

THE HABITUATION OF SEXUAL RESPONSES IN MEN AND WOMEN

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## **DEDICATION**

To my dad, who taught me that the best kind of knowledge is that which is learned for its own sake. Without that foundation, this accomplishment would not have been possible.

## **ABSTRACT**

### **The Habituation of Sexual Response in Men and Women**

Studies investigating the sexual responses of men and women in the laboratory reveal reliable sex differences. Men's genital and subjective sexual responses exhibit a high degree of concordance and are category-specific (i.e., are dependent on the types of sexual cues presented). In comparison, women's genital and subjective responses exhibit lower concordance and their genital responses are much less category-specific. One functional explanation for these sex differences is the preparation hypothesis of women's genital responses: Women's genital responses occur automatically in the presence of any sexual cue to protect the reproductive tract from injuries that may result from sexual activity. If this hypothesis is correct, then there should be a sex difference in patterns of habituation of genital responses. Specifically, women's genital responses should be more resistant to habituation than men's because the costs of not producing a genital response to sexual cues are inherently higher for women than for men. The results of two studies of 38 men and 38 women suggest, however, that repeated exposure to sexual stimuli leads to similar degrees of habituation of genital responses in men and women. Of note, attention appeared to influence the pattern of genital responses in both studies and higher attention did not preclude habituation. Implications for the preparation hypothesis, models of sexual arousal, and directions for future research are discussed.

## PREFACE

The two empirical chapters in this thesis were written with the assistance of co-authors. Below, I indicate the contributions of the co-authors and where the chapter (or a similar version) was published. The format for the chapters adheres to the American Psychological Association guidelines, with references, figures, and tables at the end of the chapter. The general formatting of the thesis follows the School of Graduate Studies Guidelines for theses.

### Chapter Two:

Dawson, S. J., Suschinsky, K. D., & Lalumière, M. L. (under review). Habituation of sexual responses in men and women: A test of the preparation hypothesis of women's genital response. *Journal of Sexual Medicine*.

Kelly Suschinsky and Martin Lalumière are co-authors, and provided conceptual, methodological, and editorial assistance.

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# CHAPTER ONE

## Introduction

Learning allows for flexible behaviour patterns and has been implicated in a variety of response systems, including visual (e.g., orienting response in infants; Domjan, 2004), autonomic (e.g., skin conductance; Eisenstein, Bonheim, & Eisenstein, 1995), and sexual (e.g., genital blood flow; Hoffmann, 2012). Habituation is one of the most basic learning processes and has been demonstrated to affect all response systems. Essentially, habituation involves a response that declines in magnitude with repeated exposure to a stimulus, when the decline is not attributable to fatigue (Thompson & Spencer, 1966). The empirical investigation of whether sexual responses habituate has been sparse. Some researchers report patterns consistent with habituation of sexual responses in men and women, whereas others have not, and few studies have employed a common methodology. Thus, we remain unsure whether habituation of sexual responses reliably occurs and if the patterns of habituation are similar for men and women. Understanding whether or not sexual responses are subject to habituation is important, because it may shed light onto factors contributing to sexual functioning and provide a basis from which sexual therapies can be developed. For instance, the inability to habituate may result in hypersexuality (Over & Koukounas, 1995), whereas habituating too readily may result in disorders of sexual desire (e.g., hypoactive sexual desire disorder and female sexual arousal disorder; Both, Laan, & Everaerd, 2011; de Jong, 2009).

This chapter explores comparative and theoretical evidence for why habituation of sexual responses might be expected and why a sex difference in habituation might exist.

Studies investigating habituation in non-human animals provide evidence for the plasticity of sexual responses based on previous experience with a mate (Pfaus et al. 2012). Interestingly, this effect seems to be influenced by mating effort or pair-bonding. Specifically, that monogamous pair-bonding leads to a resistance to habituate to one's partner. Furthermore, sex differences in mating effort lead to the possibility of a sex difference in habituation to sexual stimuli. Another possibility is that women's genital responses function to protect them from damage to the genitals that may occur during sexual activity (Chivers, 2005; Laan, 1994; van Lunsen & Laan, 2004). Thus, women may not habituate as readily as men because the costs of not responding to sexual cues are higher for women. In this chapter, methodological issues with laboratory studies examining habituation in men and women separately are addressed and the rationale for the current studies is provided.

