specific either genitally or subjectively, but less concordant than less masculine women.

Independent samples t-tests were conducted to compare the masculinity factor scores of predominantly and exclusively heterosexual women. There were no significant differences using either factor score; in general, however, predominantly heterosexual women tended to be more masculine than exclusively heterosexual women on both the factor score using all measures expected to elicit a sex difference ( $M = -.18$ ,  $SD = 1.03$ , and  $M = -.73$ ,  $SD = .56$ , respectively) and the factor score using only those measures that did elicit a sex difference in the current study ( $M = -.52$ ,  $SD = .98$ , and  $M = -.66$ ,  $SD = .73$ , respectively).

## **DISCUSSION**

Results from the current study support the use of vaginal photoplethysmography as a measure of physiological arousal in women. Women, similar to men, experienced much more genital responses to sexual stimuli compared to non-sexual stimuli. As predicted, women's pattern of genital responses differed from men's, in that women's genital responses were less category-specific. Subjectively, men and women were both fairly category-specific, reporting higher levels of arousal to one or two sexual stimulus

categories compared to all other sexual stimulus categories. Women were also less concordant than men, exhibiting lower correlations between genital and subjective sexual arousal. Degree of masculinity had an unexpected effect on women's arousal patterns: Overall, higher masculinity was not associated with greater category-specificity and negatively associated with concordance between genital and subjective sexual arousal. These results are discussed below. Limitations associated with the study are discussed, as well as several lines of future research.

### **Vaginal Photoplethysmography as a Measure of Sexual Arousal**

The current study provides evidence that supports the use of vaginal photoplethysmography to assess physiological sexual arousal in women. Phallometry is accepted as a well-validated measure of sexual arousal in men (for reviews see Geer & Janssen, 2000; Rosen & Beck, 1988), but little research had been conducted on the validity of VPP. Both men and women exhibited their greatest genital responses to the sexual stimuli, and only sexual stimuli produced a genital response. This pattern of genital response mirrored subjective responses; only sexual stimuli generated subjective sexual arousal. The current study improves on previous research by assessing genital responses to a wide range of non-sexual, emotionally charged stimuli and a variety of sexual stimuli.

It was expected that emotionally charged stimuli (sexual or non-sexual) would produce changes in blood volume. In fact, the pattern of blood volume changes did not match the stimulus categories in the predicted direction. Past research has shown that changes in

blood pressure are greater in response to sexual stimuli compared to neutral stimuli, and that men show greater responses to sexual stimuli than women (e.g., Hoon et al., 1976; Sarlo et al., 2005). Overall, the men tested in the current study exhibited greater changes in blood volume than the women did, consistent with Sarlo et al.'s finding. The pattern of changes in blood volume in the current study, however, were in the opposite direction, in that the neutral stimuli appeared to produce the greatest changes in blood volume.

There are two possible interpretations of this finding. First, the measure of blood volume used in this study may not have been valid. Second, the emotional stimuli did not provoke an emotional response at the physiological level. The first possibility appears to be more likely, because participants reported feeling the intended emotions. The finger cuff is a fairly new instrument to assess blood volume, and there is no established protocol to score the responses. A perfect demonstration of the validity of vaginal photoplethysmography would be to show that non-sexual, emotionally charged stimuli produce physiological arousal but no changes in VPA, and that sexual stimuli produce both genital and general physiological arousal.

Although it appears that vaginal photoplethysmography accurately assesses sexual arousal in women, the degree of accuracy with which VPP can assess sexual *interest* in women is less clear. *Sexual arousal* refers to genital or subjective responses whereas *sexual interest* refers to some sort of ranking of arousal across different stimulus categories. As noted by Chivers (2005), men's sexual arousal appears to reflect their sexual interests: Men genitally respond the most to stimuli that involve their preferred

partner based on gender (e.g., Chivers et al., 2004; Chivers & Bailey, 2005, Freund et al., 1973) and age (Blanchard et al., 2001; Freund et al., 1973). Men's genital responses are used to infer sexual interest in forensic populations because phallogometric responses are more valid than self-report in this context (they match sexual history, whereas self-reported arousal does not). In women, the relationship between sexual arousal and interest is less clear: Women experience similar increases in genital arousal to preferred and non-preferred stimuli in this and other studies (e.g., Chivers et al. 2004; Chivers & Bailey, 2005). Because women's sexual interests may not be as closely linked to their genital arousal patterns, the usefulness of VPP as an assessment or diagnostic tool in forensic or clinical settings is likely limited, at least until women's patterns of genital arousal are better understood.

### **Category-Specificity of Genital and Subjective Arousal**

The results of the current study replicate past research indicating that men's genital responses are more category-specific than women's (e.g., Chivers et al., 2004; Chivers & Bailey, 2005; Chivers & Blanchard, 2006). The vast majority of men exhibited their highest level of genital response to either the male-female or female-female stimuli; none of the men responded equally to two stimulus categories. Women, however, were more variable in their responses; some women responded the most genitally to either the male-female or female-female stimuli and one third of the women either responded the most to one of the other sexual stimulus categories or equally to two sexual stimulus categories.

Previous research has indicated that, similar to genital responses, men's subjective responses are category-specific. Women's subjective responses are considered somewhat category-specific, because they typically report their highest level of arousal to one stimulus category, and a lower level of arousal to other stimulus categories (Chivers et al., 2004; Chivers & Bailey, 2005; Chivers & Blanchard, 2006). The results from the current study indicate that both men and women are category-specific in terms of their subjective sexual response. The fact that men appeared to be slightly less category-specific than women for subjective sexual arousal is likely the result of the nature of the specificity index used in the current study. As indicated by Figure 2.2, men reported high levels of subjective arousal to both the female-female and male-female stimuli and low levels of subjective arousal to the other sexual stimuli; women, however, reported their highest level of subjective arousal to the male-female stimuli and low levels of subjective arousal to all other sexual stimuli. The difference between women's subjective responses to the category that produced the highest level of response (the male-female stimuli) and the average of their responses to all other sexual stimuli is thus much larger than the difference between men's subjective responses to either the male-female or female-female stimuli and the average of their responses to all other sexual stimuli because men responded almost equally high to two stimulus categories.

Clearly, women's genital responses are more variable than men's. Perhaps this variability is the result of a greater erotic plasticity of the female sex drive. Baumeister (2000) suggested that the degree to which an individual's sex drive (in terms of general opinions, feelings of arousal, and behaviors) can be formed and modified by external factors such

as cultural and situational pressures is greater in women than in men. There are three basic tenets to Baumeister's theory: 1) women will show more intra-individual variation in sexual behavior over time than men; 2) women will be more susceptible to the influence of sociocultural variables than men; and 3) women will experience less sexual attitude-behavior consistency than men. The first and third tenets are particularly relevant for the concept of category-specificity. In terms of variation across time, it appears that women are much more flexible than men regarding sexual behaviors; in swinging populations, for example, same-sex sexual activities are common for women but rare in men (Fang, 1976). Harrison, Bennett, Globetti, and Alsikafi (1974) examined the influence of dating experience on sexual standards and found that as women accumulated more dating experience, they became more permissive in their sexual practices; men exhibited no change.

Some researchers also suggest that sexual orientation and identity are less stable in women. Diamond (2003) reported data collected from interviews with 80 non-heterosexual women between 18 and 25 years of age. Three separate interviews were conducted, one two years after initial contact was made, the other five years after initial contact. Initial interviews assessed the age at which participants first questioned their sexual identity, first experienced a same-sex attraction and contact, and first openly adopted a sexual minority identity (Diamond, 1998). The second set of follow-up interviews (i.e., the interviews conducted five years after the first interview) assessed how the participants perceived their sexual identity at the time of the interview. Forty-eight percent of the women interviewed changed their sexual identity label within the

five-year follow-up period. Slightly less than half of those women who relinquished their sexual minority identities adopted a heterosexual sexual identity, and the remainder adopted an unlabeled identity. Similarly, Rust (1993) presented non-heterosexual women with questionnaires regarding their sexual identity histories. Questions focused on whether psychological events (e.g., first awareness of homosexual attraction, first questioning of heterosexual sexual identity, first self-identification as lesbian or bisexual, and the number of times a respondent had questioned whether they had adopted the correct sexual minority identity) had taken place in their lives and at what age they had occurred. Rust's data indicated that one out of three lesbians had experienced a period of wondering whether she was bisexual since adopting a lesbian identity. Even more bisexual women wondered whether they were lesbians; one out of two bisexual women wondered whether they were lesbians since adopting a bisexual identity.

With respect to the association between sexual attitudes and behavior, it does appear that women are less consistent than men. For example, women have sex without desire more often than men do. O'Sullivan and Allgeier (1998) asked a university sample of men and women to record their sexual activities in a diary for a two-week period. Women reported engaging in unwanted sexual activity significantly more frequently than men. Women are also less consistent with respect to their attitudes and behaviors regarding safe sex.

Herold and Mewhinney (1993) asked men and women about condom use in a singles bar. Women reported a higher intention of using condoms and greater fear of sexually transmitted diseases than men, but actual condom use was not significantly different between the sexes.

Further demonstrating the greater flexibility of women, and consistent with the results of the present study, Rullo, Kinnish, and Strassberg (2006) found that heterosexual women were significantly more likely to report engaging in homosexual fantasies and experiencing homosexual romantic attractions than heterosexual men. The exclusion criteria employed in the current study were intended to bias participant selection in favor of heterosexual participants. Despite these criteria, a fair proportion of the women who participated in the study reported that they had experienced sexual attractions or engaged in sexual fantasies involving women ( $n = 15$ ). In comparison, only one man reported experiencing any sexual attractions or engaging in any fantasies involving men. Perhaps because men's sexual attitudes and behaviors are more rigid (or organized earlier in development), men only genitally respond to the stimuli that they prefer, whereas women genitally respond to a variety of stimuli categories because they are more flexible in their interests.

Due to the fact that there appeared to be two different groups of women who participated in the experiment (i.e., those who were exclusively heterosexual and did not report any sexual attraction or fantasies directed toward women, and those who were predominantly heterosexual and reported occasional sexual attraction or fantasies involving women), exploratory analyses were conducted to determine if "degree" of heterosexuality was related to category-specificity. The exploratory analyses revealed an intriguing finding: Women who reported being exclusively heterosexual tended to be less category-specific in terms of genital responses than women who were classified as predominantly

heterosexual. Another intriguing finding is that the exclusively heterosexual women were more category-specific than predominantly heterosexual women in terms of subjective sexual arousal. It is curious that women who report being exclusively attracted to and interested in men actually experienced greater genital arousal to more stimulus categories than women who admit to being occasionally attracted to or interested in other women. Why do these women report that they only feel subjectively aroused to one stimulus category (i.e., the male-female stimulus category), when they are actually genitally responding to many stimulus categories? The notion that women are less category-specific (genitally) because they have more “flexible” interests is not consistent with these findings.

### **Concordance of Genital and Subjective Arousal**

Both men and women exhibited a positive relationship between genital and subjective sexual arousal. Similar to previous findings (e.g., Chivers et al., 2005), women were less concordant than men overall. This sex difference was obtained for both types of subjective measures, but was maximized when subjective arousal was measured in a static manner, after stimulus offset. The two measures of subjective sexual arousal correlated highly with each other for both sexes, indicating that both men and women responded subjectively in a consistent manner.

Some research suggests that continuous measures of subjective arousal yield higher concordance rates. Chivers, Seto, Lalumière, and Laan (2006) found that when women

are asked to continuously rate their subjective arousal throughout a stimulus, concordance rates increase. The results from the current study are not consistent with this finding: The larger sex difference in concordance using post-stimulus assessments of subjective arousal appears to be caused by a decrease in concordance in men using continuous assessments of sexual arousal. Wincze et al. (1980) reported that continuous subjective monitoring can result in lower physiological responses in men, thereby influencing concordance levels. Another possibility is that men are more distracted than women when exposed to sexual stimuli, reducing the accuracy of self-reported arousal during stimulus presentation.

Exclusively heterosexual women tended to be less concordant overall than predominantly heterosexual women. The differences were not significant, likely because the sample size was quite small for the group of exclusively heterosexual women, and future studies should attempt to replicate this result. It seems that exclusively heterosexual women are more “feminine” in their patterns of arousal.