### **The Coolidge Effect**

The term "Coolidge effect" originated from a fable about a former president of the United States and his wife, in reference to the copulatory behaviours of a rooster and his hens (Bermant, 1976). The Coolidge effect is the restoration of mating behaviour after satiation in response to the introduction of a novel mate. This effect has been demonstrated most convincingly in sheep (Pepelko & Clegg, 1965) and cattle (Almquist & Hale, 1956; Hafez, Schein, & Ewbank, 1969), with mixed support in rodents (Dewsbury, 1981).

Studies of the sexual behaviour of rams provide a good illustration of the Coolidge effect (Bermant, Clegg, & Beamer, 1969; Pepelko & Clegg, 1965). In these studies, a ram copulates to the point of satiety—until he ceases to display mounting

behaviours. The familiar ewe is then removed and returned, or is removed and replaced by a novel ewe and the ram copulates until satiety once more. The Coolidge effect is shown in the fact that the ram engages in a significantly greater number of copulations with the novel ewe than with the familiar ewe.

Studies investigating the Coolidge effect among various rodent species provide less conclusive results (Dewsbury, 1981). These differences are likely due to the complexity of rodent sexual behaviour, in that mounting behaviour frequently occurs in the absence of ejaculation making satiation harder to observe. Fisher (1962) found that satiated male rats engaged in significantly more mounts and subsequent ejaculations in the presence of novel females than when coupled with the familiar female. Dewsbury (1971) performed a similar study with mice but failed to find a marked preference for novel females after satiation. Gray and Dewsbury (1973) found that mounting behaviour in prairie voles was slightly more likely to occur with the familiar female than with novel females. Gray and Dewsbury suggested that the monogamous pair-bonding in prairie voles might affect habituation to one's partner. Monogamous versus non-monogamous mating tactics may thus affect whether or not the Coolidge effect can be elicited.

### **Sex Differences in Mating Effort**

The Coolidge effect may not be a universal phenomenon among animal species, but rather a process that is affected by the type of pair-bond or the complexity of the sexual behaviours involved. One could thus expect sex differences with respect to habituation, resulting from different mating tactics employed by each sex. Over evolutionary history, men may have been selected to respond to cues of youth and beauty (indicative of reproductive potential) in a sexual partner and from being responsive to

varied sexual opportunities. In other words, selection likely favored men who employed short-term mating effort (i.e., multiple sexual partners with minimal investment; Symons, 1979) under certain conditions. One process that may facilitate short-term mating is habituation, whereby a man loses interest in a woman once they have mated, motivating him to pursue alternate women to maximize his reproductive output. Women, due to the costs involved with gestation and child rearing, invest significantly more in their offspring compared to men. Selection likely favored women who were discriminatory in their mate choice based on indicators of both good genes and ability to acquire and commit resources. Because of their higher potential investment, women would benefit less than men from having multiple sexual partners (Symons, 1979). Long-term mating or a monogamous pair-bond would be facilitated by a resistance to habituation to one's partner. This sex difference in mating effort and the hypothesized difference in the ability to habituate suggests that men and women may respond differently when repeatedly exposed to a sexual stimulus.

### **Sex Differences in Genital Response Patterns**

Studies of category-specificity demonstrate that men and women exhibit different patterns of genital response depending on the sexual target and activity presented in the stimulus. Specifically, men exhibit a category-specific pattern of genital response, in that they respond the most to the sexual target or activity that matches their preference (Chivers, 2005; Chivers & Bailey, 2005; Chivers, Rieger, Latty, & Bailey, 2004; Suschinsky & Lalumière, 2011a; Suschinsky, Lalumière, & Chivers, 2009). Women exhibit a category non-specific pattern of genital responses, in that they produce similar degrees of genital response to all stimuli involving sexual cues, irrespective of whether or

not it matches their preference (Chivers, 2005; Chivers & Bailey, 2005; Chivers et al., 2004; Suschinsky & Lalumière, 2011a; Suschinsky et al., 2009). Women's non-specific genital response pattern may restrict their ability to habituate because their genital responses are not contingent on the sexual target or activity presented (i.e., they respond to all sexual cues). Some have suggested that genital non-specificity in women is indicative of a highly automatized response system (Chivers, 2005; Laan, 1994; van Lunsen & Laan, 2004).

### **The Preparation Hypothesis of Women's Genital Responses**

Automatic genital responding in women in the presence of sexual cues is hypothesized to serve the protective function of preparing the vaginal lumen for potential sexual activity. Genital responses in women are most commonly assessed using vaginal photoplethysmography (VPP). VPP indirectly measures pressure changes within the blood vessels of the vaginal wall associated with each heartbeat (i.e., vaginal pulse amplitude; Geer, Morokoff, & Greenwood, 1974). Lubrication of the vagina results from the increased pressure within the blood vessels causing interstitial fluid to be secreted (Levin, 2003). This fluid protects the vagina from damage (e.g., tears) that may occur during penetration (Anderson, McLain, & Riviello, 2006). Chivers, Seto, Lalumière, Laan, and Grimbos (2010) suggested that ancestral women who did not produce a genital response in the presence of sexual cues would have sometimes suffered the cost of injuries to the reproductive tract, hindering their reproductive capabilities. Thus, an automatic genital response system would have evolved to be highly sensitive to sexual cues in the environment because the risks and costs associated with not responding are

particularly high compared to the assumed relatively low metabolic costs of producing a genital response.

Laboratory studies of genital responses provide evidence for an automatic response system in women. For instance, women produce a genital response shortly after sexual cues are presented (within 3.9 s; Suschinsky, Chivers, & Lalumière, under review) and produce a response to cues that they find aversive (Suschinsky & Lalumière, 2011a; 2011b). Studies using subliminal priming are also consistent with this idea, in that genital responses are activated after subliminal exposure to a sexual stimulus (Ponseti & Bosinski, 2010). If the costs of not responding to a sexual stimulus are higher for women than for men, then it follows that habituation of genital responses may be harder to elicit (or the effect may be less pronounced) in women compared to men.

### **Habituation of Sexual Responses in Men and Women**

The majority of research investigating the habituation of sexual responses has been conducted with men ( $k = 12$ ) and women ( $k = 2$ ) separately. There is only one published study examining the phenomenon in both men and women using the same experimental design and this study produced a very unusual finding for men and did not directly compare men and women (Both et al., 2011). The most appropriate procedure to elicit habituation involves presenting the same sexual stimulus repeatedly whilst simultaneously assessing genital responses. To eliminate fatigue as an explanation for the decline in responding, novel sexual stimuli are presented after the habituation trials, typically resulting in an increase in responding. Dishabituation involves reintroducing the original stimulus after novel stimulation, resulting in a recovered response to the original habituated stimulus (Domjan, 2004). Unfortunately, many studies have failed to use

appropriate procedures when attempting to elicit habituation, thus hindering our ability to determine whether habituation occurs similarly in both sexes. The following review describes the various procedures, stimuli, and analyses used in studies of habituation, and identifies the existing weaknesses (if any) of some of the methodologies.

Rosen (1973) measured changes in genital responses to different erotic audio stories across four experimental sessions, each one week apart. Penile responding did not decrease sequentially across trials or sessions, likely a result of the use of varied stimuli rather than a repeated stimulus. Julien and Over (1984) used a variety of stimulus modalities (films, slides, spoken and written stories, and self-generated fantasies) that increased incrementally in intensity. Not surprisingly, they reported a pattern inconsistent with habituation, in which genital responses increased with matched increases in stimulus intensity. Palk and O’Gorman (2004) failed to elicit habituation in male sexual offenders using scripted audio stories (i.e., designed to match the offenders’ preferences) as the habituation stimulus. Similarly, Smith and Over (1987) reported that penile responding remained constant across trials when using self-generated as well as scripted sexual fantasies as the habituation stimuli. One problem with using personally tailored stories and fantasies as stimuli when trying to produce habituation is that participants can vary the stimulus so that it retains erotic saliency and novelty. Thus, in order to elicit habituation, it appears necessary that the stimulus needs to be under the control of the experimenter and that the stimulus needs to be of the same intensity and of similar content across trials.

Some studies have used between-subjects rather than within-subjects designs to determine if habituation was elicited (Laan & Everaerd 1995; O’Donohue & Geer, 1985).

In a between-subjects habituation design, one group is exposed to a variety of sexual stimuli whilst the other group is exposed to the same sexual stimulus repeatedly. The difference between the two groups is taken as evidence for (or against) habituation. This can be problematic because the difference in response patterns between the groups may not be attributable to a decline in responding in the repeated stimulus condition, but rather due to the increase in responding across trials in the varied stimulus condition (Over & Koukounas, 1995). A within-subjects design, whereby changes in genital responding within individuals are examined, is a more appropriate methodology to determine if repeated exposure causes a diminution in genital responding. Another methodological concern is that some studies use only one film clip to elicit habituation, rather than counterbalancing different film clips as habituation stimuli (Koukounas & Over, 1993; 1999; 2000; 2001; Meuwissen & Over, 1990). The results of these studies leave open the question of whether habituation is limited to the particular film used or if it reflects a true phenomenon.