Why are women less concordant overall than men? How is it possible for them to be experiencing strong genital responses, but not report feeling sexually aroused or vice versa? Research outside of the realm of sexuality suggests that men and women rely on different strategies when assessing internal states. Pennebaker and Roberts (1992) reviewed gender differences in the perception of various bodily states, such as blood glucose levels, heart rate, and blood pressure. Two different paradigms are used in research on visceral perception: experimental settings in which a participant is tested in a

laboratory relatively free from external situational cues, and naturalistic settings in which a participant is required to estimate his or her physiological states throughout a normal day and then monitor the state in question. The review indicates that both men and women are better at estimating their physiological states when they are in naturalistic settings and have access to external situational cues. In experimental settings devoid of external situational cues, however, a clear sex difference emerges, in that men are more accurate at assessing bodily states than women when there is little information available from the environment. Perhaps this sex difference in perception of internal states is responsible for the fact that men are more concordant than women in laboratory assessments of sexual arousal. The experimental setting was designed to be as “natural” as possible, in that the participant was reclined in a comfortable chair and surrounded by a tasteful décor. Despite the attempt to make the experimental setting as comfortable and realistic as possible, it remained devoid of situational cues. Studies examining concordance in more naturalistic settings could provide a test of this possibility.

Another possible explanation is that men and women are designed differently in terms of their physiological and psychological response systems. As alluded to by Symons (1979), it may not be in a woman’s best interest to possess physiological and psychological sexual response systems that are strongly linked. Because women are choosier when it comes to sex, a lack of awareness of sexual arousal may help women make more judicious decisions.

Future research should test the possibility that there may be certain contexts in which

concordance should be expected to be maximized in women. For example, although it may be beneficial for a woman to be less aware of her sexual arousal when *judging* potential mates, it may not be beneficial to be unaware of arousal once she has reached a decision and is involved in an intimate relationship. It would likely be in a woman's best interests to be aware of sexual arousal in response to her current mate, in order to promote sexual activities in the relationship. Studies manipulating the content of sexual stimuli (e.g., a couple involved in a committed relationship versus a man and woman meeting and having sex without being in a committed relationship) could provide a test of this hypothesis.

### **Masculinity in Women and Sexual Arousal Patterns**

Degree of masculinity was not consistently and significantly related to either category-specificity (genital or subjective) or concordance in women. A general trend contrary to prediction was observed, however: Masculinity in women was negatively associated with concordance between genital and subjective arousal. Exclusively heterosexual women were slightly less masculine than predominantly heterosexual women, although this difference was not significant. Exclusively heterosexual women were also less "masculine" in terms of category-specificity and concordance. Although the results did not provide support for the original hypothesis that more masculine women would show a more "male-like" pattern of arousal, in terms of category-specificity and concordance, future studies of very feminine women may provide clues to psychosexual development. This issue will be discussed further in the final section of the Discussion.

## **Limitations**

There are limitations associated with the current study. One limitation involves the stimuli that were used. Although the current study improves upon past research by incorporating non-sexual stimuli of both a positive and negative valence, as well as several types of sexual stimuli, it is possible that other non-sexual stimuli that elicit other emotions could have produced a genital response. It would be beneficial in the future to incorporate emotions such as anger or disgust or humor into studies, to determine whether or not women experience genital responses to these intense emotions. For instance, Kukkonen et al. (2006) found no differences in peak systolic and peak diastolic velocity of clitoral blood flow in women who were presented with a humorous film in comparison to women who were presented with an erotic film. It is possible that the films employed in the current study did not elicit levels of humor similar to Kukkonen et al.'s, which may have contributed to the significant differences in genital responses between the non-sexual and sexual film clips.

Another limitation involves the presentation of a multitude of stimuli meant to elicit strong emotional responses over a fairly short period of time. Some research suggests that emotional arousal of any kind (positive or negative) can facilitate sexual arousal (e.g., Dutton & Aron, 1974; Meston & Frolich, 2003). One could argue that the emotional or physiological responses elicited by one stimulus could have influenced subsequent responses through this excitation transfer. This possibility is unlikely, however, for two

reasons. First, all participants viewed the stimuli in randomized orders that differed across participants. Because there were no genital responses to the non-sexual and neutral stimulus categories at all, it is unlikely that viewing non-sexual or neutral stimulus categories influenced responses to sexual stimuli. Second, an examination of the post-stimulus responses indicates that there were no carry-over effects in terms of self-reported emotions (Appendix 7); participants did not report high levels of positive emotions (e.g., happiness, exhilaration) in response to the negative non-sexual films and vice versa.

The calculation of concordance used in the current study was quite simplistic. The correlations that were computed in the current study were based on a single piece of information (for each stimulus) from the data recorded for genital response and subjective response (i.e., the difference between the highest point and the trial's baseline level). More complex analyses, such as time series analysis, could allow for the calculation of changes in both types of arousal in real time, to determine concordance at a finer level of analysis.

There are two limitations regarding the relationship between degree of masculinity and category-specificity and concordance. The first limitation is that few of the sexually dimorphic measures actually produced a sex difference. Men and women performed almost equally well on the mental rotation task; this finding is quite unusual because the vast majority of research suggests that the sex difference on mental rotation is the most consistent sex difference in cognitive abilities (Voyer et al., 1995). Likewise, only one of

the three subscales of the Aggression Questionnaire (Buss & Perry, 1992) known to elicit higher scores in men did so; one of the subscales (Anger) even yielded higher scores for women. 2D:4D was also not significantly different between the sexes. These results suggest that perhaps the sample of participants tested was somewhat unique. It should be kept in mind, however, that typically large samples are required to obtain significant sex differences on these measures.

The second limitation related to the masculinity index pertains to the use of factor analysis to determine whether degree of masculinity was associated with degree of category-specificity and concordance. The sample size required to conduct a factor analysis is typically larger than that of the one employed in the current study. Also, it is possible that the effect of masculinity on category-specificity is quite small and would be difficult to detect in a small sample size.

Lastly, the generalizability of the results is questionable. A well-known selection bias exists in sexual psychophysiological research, such that individuals who volunteer to participate in experiments pertaining to sex are typically more sexually experienced, less concerned about their performance, and have been exposed to more erotica than non-volunteers (Wolchik et al., 1985). Chivers et al. (2004) have suggested that the simple fact that volunteers differ from non-volunteers in terms of sexual experience should not imply that volunteers' patterns of arousal are significantly different from non-volunteers. Chivers et al. found that levels of cooperation were not associated with arousal patterns in women, suggesting that there may be no difference in arousal patterns between

volunteers and non-volunteers. Despite this finding, it is still important to note that the results from the current study may only be generalizable to individuals similar to those who participated in the study.

### **Future Directions**

Little research has been conducted in the area of women's sexual arousal, as evidenced by the fact that only three studies until now have been concerned with testing the discriminative validity of vaginal photoplethysmography, in comparison to the dozens of studies that have been conducted to assess the validity of phallometry. Male sexual arousal is well understood and somewhat simple, but female sexual arousal seems complex and is poorly understood. Three areas of future research are outlined below.

**The Generality of Category-Specificity.** Most researchers have noted that women's genital arousal appears to be organized differently from that of men's (e.g., Chivers & Blanchard, 2006). Men are said to be category-specific with respect to their sexual arousal; that is, they respond highly to stimuli that involves content that reflects their subjective preferences for the most part. This is true for gender preferences (e.g., Chivers et al., 2004; Chivers & Bailey, 2005; Chivers & Blanchard, 2006; Freund et al., 1973; Sakheim, Barlow, Beck, & Abrahamson, 1985), age preferences (e.g., Seto et al., 2000), fetishistic object preferences (Blanchard, Racansky, & Steiner, 1986), and sexual activities (e.g., Lalumière et al., 2003).

Women, however, are not category-specific with respect to *gender*; on average women

respond similarly to sexual stimuli depicting *either* men or women. Only recently has level of sexual activity (e.g., no sexual activity, solitary sexual activity, and partnered sexual activity) been assessed to determine whether or not women can be category-specific in other ways (Chivers & Blanchard, 2006). When considering level of activity, it appears that women are in fact category-specific, similar to men: Both women and men experienced their greatest genital responses to stimuli depicting explicit partnered sexual activity in comparison to stimuli depicting nude men or women engaging in non-sexual activity or masturbation. One limitation associated with the Chivers and Blanchard study, however, is that category-specificity could not be inferred for responses to qualitatively different activities of the same intensity.

Only two published studies to date has investigated the nature of women's responses to different kinds of sexual activity (i.e., "deviant" versus "normal"). The first study has been described earlier (Laan et al., 1995). The second study was conducted more recently, using Laan et al.'s stimuli (Both, Everaerd, & Laan, 2003). In Both et al.'s study, men and women were presented with a consensual sexual film clip and a sexually threatening film clip: Both men and women responded more to the consensual film clip than to the sexually threatening clip, and both sexes exhibited genital responses to the sexually threatening clip that were greater than their responses to a neutral stimulus. No other research has investigated the possibility that women may be category-specific with respect to the nature of the activity that is depicted. For example, do men and women differ in their responses to sadomasochistic and non-sadomasochistic stimuli? Or stimuli depicting groups of people having sex?

Behaviorally, men appear to be much less category-specific than women with regard to sexual activities. Baumeister (2000) noted that most researchers report a sex difference with respect to paraphilias or deviant sexual interests: Men are typically more afflicted by paraphilias than women, and many men with paraphilias exhibit more than one (Abel & Rouleau, 1990; Freund, Seto, & Kuban, 1997; Långström & Seto, 2006). Abel and Rouleau interviewed 561 male sex offenders and found that over half of the adult offenders who exhibited deviant sexual interests before age 18 reported having two different paraphilias. On average, these individuals reported an average commission of 380 sex offenses by young adulthood. Freund et al. compared 847 clinical patients (i.e., men who had engaged in at least one act of exhibitionism, voyeurism, frotteurism, or rape) with 162 control participants (i.e., men who reported that they had never engaged in these behaviors). Their results indicated that voyeurism, exhibitionism, and frotteurism were closely related. The presence of multiple paraphilias is not a unique characteristic of sex offenders. Långström and Seto investigated the co-occurrence of paraphilias in respondents to a national survey in Sweden and found that men were more likely to report paraphilic behaviors and that those respondents who reported either exhibitionistic or voyeuristic behaviors were significantly more likely to engage in other paraphilic behavior, such as sadomasochistic behavior and cross-dressing.

Similarly, men typically prefer greater partner variety than women overall. Bailey, Gaulin, Agyei, and Gladue (1994) investigated several sexually differentiated aspects of mating psychology in heterosexual and homosexual men and women. Bailey et al. found

that, overall, men were significantly more likely than women to report being interesting in uncommitted sexual relationships. Dowsley (1996) assessed university students' interest in long-term committed relationships by administering the PVCS (Lalumière et al., 1996) at two different times over the course of the school year (the beginning and end of the first university semester). Results indicated that men were less likely to prefer long-term committed relationships than women. Men's interest in uncommitted relationships also seemed to increase over time, as men had significantly higher PVCS scores during the second testing phase than the first phase. There were no changes for women.

Likewise, no published data exist on women's genital responses to sexual stimuli involving actors of varying ages. Non-sex offending heterosexual men are quite category-specific in this regard, in that they show their greatest arousal to stimuli depicting young adult women. Stimuli depicting young adolescent and child females elicit much lower responses (Freund et al., 1973; Quinsey et al., 1975; Quinsey et al., 1996). A study of viewing time suggests that women are much less attracted to male adolescents than male adults (Quinsey et al., 1996), suggesting that they may be, like men, category-specific with respect to age.

Another issue involves the definition of category-specificity. Most researchers suggest that category-specificity is related to one's *sexual preferences*, such that if an individual responds highly to stimuli with *preferred* activities or partners depicted it is concluded that he or she is category-specific (e.g., Chivers & Blanchard, 2006). The problem with

that definition is that some individuals may respond genitally the most or exclusively to a non-preferred stimulus category (as some women in this study did); perhaps category-specificity should not be defined in terms of *preferences*, but rather in terms of general response patterns, such that an individual who responds significantly more to one category of stimuli than others, regardless of stated preference, may be described as category-specific, because most of his or her response output was directed at one category. The index used in the current study to assess category-specificity did not follow the typical definition of category-specificity (i.e., higher responses to stimulus category depicting preferred partner), but rather the more generalized definition of category-specificity proposed here.