In addition to variations in methodology, habituation studies have no agreed upon method for interpreting genital response patterns. Some studies have assessed habituation as a percentage decline from the maximum response across trials (Meuwissen & Over, 1990), whereas others suggest that a linear trend analysis is more appropriate (Laan & Everaerd, 1995). The majority of studies interpret the proportion of variance in genital response as a function of trial (i.e., effect size) as evidence for habituation (Both et al., 2011; Koukounas & Over, 1993; 1999; 2000; 2001). Some studies have transformed the genital response data within-subjects into a standard score (Koukounas & Over, 1993; 1999; 2000; 2001), whilst others have used unstandardized scores (Both et al., 2011;

Laan & Everaerd, 1995). Moreover, some studies have used the peak to trough values (Koukounas & Over, 1993; 1999; 2000; 2001), and others have used mean to trough values for genital responses (Both et al., 2011; Laan & Everaerd, 1995). Whilst peak and mean genital responses are typically highly correlated, they are not necessarily equivalent, thus making it difficult to compare the genital response patterns of these studies directly. In addition, some studies have taken into account the possibility of fluctuating baselines across trials and have compensated by subtracting the genital response during a baseline stimulus from the peak or mean genital response during a trial (Koukounas & Over, 1993; 1999; 2000; 2001). Other researchers have been interested in the extent to which an individual becomes aroused during a stimulus presentation and have subtracted the genital response at the onset of the trial from the peak or mean genital response during the trial (O'Donohue & Geer, 1985). The variability in methodology makes it difficult to directly compare the patterns of genital response across studies. Moreover, there is only one study that includes men and women using the same design, and this study examined men's and women's response patterns separately. Thus, we remain unsure whether a sex difference exists in patterns of habituation of genital responses.

### **The Rationale for the Current Two Studies**

Laboratory studies of sexual responses indicate that men and women exhibit distinct patterns of genital response. Women's genital responses appear to be less dependent on the types of sexual stimuli presented, and instead may function to prepare the vaginal lumen for sexual activity when exposed to cues perceived as sexual. We thus predicted that women's genital responses should be more resistant to the effects of

repeated exposure than men's genital responses. A similar prediction can be made from sex differences in mating effort. Chapter Two is an empirical study that tests men and women using the same habituation design to determine whether a sex difference exists in habituation. Chapter Three details a separate empirical study that uses stimuli thought to better reflect sexual encounters outside of the laboratory and thus provide a more ecologically valid test of habituation and the preparation hypothesis. The aim of the second study was to determine whether habituation of genital responses can be elicited when a related process (attention) is maintained across trials, and any sex differences thereof. Chapter Four discusses the implications of the findings for the preparation hypothesis and the importance of cognitive factors in the production of sexual responses in men and women.

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## CHAPTER TWO

### **Habituation of Sexual Responses in Men and Women: A Test of the Preparation Hypothesis of Women's Genital Responses**

#### **Abstract**

Laboratory studies have revealed two well-replicated sex differences in sexual response patterns: category-specificity and sexual concordance. Men's genital responses are dependent on specific sexual cues, and are concordant with subjective reports of arousal. Women's genital responses are less dependent on specific sexual cues, and are less concordant with their subjective reports. The preparation hypothesis provides a functional explanation for these sex differences and posits that women's genital responses are not tied to sexual preferences but rather occur automatically in the presence of any sexual cue, to protect the genital tissues from injuries incurred through sexual activity. This hypothesis leads to the expectation that women's genital responses may not habituate as quickly or as completely as men's. The aim of the current study was to determine whether there is a sex difference in the habituation of genital responses and to further test the preparation hypothesis of women's genital responses. Twenty men and 20 women had their genital responses measured while they were exposed to nine consecutive presentations of the same erotic film clip (habituation), followed by two presentations of different erotic film clips (novelty), followed by two presentations of the original erotic film clip (dishabituation). Genital responses were measured continuously using penile strain gauges (assessing penile circumference) and vaginal probes (assessing vaginal pulse amplitude). Participants reported subjective sexual arousal, perceived genital arousal, and attention after each film clip presentation. Men and women displayed very

similar patterns of genital responses, consistent with habituation and novelty effects. Effects of habituation and novelty were eliminated once subjective reports of attention were co-varied. Contrary to the prediction from the preparation hypothesis of women's genital responses, men's and women's responses showed similar patterns of habituation upon repeated exposure. Future research should attempt to maintain participants' attention in order to further test the preparation hypothesis.