**Responses to Female-Female Stimuli in Heterosexual Women.** As noted, past research indicates that heterosexual women respond genitally to stimuli that depict not only male-female sex, but male-male and even female-female sex (e.g., Chivers et al., 2004; Chivers & Bailey, 2005; Chivers & Blanchard, 2006).<sup>7</sup> Chivers (2005) suggested that a non-specific pattern of genital response in women may be related to the automaticity of genital arousal in response to sexual stimuli in general, preferred or not. She suggested that women are responding to any cues of sexual activity as a protective mechanism to avoid severe genital damage during a potential sexual assault.

In this and other studies, women responded very highly to female-female sex.<sup>8</sup> Another

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<sup>7</sup> Low category-specificity in women was first reported by Laan, Sonderman, and Janssen (1995), but first clearly documented by Chivers et al. (2004).

<sup>8</sup> In Chivers' studies, the female-female stimuli included penetration (through the use of strap-on dildos), leaving open the possibility that the women were responding genitally to this "heterosexual" aspect of the

clue to explaining this finding may be found in men and women's sexual fantasies. Some researchers suggest that there is a sex difference in the content of sexual fantasies. Men tend to see themselves as active participants in their fantasies, such that the target women are the objects of desire in the fantasy. Women, however, tend to fantasize about being the recipients of the sexual activity (Mednick, 1977). Money and Erhardt (1972) suggested that this pattern is a result of different psychological processes: A man may fantasize about a woman or see a woman in an erotic film as an object. He then removes her from the fantasy or film and then envisions having sex with her. Women, however, do not see men as objects in their sexual fantasies; instead, women identify with the woman depicted in a sexual fantasy or film, and imagine themselves as the object of the partner's passion. Ellis and Symons (1990) presented men and women with a questionnaire about the content of their sexual fantasies and the importance of different factors (e.g., setting, partner's personality, and activities). Women were two and a half times more likely to report that they focused on their own responses during a fantasy and that their imaginary partner's response to them is more important than the visual image of that partner. The women who participated in the present experiment may have been envisioning themselves as the recipient in the sexual stimuli, resulting in relatively high levels of arousal to all categories, even to the category that does not include men. Men, on the other hand, did not respond to the male-male stimuli because that category did not involve their preferred partner. Future studies could manipulate instruction set ("imagine having sex with the person depicted in the film" versus "imagine you are the person shown in the film") to investigate these ideas.

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sexual interaction. The female-female stimuli used in the current study did not include, by design, any penetration. Female participants still showed significant genital responses to these stimuli.

**Exclusive Versus Predominantly Female Heterosexuality.** It is obvious that the sample of women who participated in the current study was composed of two distinct groups. All women reported their sexual orientation as heterosexual, but closer inspection of their scores on the Kinsey Scale indicated that many were not exclusively heterosexual, but rather predominantly heterosexual. Comparisons of genital responses and subjective responses between the two groups of women revealed intriguing results: The women who claimed to be exclusively heterosexual and reported no sexual attractions or fantasies toward women were less category-specific (genitally) than women who admitted to the occasional sexual attraction or fantasy involving a woman.

Perhaps there is some underlying factor causing the two groups of women to respond differently. Personality characteristics may differ between the two groups, such as sex guilt. Sex guilt involves the tendency to punish oneself for violating internalized standards for sexual behaviors (Mosher, 1966). Morokoff (1985) presented women with either a non-erotic or erotic film clip. The non-erotic film clip depicted a man and woman eating breakfast and the woman envisioning herself in several dreams; the erotic film clip depicted a man and woman engaging in kissing, caressing, genital stimulation, and intercourse. After watching either film clip, participants were asked to engage in an erotic fantasy and then write out the fantasy. Physiological changes in arousal were assessed using the VPA component of vaginal photoplethysmography. Participants were also asked to report how subjectively aroused they felt. Women who were high in sex guilt reported lower levels of subjective arousal than low sex guilt women, but actually

experienced significantly greater genital responses than low sex guilt women in the erotic film condition. Based on Morokoff's findings, perhaps women who do not report any sexual attraction or fantasies directed toward members of the same sex are higher in sex guilt than women who experience (and report) sexual attraction or fantasies involving other women. Future studies should assess sex guilt and other potentially relevant personality features to examine intra-sex differences in genital responding.

Similarly, perhaps there are behavioral differences between the two groups. Laan and Everaerd (1995) performed a meta-analysis of six studies that had been conducted in their laboratory to assess the determinants of sexual arousal. Multiple regression analyses revealed that there were different predictors of genital and subjective sexual arousal. Higher genital arousal was associated with youth (i.e., younger women experienced greater genital arousal) and religious conviction. Also, women with no previous exposure to erotic stimuli experienced greater genital responses. Higher subjective arousal was also associated with little previous exposure to erotic stimuli, but also with higher masturbation frequency and higher intercourse frequency. Perhaps the predominantly heterosexual women in the current study were more sexually experienced, which resulted in greater awareness of arousal that resulted in greater category-specificity and higher concordance.

There were only a few relevant sexual history indicators that were assessed in the current study. Overall, there were no significant differences between the two groups of women with respect to number of sexual partners, age at first intercourse, frequency of

masturbation, exposure to erotica, or sexual desire. Exclusively heterosexual women tended to be more satisfied with their current intimate relationship than predominantly heterosexual women. Of course, it is difficult to see a clear pattern of results with such a small group, and future studies of larger samples are necessary.

## **Conclusion**

The results of this study indicate that vaginal photoplethysmography is an accurate and valid measure of sexual arousal in women. VPP has the ability to differentiate between various types of stimuli; the highest arousal is observed in response to sexual stimuli, and equally low levels of arousal tend to occur in response to non-sexual but emotionally charged stimuli and neutral stimuli. Low category-specificity of genital arousal and low concordance between genital and subjective arousal in women appear to be more than simple by-products of the difficulty in measuring female sexual arousal; they are valid phenomena in need of explanation. Likewise, several other issues related to sexual arousal in women are in need of further exploration and explanation. The development of a valid measure of genital arousal will allow researchers to better study women's complex sexuality.

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## **APPENDIX 1**

### **Recruitment Advertisements**

## **Newspaper Advertisement**

### **SEXUAL AROUSAL STUDY**

Dept. of Psychology at the University of Lethbridge

is seeking participants

Men & Women 18-28

\*reimbursement for time\*

Contact Kelly for more info:

329-2430

sexualarousallab@ gmail.com

## Poster Advertisement

# VOLUNTEERS

## NEEDED



Participation Includes:

- Men and Women 18—28
- Watching short film clips
- Measuring sexual arousal
- Completing questionnaires

## SEXUAL AROUSAL STUDY

Participation is individual, confidential, and anonymous.

Participants will be reimbursed for their time.

For more information contact:

**KELLY** at 329-2430

Department of Psychology  
University of Lethbridge

## **APPENDIX 2**

### **QUESTIONNAIRES**

Note: Only questionnaires that have not been published elsewhere are included in this appendix. The Preference for Partner Variety and Casual Sex Scale (Lalumière et al., 1996), Relationship Assessment Scale (Hendrick, 1988), Bem Sex Role Inventory (Bem, 1974), and Aggression Questionnaire (Buss & Perry, 1992) are not included. Some of the questions included in the Sexual History Questionnaire have been developed from Chivers (2004).

Key:

BQ – Biographic Questionnaire

SHQ – Sexual History Questionnaire (including Kinsey Scale questions on p. 136)

LOS – Lippa Occupation Survey (short version)

AS – Arousal Study General Questions



# Arousal Study 2006-2007

**PLEASE DO NOT WRITE IN THIS AREA**

Participant ID #: \_\_\_\_\_

Date Completed: \_\_\_\_\_

Initials of Experimenter: \_\_\_\_\_

Date Data Entered: \_\_\_\_\_

Please note that this study is completely confidential and anonymous. Your name cannot be linked to your responses and responses will not be examined before the study is completed. Please answer as honestly as possible.

University of  
**Lethbridge**





## Questionnaire

This questionnaire asks about your personal information, relationship satisfaction, sexual experiences, sexual behaviours, sexual orientation, and typical sexual responses to sexual stimuli in adulthood (since age 18). You will also be asked questions about your personality. Each section has directions, in bold type, on how to answer the questions. Please read the directions and questions carefully, and place a checkmark in the circle of the answer that most applies to you, or write your answer in the space provided.

If a question does not apply to you, please write NA (not applicable) in the space provided. If you do not feel comfortable answering a question, please draw a slash through it and go to the next question.

When you have finished answering the questionnaire, please put it in the envelope provided. Remember, all of your answers are completely confidential and identified by a participant identification number only.



The following questions ask about your personal information. Please read each question carefully and either place a checkmark in the circle of the answer that best describes you, or write your answer in the space provided. Remember, all of your answers are completely confidential.

1. Age: \_\_\_\_\_
2. Date of Birth (DD/MM/YY): \_\_\_\_\_
3. Relationship Status:
 

<input type="radio"/> Single	<input type="radio"/> Married
<input type="radio"/> Dating	<input type="radio"/> Common Law
<input type="radio"/> Engaged	<input type="radio"/> Divorced
<input type="radio"/> Widowed	
4. If you are currently in a relationship please state the length of that relationship:  
\_\_\_\_\_ years OR \_\_\_\_\_ months
5. How many children do you have? \_\_\_\_\_
6. Ethnic Background:
 

<input type="radio"/>	_____				
Caucasian	African	First	Asian	Other (please specify)	
	American	Nations			
7. Highest Level of Education Completed:
  - Completed Grade 8
  - Some high school completed (grades 9-11)
  - Graduated from high school, or equivalent
  - Vocational, trade or business school completed
  - Community college – currently attending or completed diploma
  - University – currently attending or completed bachelor's degree
  - Graduate or professional school (M.A., Ph.D., M.B.A., M.D.) – currently attending or completed degree
8. Sexual Orientation:
 

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	_____
Heterosexual	Bisexual	Homosexual	Other (please specify)	
9. Which hand do you use predominantly to write with?
 

<input type="radio"/>	<input type="radio"/>
Left	Right



10. How many of the following do you have:

- a. older brothers \_\_\_\_\_ b. younger brothers \_\_\_\_\_  
c. older sisters \_\_\_\_\_ d. younger sisters \_\_\_\_\_

11. How many of the following are you biologically related to through your mother:

- a. older brothers \_\_\_\_\_ b. younger brothers \_\_\_\_\_  
c. older sisters \_\_\_\_\_ d. younger sisters \_\_\_\_\_

12. Are you currently employed at a paid job?

- Yes, full-time                       No, full-time homemaker  
 Yes, part-time                       No, retired  
 No, full-time student               No, currently unemployed

If yes, what is your current position/title? \_\_\_\_\_

13. What is the total amount of money your household earned last year?

- Less than \$10 000                       \$40 001 to \$50 000  
 \$10 001 to \$20 000                       \$50 001 to \$75 000  
 \$20 001 to \$30 000                       \$75 000 to \$100 000  
 \$30 001 to \$40 000                       More than \$100 000

14. What are your parents' occupations: Father \_\_\_\_\_ Mother \_\_\_\_\_

15. Did you use any of the following substances or beverages today? Please check all that apply.

- Beverage containing caffeine (e.g., coffee, tea, Coke, Mountain Dew)  
 Alcohol  
 Marijuana  
 Tobacco  
 Other recreational drug  
 I did not use any of these substances/beverages

16. Do you engage in regular physical activity?                       Yes                       No

17. If Yes, how many times per week? \_\_\_\_\_



18. Did you engage in physical exercise today?  Yes  No
19. If Yes, how many hours did you exercise before coming into the laboratory today? \_\_\_\_\_
20. Do you have a history of mental illnesses?  Yes  No
21. If Yes please list them: \_\_\_\_\_  
\_\_\_\_\_
22. Do you currently have a sexually transmitted disease?  Yes  No
23. If Yes please list them: \_\_\_\_\_
24. Did you take any medications today?  Yes  No
25. If yes please list what you took: \_\_\_\_\_  
\_\_\_\_\_

**If you are a WOMAN, please continue to answer the following questions.**

**If you are a MAN, please ignore the following questions and begin answering the questions on the next page.**

**WOMEN:**

26. Do you currently use hormonal contraceptives?  Yes  No  
If yes, please list the name below \_\_\_\_\_
27. How long (in days), on average, is your monthly cycle? (From the beginning of one period to the next?) \_\_\_\_\_ days
28. How many days do you typically menstruate/bleed for? \_\_\_\_\_ days
29. What date did your last period begin? (e.g., June 27; if you know the day of the week but are not sure about the correct date, please look at the calendar on the table)  
\_\_\_\_\_ (day) \_\_\_\_\_ (month)
30. Are you currently pregnant?  Yes  No



The following questions ask about your romantic and sexual attractions, sexual contacts, and sexual identity, in adulthood. Please read each question carefully and read the options presented after each question. Please check the circle next to the response that best describes you. Remember, all of your answers are completely confidential.

1. Please think about the people you have typically been romantically attracted to. By “romantically” attracted we mean a deep emotional connection that is more than friendship. Would you say that your romantic attractions are toward:
  - Women only
  - Women mostly, but men occasionally too
  - Women mostly, but men frequently (but not more than toward women)
  - Women and men about equally
  - Men mostly, but women frequently (but not more than toward men)
  - Men mostly, but women occasionally too
  - Men only
2. Please think about the people you have typically been sexually attracted to. By “sexually” attracted we mean you experience sexual desire or interest in someone. Would you say that your sexual attractions are toward:
  - Women only
  - Women mostly, but men occasionally too
  - Women mostly, but men frequently (but not more than toward women)
  - Women and men about equally
  - Men mostly, but women frequently (but not more than toward men)
  - Men mostly, but women occasionally too
  - Men only
3. Please think about the people you typically have sexual fantasies about. By a “sexual fantasy” we mean sexual scenarios or daydreams you think about, and may use when masturbating and/or having sex with a partner. Would you say your sexual fantasies are about:
  - Women only
  - Women mostly, but men occasionally too
  - Women mostly, but men frequently (but not more than about women)
  - Women and men about equally
  - Men mostly, but women frequently (but not more than about men)
  - Men mostly, but women occasionally too
  - Men only



4. Now, please think about having sexual contact with a man. If this is difficult for you to imagine, try thinking about being in one of the films you saw today. How sexually interested or excited do you feel by the thought of having sex with a man?
- Not at all                       Definitely
- A little bit                       Extremely
- Somewhat
5. Keep thinking about having sexual contact with a man. How “turned-off” or disgusted do you feel by the idea of having sex with a man?
- Not at all                       Definitely
- A little bit                       Extremely
- Somewhat
6. Now, please think about having sexual contact with a woman. If this is difficult for you to imagine, try thinking about being in one of the films you saw today. How sexually interested or excited do you feel by the thought of having sex with a woman?
- Not at all                       Definitely
- A little bit                       Extremely
- Somewhat
7. Keep thinking about having sexual contact with a woman. How “turned off” or disgusted do you feel by the idea of having sex with a woman?
- Not at all                       Definitely
- A little bit                       Extremely
- Somewhat
8. Do you define your sexual identity as...
- Gay
- Lesbian
- Bisexual
- Heterosexual
- Asexual
- Other, please specify: \_\_\_\_\_





**For questions 23 through 37, please consider an average month from the past year.**

23. How many times, per month, do you typically desire sexual contact with a partner? \_\_\_\_\_

24. How many times, per month, do you typically have sexual contact with a partner? \_\_\_\_\_

25. How often do you usually reach orgasm during sexual intercourse with a man? If you haven't had sexual contact with a man in the past year, consider your past sexual contacts with men when answering this question.

- Never
- Rarely (between 1% and 20% of sexual contacts)
- Fairly often (between 21% and 40% of sexual contacts)
- Often (between 41% and 60% of sexual contacts)
- Usually (between 61% and 80% of sexual contacts)
- Almost always (between 81% and 99% of sexual contacts)
- Always (100% of sexual contacts)
- Never had sexual intercourse with a man

26. How often do you usually reach orgasm during vaginal contact with a man? If you haven't had sexual contact with a man in the past year, consider your past sexual contacts with men when answering this question.

- Never
- Rarely (between 1% and 20% of sexual contacts)
- Fairly often (between 21% and 40% of sexual contacts)
- Often (between 41% and 60% of sexual contacts)
- Usually (between 61% and 80% of sexual contacts)
- Almost always (between 81% and 99% of sexual contacts)
- Always (100% of sexual contacts)
- Never had vaginal sexual contact with a man



27. How often do you usually reach orgasm during anal contact with a man? If you haven't had sexual contact with a man in the past year, consider your past sexual contacts with men when answering this question.
- Never
  - Rarely (between 1% and 20% of sexual contacts)
  - Fairly often (between 21% and 40% of sexual contacts)
  - Often (between 41% and 60% of sexual contacts)
  - Usually (between 61% and 80% of sexual contacts)
  - Almost always (between 81% and 99% of sexual contacts)
  - Always (100% of sexual contacts)
  - Never had anal sexual contact with a man
28. How often do you usually reach orgasm during oral sex with a man? If you haven't had sexual contact with a man in the past year, consider your past sexual contacts with men when answering this question.
- Never
  - Rarely (between 1% and 20% of sexual contacts)
  - Fairly often (between 21% and 40% of sexual contacts)
  - Often (between 41% and 60% of sexual contacts)
  - Usually (between 61% and 80% of sexual contacts)
  - Almost always (between 81% and 99% of sexual contacts)
  - Always (100% of sexual contacts)
  - Never had oral sexual contact with a man
29. How often do you usually reach orgasm during sexual intercourse with a woman? If you haven't had sexual contact with a woman in the past year, consider your past sexual contacts with women when answering this question.
- Never
  - Rarely (between 1% and 20% of sexual contacts)
  - Fairly often (between 21% and 40% of sexual contacts)
  - Often (between 41% and 60% of sexual contacts)
  - Usually (between 61% and 80% of sexual contacts)
  - Almost always (between 81% and 99% of sexual contacts)
  - Always (100% of sexual contacts)
  - Never had sexual intercourse with a woman



30. How often do you usually reach orgasm during vaginal contact with a woman?  
If you haven't had sexual contact with a woman in the past year, consider your past sexual contacts with women when answering this question.
- Never
  - Rarely (between 1% and 20% of sexual contacts)
  - Fairly often (between 21% and 40% of sexual contacts)
  - Often (between 41% and 60% of sexual contacts)
  - Usually (between 61% and 80% of sexual contacts)
  - Almost always (between 81% and 99% of sexual contacts)
  - Always (100% of sexual contacts)
  - Never had vaginal sexual contact with a woman
31. How often do you usually reach orgasm during anal contact with a woman? If you haven't had sexual contact with a woman in the past year, consider your past sexual contacts with women when answering this question.
- Never
  - Rarely (between 1% and 20% of sexual contacts)
  - Fairly often (between 21% and 40% of sexual contacts)
  - Often (between 41% and 60% of sexual contacts)
  - Usually (between 61% and 80% of sexual contacts)
  - Almost always (between 81% and 99% of sexual contacts)
  - Always (100% of sexual contacts)
  - Never had anal sexual contact with a woman
32. How often do you usually reach orgasm during oral sex with a woman? If you haven't had sexual contact with a woman in the past year, consider your past sexual contacts with women when answering this question.
- Never
  - Rarely (between 1% and 20% of sexual contacts)
  - Fairly often (between 21% and 40% of sexual contacts)
  - Often (between 41% and 60% of sexual contacts)
  - Usually (between 61% and 80% of sexual contacts)
  - Almost always (between 81% and 99% of sexual contacts)
  - Always (100% of sexual contacts)
  - Never had oral sexual contact with a woman
33. How many times, per month, do you typically masturbate? \_\_\_\_\_



34. How often do you reach orgasm when you masturbate?
- Never
  - Rarely (between 1% and 20%)
  - Fairly often (between 21% and 40%)
  - Often (between 41% and 60%)
  - Usually (between 61% and 80%)
  - Almost always (between 81% and 99%)
  - Always (100%)
  - I do not masturbate
35. How often do you find yourself thinking about sex with interest or desire?
- Never
  - Less than once per month
  - Once per month
  - Once per week
  - Several times a week
  - Once per day
  - Several times per day
36. How often do you have trouble becoming or staying mentally sexually aroused?
- Never
  - Less than half of the time
  - About half of the time
  - More than half of the time
  - All the time
37. How often do you have trouble becoming or staying physically sexually aroused?
- Never
  - Less than half of the time
  - About half of the time
  - More than half of the time
  - All the time
38. How happy are you with the quality of your sex life? By “sex life” we mean all your sexual outlets, both with partners and without.
- Very unhappy
  - Somewhat unhappy
  - Neutral – neither happy nor unhappy
  - Somewhat happy
  - Very happy



Please rate your interest in the following occupations on a 7-point scale that ranges from “1 – strongly dislike” to “7 – strongly like” Don’t worry about whether you would be good at the occupation or how you would get trained or how much money you could make. Think only about whether you would like to do the work that the job requires.

**1. Car Mechanic**

1	2	3	4	5	6	7
Strongly dislike						Strongly like

**2. Costume Designer**

1	2	3	4	5	6	7
Strongly dislike						Strongly like

**3. Builder**

1	2	3	4	5	6	7
Strongly dislike						Strongly like

**4. Dance Teacher**

1	2	3	4	5	6	7
Strongly dislike						Strongly like

**5. Carpenter**

1	2	3	4	5	6	7
Strongly dislike						Strongly like

**6. School Teacher**

1	2	3	4	5	6	7
Strongly dislike						Strongly like

**7. Electrical Engineer**

1	2	3	4	5	6	7
Strongly dislike						Strongly like

**8. Florist**

1	2	3	4	5	6	7
Strongly dislike						Strongly like

**9. Inventor**

1	2	3	4	5	6	7
Strongly dislike						Strongly like

**10. Social Worker.**

1	2	3	4	5	6	7
Strongly dislike						Strongly like



We would like to understand your experience of participating in this study. Please think about your experience today and check the circle that best describes your experience.

***If you are a WOMAN, please answer the following questions and then go to the second last page of the booklet. If you are a MAN, please answer the questions on the next page.***

**WOMEN:**

1. Did you find the vaginal gauge uncomfortable?

- |                                    |                                  |
|------------------------------------|----------------------------------|
| <input type="radio"/> Not at all   | <input type="radio"/> Definitely |
| <input type="radio"/> A little bit | <input type="radio"/> Extremely  |
| <input type="radio"/> Somewhat     |                                  |

2. Did you find the vaginal gauge distracting?

- |                                    |                                  |
|------------------------------------|----------------------------------|
| <input type="radio"/> Not at all   | <input type="radio"/> Definitely |
| <input type="radio"/> A little bit | <input type="radio"/> Extremely  |
| <input type="radio"/> Somewhat     |                                  |

3. Did you find using the keypad to monitor your sexual arousal distracting?

- |                                    |                                  |
|------------------------------------|----------------------------------|
| <input type="radio"/> Not at all   | <input type="radio"/> Definitely |
| <input type="radio"/> A little bit | <input type="radio"/> Extremely  |
| <input type="radio"/> Somewhat     |                                  |

4. How did you feel during the testing procedure?

- Very tense and uncomfortable
- Somewhat tense and uncomfortable
- Neutral
- Somewhat comfortable and relaxed
- Very comfortable and relaxed

**MEN'S QUESTIONS**

1. Did you find the penile gauge uncomfortable?

- Not at all                       Definitely  
 A little bit                       Extremely  
 Somewhat

2. Did you find the penile gauge distracting?

- Not at all                       Definitely  
 A little bit                       Extremely  
 Somewhat

3. Did you find using the keypad to monitor your sexual arousal distracting?

- Not at all                       Definitely  
 A little bit                       Extremely  
 Somewhat

4. How did you feel during the testing procedure?

- Very tense and uncomfortable  
 Somewhat tense and uncomfortable  
 Neutral  
 Somewhat comfortable and relaxed  
 Very comfortable and relaxed



## Questions for both MEN and WOMEN:

The following is a list of movies included in this study, please check all of the movies that you have seen prior to this study.

- Raising Helen
- Coaster Expedition
- Cujo
- Blue Crush
- Stepmom
- Waves – The Best Virgin Island Beaches
- Burning Lust
- A Guide to Eating Out
- The Accused
- Best of Jason Adonis
- Private Pleasures
- A League of their Own
- Losing Isaiah
- Caribbean Heat
- Taste of Ambrosia
- Thelma & Louise
- Kiss the Girls



Questions for both MEN and WOMEN:

What do you think the purpose of this study is?

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If you wish to make any comments about your experience participating in this study, please feel free to write as much or as little as you like in the space below (you may also use the backside of this paper if needed).

Thank you for completing this questionnaire. Please take a minute to make sure you answered all the questions. When you are finished, please put this questionnaire in the envelope provided. Please seal the envelope and place it in the box under the table, then tell the experimenter you have finished.