## **Introduction**

Laboratory studies of human sexual responses have uncovered two well-replicated sex differences. The first involves the specific features of a sexual stimulus that elicit a genital response. Men exhibit a high degree of discrimination between different sexual stimuli, thus exhibiting a category-specific pattern of genital response—men respond significantly more to stimuli depicting their preferred sexual target or activity. Women, however, show little to no discrimination between different sexual stimuli, exhibiting a category-nonspecific pattern of genital response—women show relatively similar genital responses to many sexual stimulus categories, including non-preferred sexual targets and activities (Chivers, Rieger, Latty, & Bailey, 2004; Suschinsky & Lalumière, 2011a; Suschinsky, Lalumière, & Chivers, 2009). The second difference involves the degree to which physiological (genital) responses correspond with subjective experiences or reports of sexual arousal. Men exhibit high concordance, or strong positive correlations between their genital responses and subjective reports of sexual arousal ( $r = .66$ , based on 81 samples, 1,732 men; Chivers, Seto, Lalumière, Laan, & Grimbos, 2011). Women exhibit significantly lower concordance than men, or much smaller positive correlations between their genital responses and subjective reports of sexual arousal ( $r = .26$ , based on 108 samples, 2,345 women; Chivers et al., 2010). One functional explanation for these sex differences in sexual response patterns is the preparation hypothesis of women's genital responses.

### **The Preparation Hypothesis**

The preparation hypothesis posits that vaginal lubrication produced from increased vaginal blood flow serves a protective function, preparing the vulva and

vaginal lumen for sexual encounters and protecting against possible genital injuries. Consistent with the hypothesis, women's genital responses seem to occur automatically and quickly in the presence of any sexual stimuli (Chivers, 2005; Laan, 1994; Laan & Janssen, 2007; Suschinsky, Chivers, & Lalumière, under review; Suschinsky & Lalumière, 2011a, van Lunsen & Laan, 2004). For example, Suschinsky et al. (under review) reported that women's genital responses occur shortly after the onset of a sexual stimulus (3.9 s) and before subjective feelings of sexual arousal are reported (if at all). Also, women produce genital responses to sexual stimuli that they find unappealing, such as stimuli involving non-consensual and violent sexual activities (Suschinsky & Lalumière, 2011a; 2011b). One study of subliminal priming also suggests automatic genital responding in women: Subliminal exposure to sexual stimuli increased genital responses to a target sexual stimulus significantly more so than subliminal exposure to nonsexual stimuli (Ponseti & Bosinski, 2010). Of course, automatic and category-nonspecific genital responses would lead to low concordance in women, because women would not report sexual arousal to non-preferred sexual stimuli (Suschinsky et al., under review).

Studies of habituation of genital responses may provide another way to investigate the preparation hypothesis. If women's genital responses serve to prepare for sexual activity and avoid injuries, then it follows that women's genital responses should be more resistant to repeated exposure than men's genital responses. This is because the costs of non-responding to sexual cues, including non-preferred cues, would be expected to be much higher for women than for men.

### **Habituation of Genital Responses**

Thompson and Spencer (1966) defined habituation as a systematic decline in the magnitude of a response as a result of repeated stimulation, provided that the decrease is not attributable to fatigue. In order to eliminate fatigue as an explanation for the decrement in responding, the habituated response must be stimulus-specific; that is, the habituated response must recover quickly upon the introduction of novel stimuli (Domjan, 2004). Short-term habituation dissipates quickly (within seconds or minutes), whilst long-term habituation lasts considerably longer (hours or days). Spontaneous recovery is an identifying feature of short-term habituation and refers to the restoration of responding to a stimulus after a time lapse between exposures. Dishabituation consists of a recovered response (compared to the response prior to novel stimulation) to the original habituation stimulus after novel stimulation, rather than simply the passage of time (Domjan, 2004).

Sex researchers have not always used proper study designs or appropriate stimuli in studies of habituation of sexual responses, significantly hindering the interpretability of the results they have obtained. In the following brief review of relevant research, we only describe studies that used research designs that provided a clear test of habituation of genital responses, that is, through repeated exposure to the same sexual stimulus. In these studies, men's genital responses were measured with penile plethysmography (PPG), and women's genital responses with vaginal photoplethysmography (VPP).

### **Habituation Studies Conducted with Men**

Two studies have used sexual fantasy as the erotic stimulus when attempting to elicit habituation. In a study with male sexual offenders, Palk and O'Gorman (2004) used personally tailored (i.e., scripted to match the offenders' preferences and fantasies) audio

stories as the habituation stimulus and failed to find a pattern of responding consistent with habituation. Smith and Over (1987) used self-generated as well as scripted sexual fantasies to induce habituation in non-offending men, finding that penile responding remained constant across trials in both conditions. One problem with using fantasy as stimuli when trying to produce habituation is that participants can potentially alter and manipulate the fantasy so that it retains erotic saliency and novelty.

Other researchers have investigated the habituation of male sexual responses using more controlled stimuli. O'Donohue and Geer (1985) investigated habituation to erotic slides of varied intensities in men, using four test conditions: constant stimuli/medium intensity, constant stimuli/high intensity, varied stimuli/medium intensity, and varied stimuli/high intensity. Consistent with short-term habituation, penile responding to constant stimuli of medium and high intensities decreased sequentially over time. The varied condition was used to eliminate fatigue as an explanation for the decrement, using a between-subjects design rather than the more customary within-subjects approach.

In a series of four studies, Koukounas and Over (1993; 1999; 2000; 2001) used erotic film clips to test for habituation and dishabituation in men. Habituation was elicited through exposure to 18 trials of the same stimulus, followed by two trials of novel stimuli to test for fatigue. Dishabituation was tested through the reintroduction of the habituation stimulus for two trials following the novel stimuli. Peak minus session baseline penile responses decreased with repeated stimulation, increased with novel stimulation, and recovered upon the reintroduction of the habituation stimulus. Unfortunately, the

researchers used the same film clip to elicit habituation in all four studies, making it unclear whether the habituation observed is unique to the particular film clip used.

Lalumière and Quinsey (1996) investigated short-term habituation in men ranked as having low or high mating effort tendencies based on a sociosexual inventory score. Repeated exposure to five presentations of the same erotic slide resulted in sequential decreases in genital responding in both groups. O'Donohue and Plaud (1991) investigated the short-term and the long-term habituation of sexual responding in men. Each participant had three sessions of 15 trials of a repeated audio stimulus (i.e., habituation condition) and three sessions of 15 trials of varied audio stimuli (i.e., control condition) during the course of the study. The researchers found habituation in the short-term, as found in other studies, as well as evidence for long-term habituation. Long-term habituation was indicated by decreases in the number of trials required to induce habituation and in the decreasing magnitude of spontaneous recovery across sessions. Long-term habituation was further assessed in another group of men in semi-weekly sessions for three consecutive weeks (Plaud, Gaither, Henderson, & Devitt, 1997). As with other studies (Koukounas & Over, 1993; 1999; 2000; 2001; Lalumière & Quinsey, 1996; O'Donohue & Geer, 1985), penile responses to the repeated audio stories decreased both intra-sessionally and inter-sessionally.

### **Habituation Studies Conducted with Women**

There are two published reports on the habituation of women's genital responses and one other study tested men and women with the same experimental design. Meuwissen and Over (1990) tested habituation and novelty (what they called dishabituation) among women using erotic film clips and scripted fantasy. Participants

were exposed to 18 trials of the repeated stimulus (either film or fantasy) and were then presented with two novel stimuli. The researchers found a pattern of genital responding consistent with habituation and novelty for both film and fantasy. To determine if habituation occurred they measured the percentage of decline across trials. Notably, at trial 18, women's genital responses remained high, at around 85% of the original response. Meuwissen and Over concluded that the 15% decline in responding from the first three trials was evidence of habituation. Other researchers have proposed that the maintenance of high genital responses in Meuwissen and Over's study suggests that women's genital responses are in fact quite resistant to the effects of repeated exposure (Laan & Everaerd, 1995).

Laan and Everaerd (1995) tested whether women's genital responses habituate upon repeated exposure using two stimulus modalities (erotic slides and erotic film clips). First they assessed habituation to erotic slides in one of two conditions: a repeated stimulus condition and a varied stimulus condition. Genital responses increased in both experimental conditions. The authors suggested that erotic slides do not elicit sufficient genital response to facilitate habituation and that a floor effect was observed. They then exposed a separate group of women to one of two conditions (repeated or varied) using erotic film clips as stimuli. Results indicated a slight but non-significant decrease in genital responding in the repeated stimulus condition. After 21 trials of repeated exposure to the same stimulus, women's genital responses remained high.