## **APPENDIX 3**

### **Telephone Script and Screening Procedure**

The screening procedure used in the current study was adapted from Chivers (personal communication, January 25, 2006).

Preliminary information:

“The purpose of this study is to investigate the validity of a method currently used for measuring sexual arousal. If you decide to participate in this study, you will travel to a laboratory located at the University. In the laboratory, you will be asked to watch non-sexual and sexual films while your physical sexual arousal is measured using medical instruments. Would you be interested in finding out more about the study?”

(if yes): “To make sure you are eligible to participate in this study, I am going to read a list of things that would exclude you from participating. If one or more of these criteria apply to you, then you are not eligible to participate in this study. You do not need to tell me which one applies to you, just let me know at the end of the list if you are or are not eligible. Do you understand?”

List of statements:

1. You are younger than 18 or older than 28.
- 2a) (Men) You are exclusively or predominantly attracted to men.  
(Women) You are exclusively or predominantly attracted to women.
- 2b) You are equally or about equally sexually attracted to women and to men.
- 3) You are currently involved in a dating or intimate relationship for less than 6 months, or you are not currently in a dating relationship.
- 4) (Women) Your menstrual cycle is irregular (shorter than 25 days and longer than 32 days).
- 5a) You have a history of serious mental illness.
- 5b) You have a history of substance abuse.
- 6) (Women) You have difficulty becoming sexually aroused (lubricated or “wet”) more than half of the time.  
(Men) You have difficulty having or keeping an erection more than half of the time.
- 7) (Women) You are pregnant.
- 8) You are taking any of the following types of medications: medications to treat a mental illness or medications to treat high blood pressure.
- 9) You have a sexually transmitted disease.
- 10) You do not speak or write English fluently.
- 11) You have never had sexual intercourse before.
- 12) You have never watched erotic movies or looked at erotic magazines.

“Do any of these statements apply to you?”

If yes (the individual meets one or more exclusion criteria), s/he will be thanked for their interest in the study.

If no (the individual does not meet any exclusion criteria), the following will be read:

Detailed study information:

“Now I’m going to tell you more about the study so you can decide if you want to participate. If you participate in this study, you will watch sexual and non-sexual films while your physical sexual arousal and your feelings of sexual arousal are measured. Changes in your blood volume will be measured by a device attached to the middle finger of your left hand.

(for men) We will measure your physical sexual arousal while you watch films using a penile gauge. This instrument is a small rubber band that goes around the middle of your penis. It measures changes in the penis during erection. In a private room, you will undress from the waist down and put on the gauge yourself. Most men say the gauge is not uncomfortable and that they can’t tell they are wearing the gauge once it is on. You will rate your subjective sexual arousal, or how “turned on” you feel by watching the films by pressing a button on a computer keypad.

(for women) We will measure your physical sexual arousal while you watch the films with an instrument called a vaginal gauge. This instrument is a small, plastic, tampon-shaped probe about 5cm long and 1.2 cm wide. In a private room, you will undress from the waist down and insert the gauge into your vagina yourself. Most women say the probe is not uncomfortable and that they can’t tell they are using the gauge once they have inserted it. You will rate your subjective sexual arousal, or how “turned on” you feel when you are watching the films by pressing a button on a keypad.

The films will show people engaging in a variety of activities, some of which are sexual and some of which are not. You will see heterosexual, gay, and lesbian couples engaging in sexual acts. Some of the interactions will be consensual and some will be non-consensual.

Between each film, you will answer questions asking about your sexual and emotional reactions to the films.

When you’ve finished watching all the films, you will be asked to complete several questionnaires, in private, asking about your sexuality and personality. An electronic scan of your hands will also be taken.

Even if you agree to participate and come to our lab, you are free to change your mind at any point. The whole procedure takes about two and a half hours. You will receive \$50 when you complete the study as a thank you for your time.

All the information that you provide during the study is strictly confidential and we have safeguards in place to protect your anonymity. Are you interested in participating?”

For women - determining menstrual cycle:

“I need to ask you some questions about your menstrual cycle so you aren’t having your period when you participate in the study. Is that okay?”

- 1) How long (in days), on average, is your monthly cycle (from the beginning of one

- period to the next?)
- 2) How many days do you typically menstruate/bleed for?
  - 3) When did your last period begin?

### Restrictions

On the day of testing, please avoid the following:

- 1) physical exercise of all types for one hour
- 2) using alcohol, tobacco products, caffeine, cold medications, or recreational drugs

Also, please refrain from engaging in sexual activity of all types for 24 hours prior to the testing session.

## **APPENDIX 4**

### **Script for Describing Study to Participants**

This script was used on the day of testing. It includes instructions on all experimental tasks.

Note: The mental rotation task is referred to as the object relations task by the experimenter, in order to avoid giving participants any hints as to how to complete the task.

The purpose of the experiment is to look at sexual arousal. While you are watching several short film clips, your physical and self-report sexual arousal will be measured.

**WOMEN** – This is the device that will be used to measure your physical sexual arousal. It is called a vaginal probe. You will insert the probe into your vagina in private. The vaginal probe measures the amount of blood that is flowing in your genitals, as the amount of blood that is flowing in that area is determined by how aroused you are. There is a tiny light that lights up the vaginal wall and the blood that is flowing within the vaginal wall. This light is then reflected back to a small light detector in the probe, depending on how dark the vaginal wall is with blood, and is a measure of how aroused you are.

**MEN** – This is the device that will be used to measure your physical sexual arousal. It is called a penile gauge. You will place the gauge onto the middle of your penis in private. The penile gauge measures changes in the penis that occur during erection.

#### Description of Procedure

Before the experiment begins, I will ask you to use the washroom down the hall. Throughout the experiment I will be in a separate room. You can ask me questions throughout the experiment through an intercom system. You do not have to push a button for the intercom to work, just simply say something out loud, and I will be able to hear you. I will respond to your questions using text messages that will appear on the computer monitor. I may not be able to answer you immediately after you ask a question or say something to me, but I will always be in the room next to you, and will respond as soon as possible. Please note that you are allowed to stop the experiment at any time you would like to.

You will watch a variety of film clips in a private room. The film clips will be presented on a computer monitor and you will use headphones to hear the sound. These film clips include sexual scenes and non-sexual scenes. The sexual scenes show sexual interactions between a variety of couples, including a man and woman having sex, two women having sex, and two men having sex. Some scenes show consensual interactions and some show non-consensual interactions. Some of the scenes are from films that you may have seen. It is important that you focus your attention only on the scenes that you are watching. Please do not think of the entire movie or what happens before or after the scene, but simply focus on what you are seeing in front of you. Just respond as naturally as possible, as if you were alone at home.

You will rate your mental sexual arousal or how turned on you feel by pressing a button on the keypad that is on the arm of the chair. If you are feeling more aroused as a film clip progresses, then you will press the up button, indicating that you are more aroused, and if you are feeling less aroused, then you will press the down button. Please

remember to continually rate your mental sexual arousal throughout the whole film clip. You can think of the lowest level of the bar to be 0 and the highest level to be 100. 0 reflects no arousal at all and 100 is equal to the level of arousal you associate with orgasm. There is no correct response, just try to respond as honestly as possible.

While you are watching the film clips, your blood volume will also be measured using a small finger cuff. If you choose to participate, I will place the finger cuff on your finger, pump up the cuff for a few seconds, then massage the cuff to release some air. I will repeat this process until we get an accurate reading.

At the end of each film clip, you will be asked several questions about the film and how you feel. You will use the same keypad that you used to rate your emotional sexual arousal during the film clips to answer these questions. To answer these questions, you will use a scale of 1 to 9. 1 is the lowest level of response, meaning that the emotion or feeling is not at all present. 5 is the moderate or average level of response, meaning that the emotion or feeling is present, but not extremely high or low. 9 is the highest level of response, meaning that the emotion or feeling is definitely present. For example, if you were asked how happy you feel, and you feel really happy, you would respond with a 7 or 8 or 9, because those numbers mean that you're really happy, and not just a little bit happy. To answer, press a number on the keypad and then hit OK. The instructions for these questions are also on the poster beside the monitor.

Here are the questions that you will be asked. Do you have any questions about them? (show participant a list of question to make sure they make sense)

Please remember that there are no right or wrong answers to these questions. Try to answer the questions as honestly as possible. Also, after you have finished answering the questions for a film clip, please return the subjective sexual arousal bar to 0.

Between film clips you may be asked to complete simple tasks, like read from a magazine out loud, or count backwards from 100. Sometimes there is a lot of time between film clips and we don't want you to get bored.

**WOMEN-** After you have seen all of the film clips, a message will appear on your screen telling you that this portion of the experiment is over. You can remove the probe and place it in the re-sealable plastic bag that is in the black case. After you have removed the probe, you can get dressed and open the door when you are ready for the next part of the experiment.

**MEN-** After you have seen all of the film clips, a message will appear on your screen telling you that this portion of the experiment is over. You can remove the gauge and place it in the re-sealable plastic bag that is in the black case. After you have removed the gauge, you can get dressed and open the door when you are ready for the next part of the experiment.

Once you have re-dressed and opened the door, I will enter the room with your

permission and ask you if you would like to use the washroom or take a short break. If you wish to use the washroom and/or take a short break you may do so. When you return, I will explain the next portion of the experiment to you, and leave while you complete the questionnaire package.

Once you have completed the questionnaires I will knock at the door and enter with your permission. You will then complete an object relations task, in which you will see a two dimensional line drawing of a three dimensional object and be asked to select drawings that match the original drawing you've seen.

After you have finished the object relations task, we will go to the experimenter room and take an electronic scan of your hands. During the scanning process, I will explain the purpose of the experiment and answer any questions you may have about the experiment. You will also receive your \$50 as a thank you for your time.

#### Inserting/Attaching the Gauge

WOMEN- Before I leave the room and lock the door, I will turn off the overhead lights, as the light may interfere with the signal from the vaginal probe. It is all right to leave the small lamp on. Once I have left the room, please undress from the waist down, leaving your underwear around your ankles. After you have undressed, please sit in the recliner in the fully reclined position. To do this, you will need to pull on the handle on the right hand side of the chair, and then grip the arms (while seated in the chair) and push backwards. Once you have the chair in the fully reclined position, you can take the probe out of the black case on the table beside the chair. To insert the probe, lie back in the recliner and gently insert the probe so that the curved part of the placement device is facing up. Your labia should be touching the placement device. After you have inserted the probe, carefully pull your underwear up, but please don't sit up fully, as this can reposition the probe. There is a light blanket that you can use to cover your legs with for this portion of the experiment. Place the headphones on your ears and say "ready" when you are ready to begin the experiment.

MEN- Before I leave the room and lock the door, I will turn off the overhead lights. It is all right to leave the small lamp on. After I leave, please undress from the waist down. After you have undressed, please sit in the recliner in the fully reclined position. To do this, you will need to pull on the handle on the right hand side of the chair, and then grip the arms (while seated in the chair) and push backwards. Once you have the chair in the fully reclined position, you can take the penile gauge out of the black case on the table beside the chair. To attach the gauge, lie back in the recliner and gently stretch the rubber and place it directly on the middle of your penis. Do not roll the gauge down as this will damage the gauge. Please try to place the cable from the penile gauge on your leg, so that there is no stretch in the cable. There is a light blanket that you can use to cover your lower legs with for this portion of the experiment. Place the headphones on your ears and say "ready" when you are ready to begin the experiment.

## How to Sit

While you are watching the film clips, you should be fully reclined in the recliner with your legs about shoulder-width apart and covered with a blanket. It is important that you try to sit as still as possible throughout this portion of the experiment, as movements can interfere with the measurements I am taking. If you have to move during this part of the experiment, please try to avoid doing so during the film clips. Also, please try to avoid any voluntary genital contractions as they will interfere with the device.

Please try to avoid talking or coughing during the films, as well, as this can interfere with the measurements I am taking. If you do need move or cough, please let me know, and I will make a note of it. If you are uncomfortable and wish to stop the experiment, however, please let me know immediately and we will stop.

## Cleaning of the Gauge/Room

The instruments that we use to measure sexual arousal are re-used. Each device goes through a thorough high-level disinfectant process that is identical to the process used to clean plastic medical devices in a hospital. This vigorous cleaning process virtually eliminates any chance of contracting a disease.

Likewise, all surfaces that participants come into contact with are wiped with alcohol swabs that kill any bacteria present. This includes the recliner (arms, seat, back, lever), headphones, keypad, desk, doorknob, etc. The sheets and blankets are washed after every use.