Only one study examined habituation in both men and women. In contrast with previous research using similar experimental designs (Koukounas & Over, 1993; 1999; 2000; 2001), Both, Laan, and Everaerd (2011) found that men showed a pattern of genital

response consistent with sensitization rather than habituation. Sensitization refers to an increase rather than decrease in response magnitude with either repeated exposure or exposure to a strong extraneous stimulus (Domjan, 2004). Subjective reports of sexual arousal, however, followed a pattern consistent with habituation. Repeated exposure to sexual stimuli did, however, evoke a decrease in the genital and subjective responses of women. Hence, a sex difference in the pattern of genital habituation was found, but this sex difference is quite different from the majority of studies that have examined men and women separately. Furthermore, Both et al. did not directly compare the responses of the men and women. Thus, the current literature provides no definitive conclusion regarding whether a sex difference exists in the habituation of genital responses in men and women.

### **The Present Study**

It is therefore unclear whether habituation of genital responses occurs similarly in both sexes. Men appear to be more likely to habituate than women, but only one study has used the same experimental procedure on both sexes, and that study produced a very unusual result for men (Both et al., 2011). The first goal of this study is to determine whether a sex difference exists in the habituation of genital responses. The second goal is to further test a prediction generated from the preparation hypothesis: That is, to determine whether women's genital responses are more resistant than men's to habituation following repeated stimulation.

## **Method**

### **Participants**

Men and women were recruited from a university campus using posters, visits to psychology classes, and an advertisement in the student newspaper. To be eligible,

participants were required to be between the ages of 18 and 30, exclusively or predominantly heterosexual, and have a personal history free from sexual dysfunction, sexually transmitted infection, substance abuse, and mental illness. In addition, participants were required to be familiar with sexually explicit material and be sexually experienced (i.e., must have engaged in sexual intercourse). Women were tested during all phases of the menstrual cycle (excluding menses).

### **Design**

The habituation design followed a modified version of the design used in Koukounas and Over's studies (Koukounas & Over, 1993; 1999; 2000; 2001). Pilot testing of four men indicated that 18 repetitions of the same 60 s film led to boredom and non-compliance (e.g., caused participants to engage in fantasy). Because habituation has been elicited in much fewer trials in other studies (Lalumière & Quinsey, 1996), our procedure involved nine repetitions of a 60 s film clip (habituation), two presentations of different 60 s film clips (novelty), and two presentations of the original 60 s film clip (dishabituation).

### **Materials**

**Audiovisual Stimuli.** In order to elicit habituation it was necessary to use sexual stimuli that had the potential to generate a high level of genital responding. Audiovisual erotic film clips tend to elicit the highest genital responses in both men and women relative to other stimulus modalities such as erotic slides or audio stories (Abel, Barlow, Blanchard, & Mavissakalian, 1975; Heiman, 1980). The film clips used in the current study were selected because they were known to elicit a genital response in both men and women (Chivers, Seto, & Blanchard, 2007; Suschinsky et al., 2009). The film clips

(presented with sound) were 60 s long and involved male-female couplings engaging in cunnilingus and intercourse. To assure that the findings would not be limited to a particular film clip, one of three similar film clips (e.g., same activities, different actors) were used as the habituation stimulus and the remaining two served as the novel stimuli. The assignment of film clips to condition was counter-balanced across participants.

**Physiological Recordings.** Men's genital responses were measured using mercury-in-rubber strain gauges (D. M. Davis, New Jersey). Data were sampled on a continuous basis throughout each trial at a rate of 10 samples/s, low-pass filtered (to .5 Hz), and digitized (40 Hz) using a Limestone Technologies Inc. (Odessa, ON) DataPac\_USB and Preftest software, Version 10. This signal was transformed into mm of circumference. Gauges were calibrated prior to each use over six 5-mm steps using a plastic cone. The penile response curves were inspected for movement artifacts and these were removed prior to data analysis.

Women's genital responses were measured using a vaginal photoplethysmograph (Technische Handelsonderneming Coos, The Netherlands) assessing changes in vaginal pulse amplitude (VPA). Data were sampled on a continuous basis throughout each trial. The signal was sampled at a rate of 10 samples/s, band-pass filtered (.5 Hz to 10 Hz), and digitized (40 Hz). A placement device attached to the cable of the VPP was used to ensure the correct depth and orientation of the light detector once inserted. Movement artifacts were removed prior to data analysis.