## Overview of Procedure

- Consent
- Rest room
- finger cuff for blood volume
- experimenter leaves room
- undress from the waist down
- attach/insert genital gauge while reclined in chair
- cover up with blanket
- say ready
- watch videos, rate emotions/arousal
- re-dress
- experimenter re-enters room with permission; offers participant a break and then discusses questionnaires
- complete questionnaire package
- experimenter re-enters room with permission to explain the object relations task
- object relations task

- hand scan
- debriefing/compensation

Explanation of Questionnaire Package (to be completed once all films have been viewed and the participant has had a chance to use the washroom if necessary).

There is an envelope with a questionnaire package inside of it. Please complete the questionnaires as honestly as possible. If you have any questions, please do not hesitate to ask me through the intercom system and I will answer them using text messages. If there are questions that you do not feel comfortable answering, I will ask you to place a star beside them, to signal that you have seen the question, but did not want to answer it. After you have finished the questionnaires, you will place the questionnaire package into the envelope you found it in, seal it, and place the sealed envelope into a box underneath the desk.

Once you have completed the questionnaire package, please let me know using the intercom system. I will re-enter the room with your permission, and explain how you are to complete the object relations task.

Explanation of Object Relations Task (Mental Rotation Task)

This is an object relations task. In this task, there are 12 target items. Beside each item there are an additional four shapes, two of which are the same as the target and two of which are different.

Please mark the two shapes that are the SAME as the target item with an X. For each correct response you give, you will receive one point. For each incorrect response, a point will be subtracted from your final score, so try not to guess. You have 5 minutes to complete the task. I will give you a two minute warning when time is almost up.

Please read the directions on the first two pages and ask any questions that you have. Please do not turn to the third page until I ask you to do so. (answer any questions)

**APPENDIX 5**

**Informed Consent Form**



## **Female Sexual Arousal: Validation of the Use of Vaginal Photoplethysmography**

Primary Researcher: Kelly Suschinsky (M.Sc. Candidate)

Co-researcher: Dr. Martin Lalumière (Supervisor)

You are being invited to take part in a research study that involves measuring your genital sexual arousal and your feelings of sexual arousal responses to sexual films and non-sexual films. The study involves answering questionnaires about your sexuality and personality, as well as answering questions about your reactions to the films. The study also involves measuring the length of your fingers. Your participation in the study will inform researchers about the use of certain measures of sexual arousal in women. The study is also investigating the physical and emotional responses of men and women to better understand arousal differences between the sexes.

### **What will happen**

Before you complete this consent form you will have a chance to look at the testing room and the genital gauges and to ask any questions.

You will be able to do both parts of this study in about 2 ½ hours. We are looking for 20 men and 20 women to participate in this study.

The first part of the study involves measuring your genital and emotional sexual arousal responses to non-sexual and sexual films. The non-sexual films will show scenery and different kinds of activities. The sexual films will show heterosexual, gay, and lesbian couples engaging in sexual acts. The experimenter will explain how to use the equipment to measure your genital responses. Once you understand how to do this, you will go into a private testing room, undress from the waist down, and attach the genital gauge. If you are male, you will put the strain gauge on the shaft of your penis. If you are female, you will insert the device into your vagina. The experimenter will guide you through the first part of the study from a separate room, using an intercom and text messages that will appear on the monitor in front of you. You will watch 22 different films that are about 90 seconds long each. In between each film, you will be asked to answer questions regarding your sexual arousal and emotional state (i.e., how happy you are). After you have watched all the films, you will remove the genital gauge, place it in a plastic bag, and re-dress.

The second part of the study involves completing questionnaires about yourself, including your sexuality. You will complete questionnaires asking about your personal information (age, marital status, etc.), sexual experiences, sexual behaviours, sexual relationships, sexual orientation, typical sexual responses to sexual stimuli, and various personality traits. You will complete these questionnaires in a private room. You will

then complete an object relations task. The researcher will also electronically scan your hands.

### **Compensation**

You will be reimbursed for your time. You will receive \$50 to reimburse your travel costs to the university and your time during the questionnaires and arousal assessment.

### **Risks**

You may feel awkward using the genital gauge, especially if you are not comfortable touching your genitals and/or if you do not use menstrual tampons (women). You may feel uncomfortable watching the sexual films, especially if you find sexually explicit films unappealing.

The genital gauges are reused and go through an extensive cleaning and high-level disinfection process between uses. High-level disinfection is a common and safe way of disinfecting instruments made of plastics (it is the same procedure used to disinfect vaginal ultrasound probes in hospitals and gynecological clinics). This procedure virtually eliminates all risks of transmission of infections.

### **Right to Withdraw**

Your participation in the study is completely voluntary. If at any point in the study you wish to stop participating, simply tell the researcher and the experiment will be stopped. You will not experience any negative consequences for your withdrawal. You will be compensated in full. Any data that was collected up until you decided to withdraw will be destroyed.

### **Possible benefits**

There are no direct benefits to you from participating in this study. Your participation will, however, inform future research in the study of sexual arousal.

### **Privacy and confidentiality**

Only the experimenters will have access to information about your identity. All of the information that you have given during the experiment will be stored anonymously. When you enter the study, you will be assigned a participant identification number and all information you provide will be identified by this number, not your name. All electronic records will be stored on a non-network computer (i.e., not connected to the internet), and any paper records will be stored in a locked filing cabinet in a locked office. Your name will never be mentioned in any publications, papers, or presentations that come from this study. Only the investigators will have access to your data.

### **Dissemination of Results**

All data obtained from the current study will be reported in group form, meaning that an individual participant's data will never be reported alone. The results from the study will likely be presented in several formats, including a written master's thesis, oral presentations, and poster presentations.

**If you have other questions**

If you have any questions about this study or would like information about the results of the study, please contact the researcher in charge of the study, Kelly Suschinsky, at the University of Lethbridge, (403) 329-2430. Questions regarding your rights as a participant may be addressed to the Office of Research Services, University of Lethbridge, (403) 329-2747.

**Signatures**

To be entered into the study, you must indicate your consent below.

- I have received answers to all of my questions to my satisfaction,
- I understand that I may freely choose to stop being a part of this study at any time,
- I agree to be part of this research study and to follow the study procedures.

and am showing my consent to participate by signing here:

\_\_\_\_\_  
Name of participant (please print clearly)

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of participant

\_\_\_\_\_  
Signature of individual obtaining consent

\_\_\_\_\_  
Date

## **APPENDIX 6**

### Debriefing Form



## **Female Sexual Arousal: Validation of the Use of Vaginal Photoplethysmography**

We are interested in determining whether or not the device most commonly used to measure female sexual arousal is an accurate measure of sexual arousal. Very little research has been conducted on the validity of the vaginal photoplethysmograph. The current study expanded previous research by including non-sexual emotional stimuli of a positive valence (e.g., happiness) as well as non-sexual emotional stimuli of a negative valence (e.g., sadness). Despite the fact that little research has been conducted to determine the validity of the device, vaginal photoplethysmography has been used in recent years and has resulted in several interesting findings. For example, the correlation or agreement between men's genital responses and ratings of subjective arousal are significantly higher than the correlation between women's genital responses and ratings of subjective arousal. Also, previous research has found that women stated sexual preference or sexual orientation (i.e., heterosexual or lesbian) does not seem to match their genital responses. One purpose of the study was to attempt to replicate these past results. We have asked men to participate in this study so we can compare women's and men's patterns of response.

Another purpose of the study was to investigate the influence of individual traits on sex differences in arousal. Past research indicates that exposure to prenatal hormones influences an individual's sexual attraction to a certain extent. We investigated the possibility that prenatal hormone exposure influences concordance rates between genital and subjective arousal, as well as responses to different stimuli categories.

Researchers have been using vaginal photoplethysmography for over a quarter of a century under the assumption that it is a valid measure. The results of the current research will help determine the validity of the measure, as well as the validity of many past results that have been found using the device. The study will also help to explain various sex differences that have been discovered in recent years.

Thank you for participating in this study. Your time and effort is greatly appreciated. Because the study is ongoing, we ask you not to tell others about the specific research questions of the study.

If you have any further comments or questions about this research project, please contact Kelly Suschinsky by e-mail at [kelly.suschinsky@uleth.ca](mailto:kelly.suschinsky@uleth.ca) or by telephone at (403) 329-2430 or Dr. Martin Lalumière by e-mail at [martin.lalumiere@uleth.ca](mailto:martin.lalumiere@uleth.ca) or by telephone at (403) 329-2406.

## **APPENDIX 7**

### **Manipulation Check**

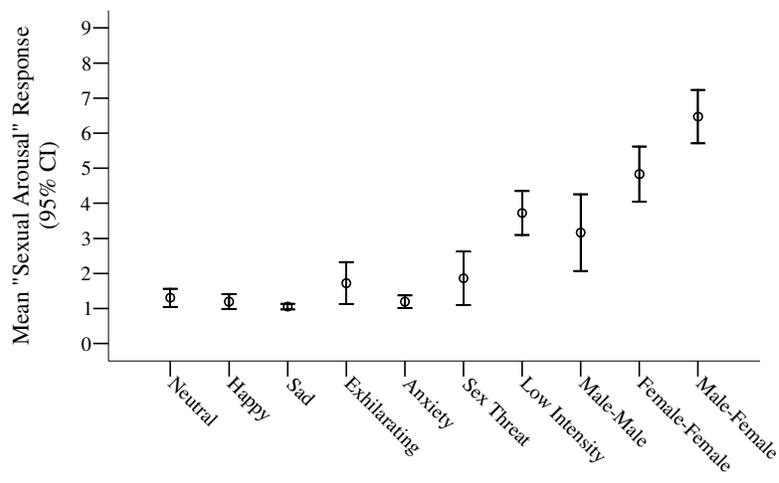
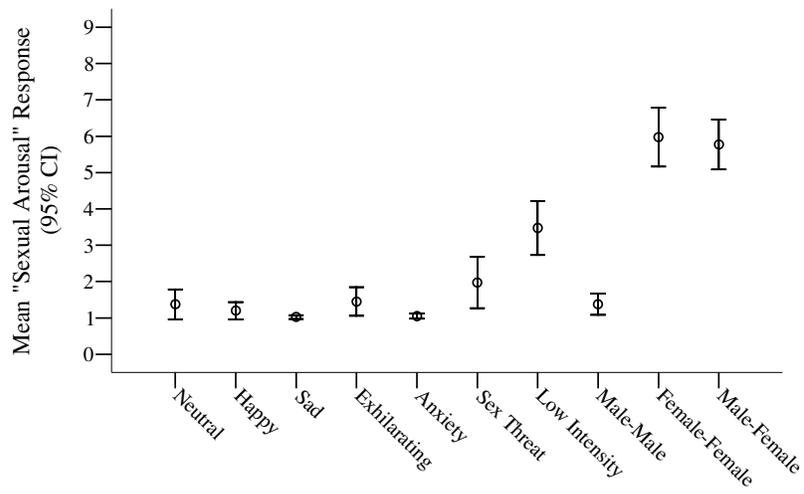


Figure A.1 Mean “sexual arousal” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category.

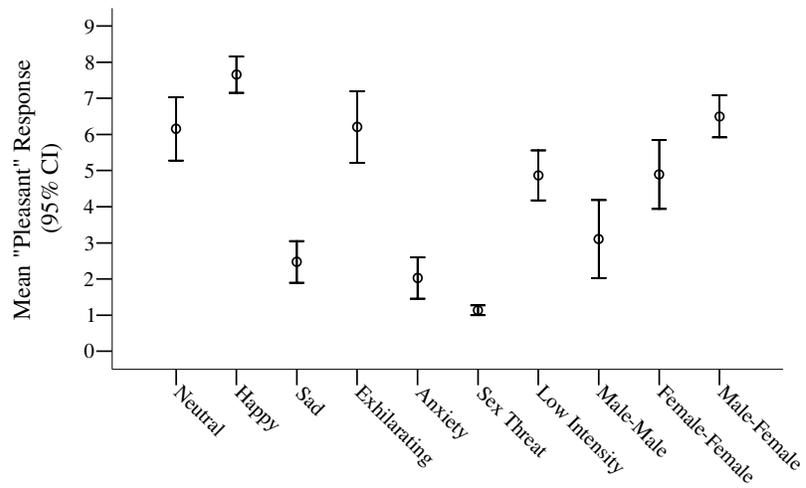
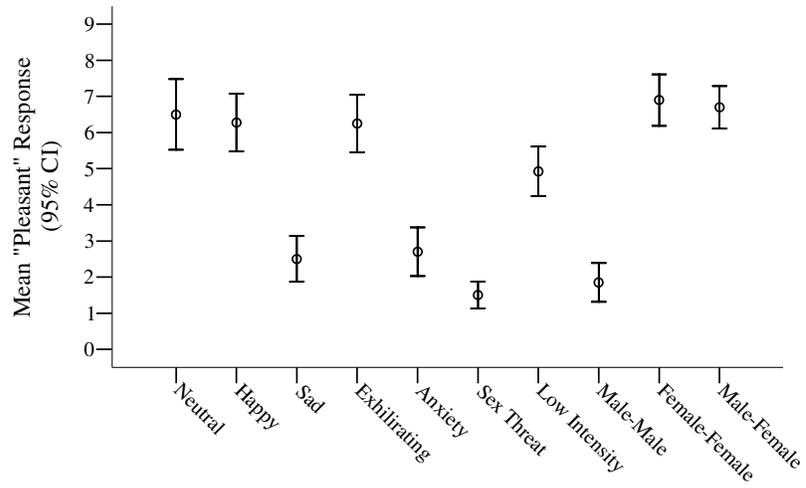


Figure A.2 Mean “pleasant” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category.

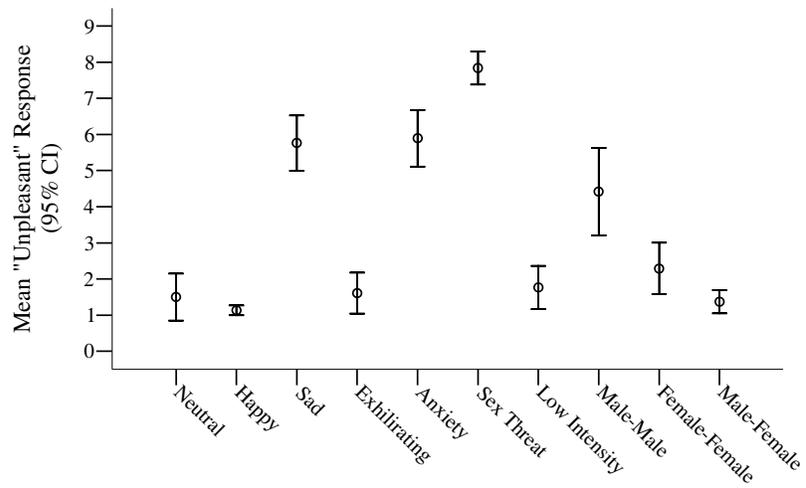
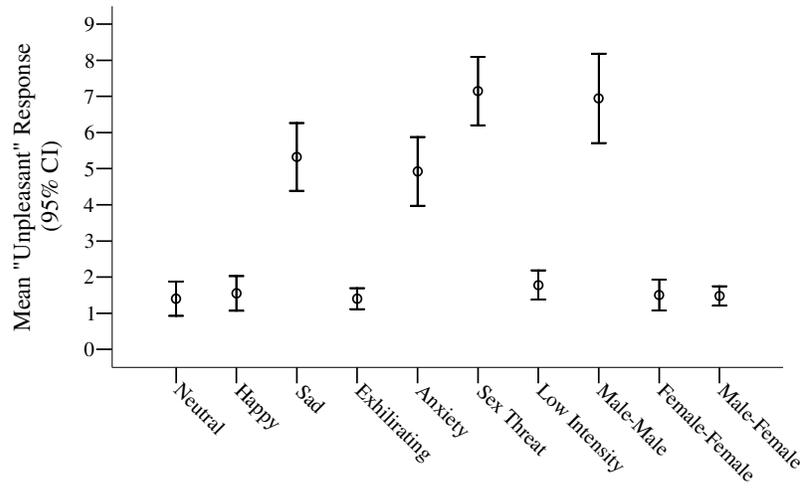


Figure A.3 Mean “unpleasant” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category.

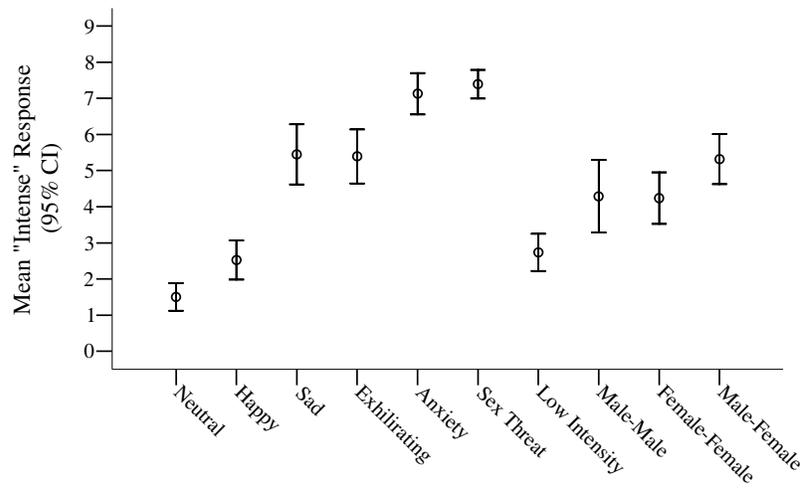
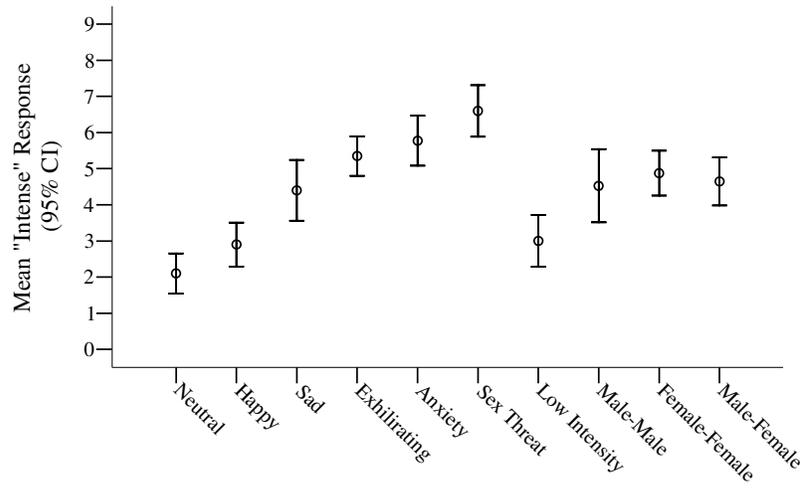


Figure A.4 Mean “intense” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category.

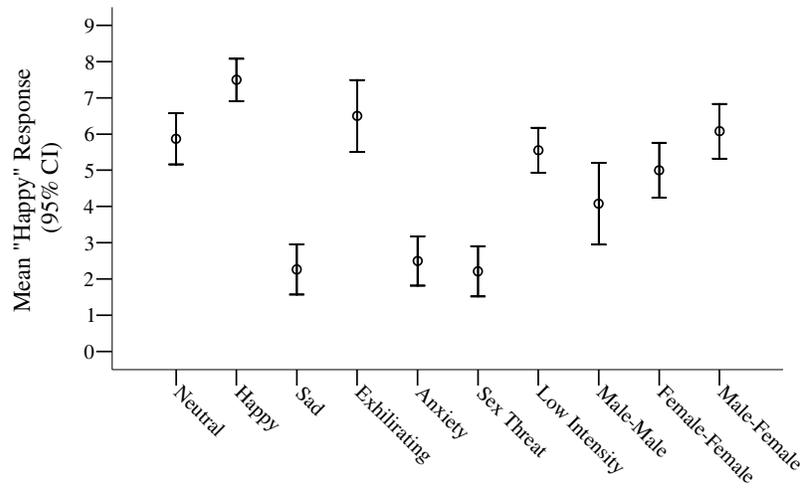
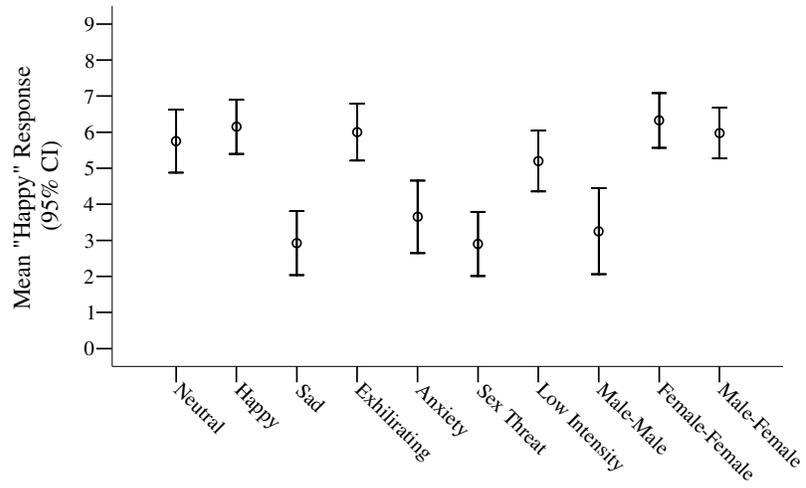


Figure A.5 Mean “happy” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category.

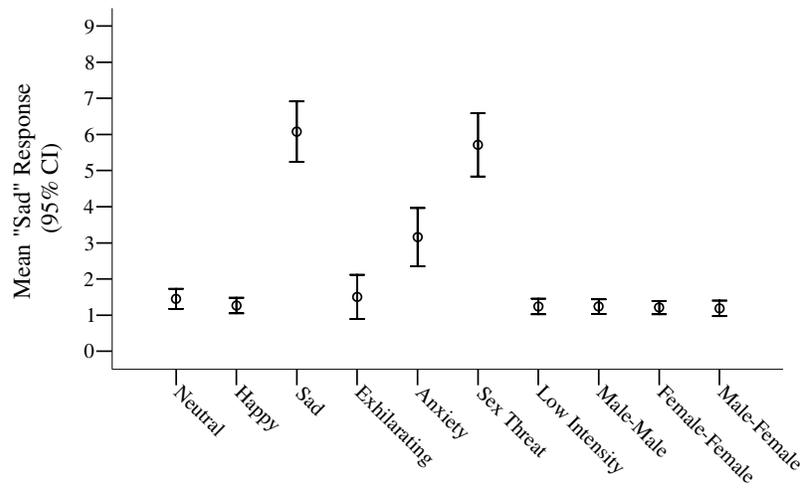
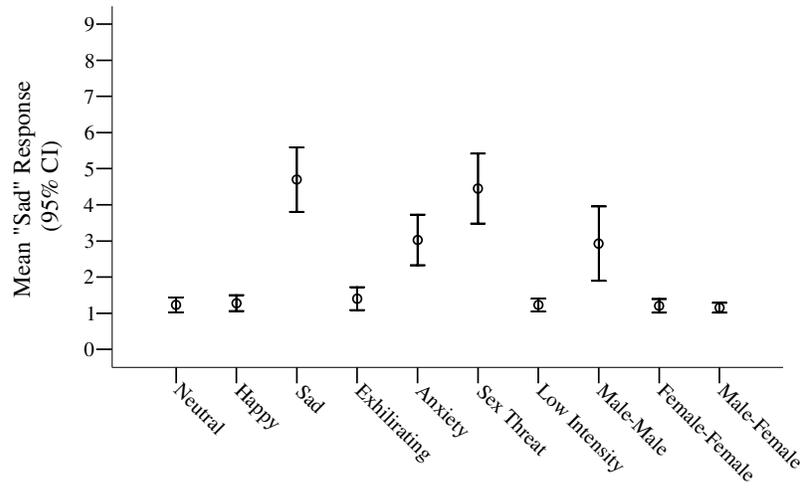


Figure A.6 Mean “sad” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category.

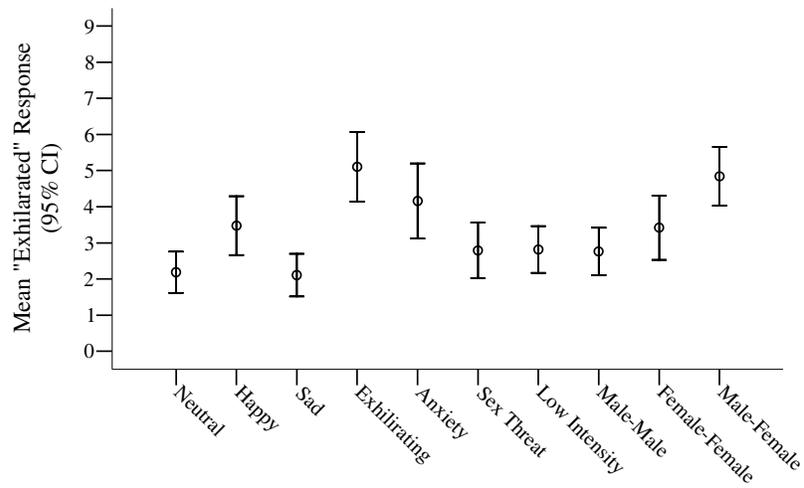
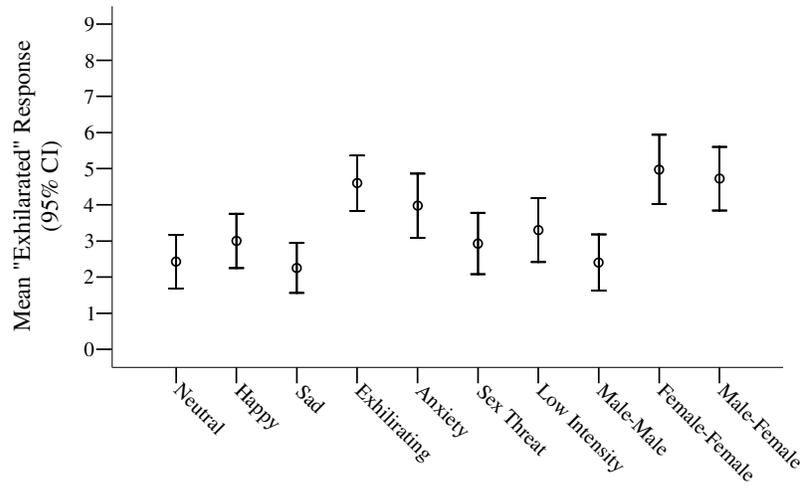


Figure A.7 Mean “exhilarated” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category.

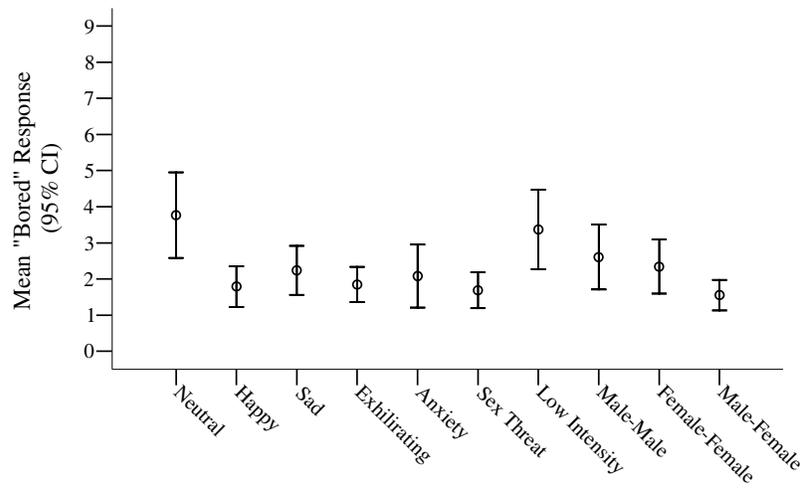
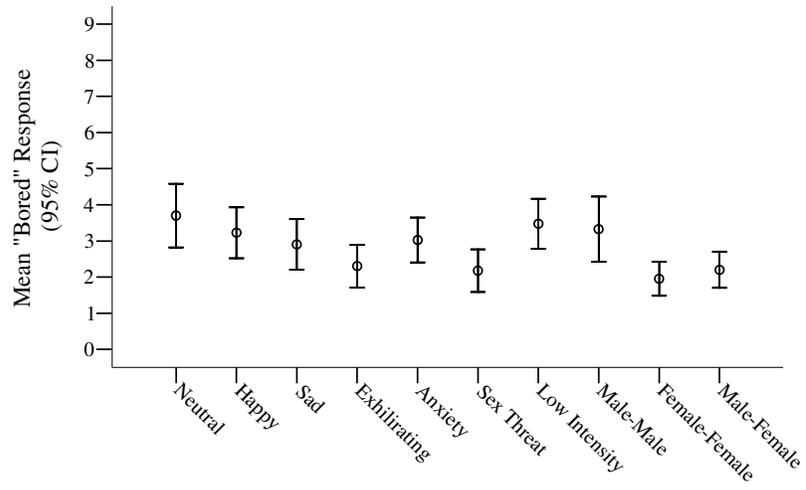


Figure A.8 Mean “bored” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category

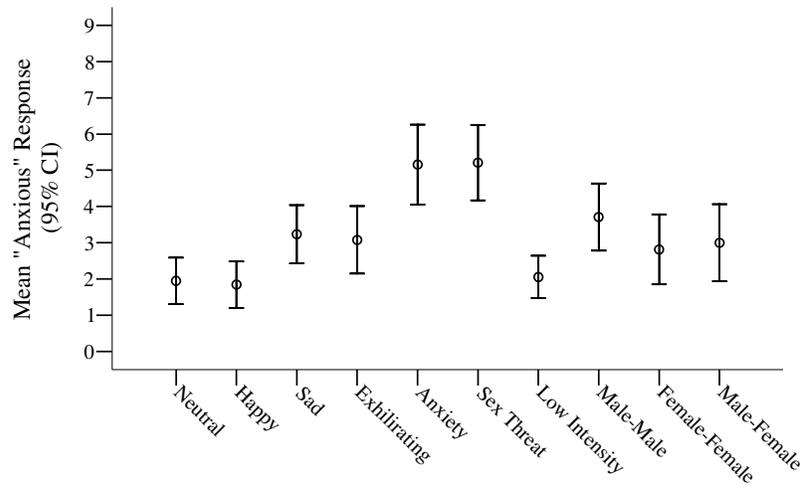
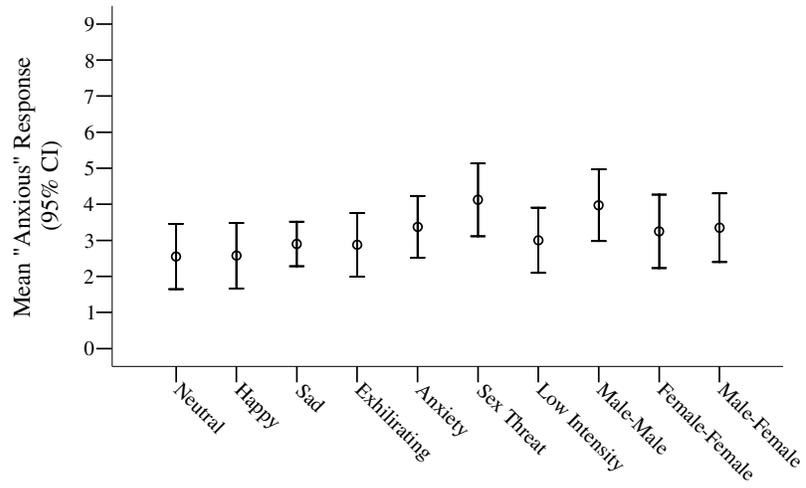


Figure A.9 Mean “anxious” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category

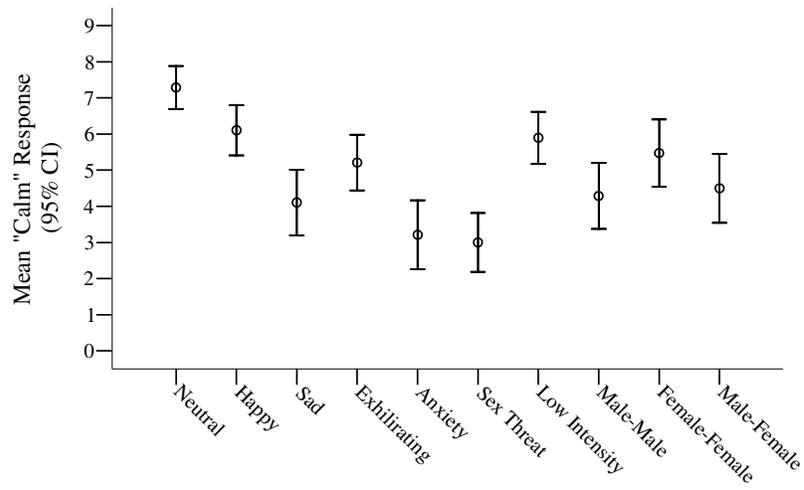
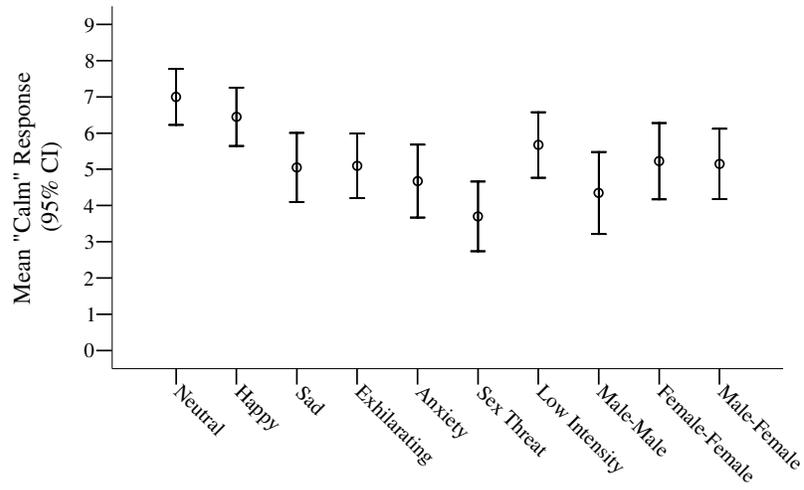


Figure A.10 Mean “calm” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category

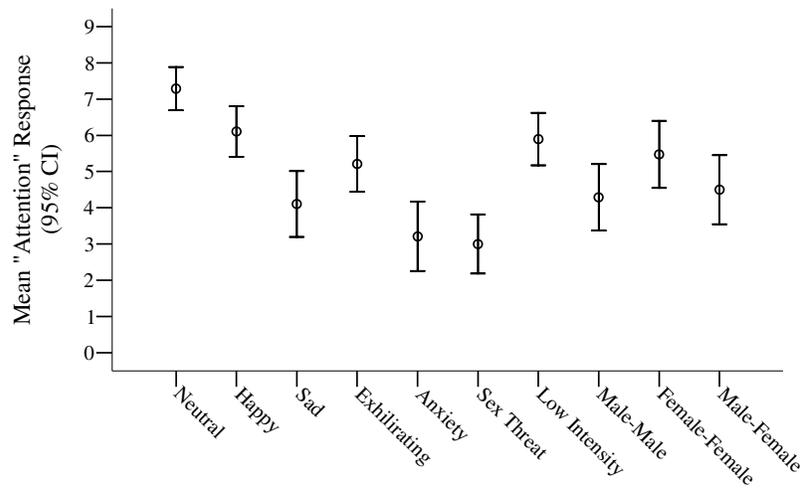
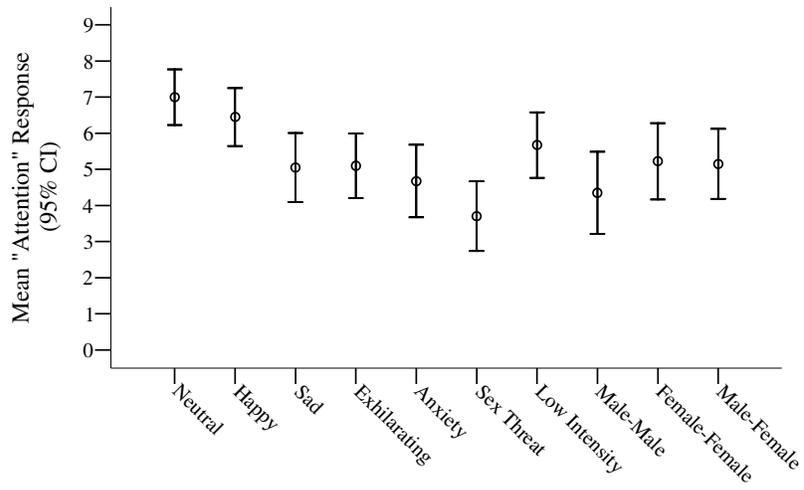


Figure A.11 Mean “attention” post-stimulus responses in men (top portion) and women (bottom portion) as a function of stimulus category