**Post-stimulus Questions.** After each trial, participants answered three questions that appeared in a fixed order on the computer screen. Participants were asked to rate how sexually aroused they had felt during the previous film clip, how aroused their genitals

had felt, and how much attention they paid to the film clip. Participants were asked to answer the questions using a 9-point scale, with 1 being the lower end (i.e., *there was no arousal/paid no attention*) and 9 being the higher end (i.e., *there was a maximal level of arousal/highest level of attention*).

**Questionnaires.** A questionnaire was used to determine participants' biographic background and sexual history, including questions about sexual orientation assessed using the Kinsey Scale (Kinsey, Pomeroy, & Martin, 1948; Kinsey, Pomeroy, Martin, & Gebhard, 1953).

### **Procedure**

The Human Subject Research Committee at the university reviewed and approved all experimental procedures according to the ethical guidelines of the Canadian Tri-Council Policy Statement.

**Screening.** Prospective participants responded to advertisements via email and received preliminary information regarding the study. They were interviewed over the phone or by email to determine their eligibility. Those who met the eligibility criteria and who were still interested in the study (75%) scheduled an appointment in the laboratory. Participants were asked to refrain from engaging in any form of sexual activity for 24 hours prior to testing. They were also asked to avoid all forms of physical exercise in the hour before testing because exercise can have an influence on genital responses due to increased arousal of the sympathetic nervous system (Meston & Gorzalka, 1996). Participants were also asked to refrain from using alcohol, tobacco, cold medications, and recreational drugs on the day of testing. Responses contained in the questionnaire indicated that all participants complied with the above stipulations.

**Experimental Procedure.** Participants were tested on an individual basis. A female experimenter (first author) explained the experimental procedure, including directions on how to insert or attach the genital gauge. After obtaining consent, the experimenter left the room (dimming the lights), leaving participants alone to undress from the waist down and to insert/attach the genital gauge whilst in a supine position in a recliner. Communication between participants and the experimenter occurred through an intercom system and text messages that appeared on the computer monitor in the participant room.

All stimuli were presented on a 17-inch computer monitor positioned at eye-level approximately five feet away from participants. The adaptation period consisted of a non-sexual stimulus (still-image of a beach scene - 300 s) and a low-intensity erotic film clip (nude female exercising - 90 s). The purpose of the adaptation period was to acclimatize participants and to determine that the initial genital responses to the habituation stimulus were higher than to neutral or low-intensity stimuli. The data collected during this period were not used in the main analyses reported below. Once participants had returned to their baseline (i.e., response prior to the low-intensity erotic film clip) or a maximum of five minutes had passed, nine presentations of the same erotic film clip, two presentations of different erotic film clips, and two presentations of the original erotic film clip followed. Following each stimulus, participants rated their sexual and genital arousal as well as their level of attention during the stimulus. Inter-stimulus intervals were an average of 90 s (a random selection of 60, 90, and 120 s for each trial) to avoid potential expectancy effects on genital responses. After the presentation of the second novel film clip there was a second return to baseline (or a maximum of five minutes) inter-stimulus

interval. No distraction tasks or other instructions were issued during the inter-stimulus intervals. After all stimuli had been presented, participants received instructions to remove the genital gauge and place it into a sealable plastic bag, re-dress, and complete the questionnaire. Upon completion of the questionnaire, the experimenter rejoined participants and debriefed them about the purposes of the study. All participants received \$40 (CAD) compensation as a thank you for their time. The entire experimental session took approximately two hours.

### **Data Preparation**

Genital responses were calculated using the difference between the peak genital response during the stimulus presentation minus the baseline response at stimulus onset. Peak minus baseline responses were highly correlated with mean minus baseline responses for men (.86) and for women (.88). Because the PPG and the VPP produce different outputs, peak minus baseline scores were standardized into within-subjects *z*-scores. Post-stimulus ratings were not standardized.

Separate one-way analyses of variance (ANOVA) were conducted for each sex to determine whether the three erotic film clips differed in their ability to induce a genital response. One-way ANOVAs using mean unstandardized genital peak minus baseline responses during the first two trials (H1 and H2) as the dependent variable and film clip (film 1, 2, 3) as the independent variable revealed no main effect of film clip for men,  $F(2, 17) = 2.11, p = .15$ , or for women,  $F(2, 17) = 3.02, p = .08$ , indicating that the film clips elicited similar levels of genital responses, in both sexes. Each film clip also generated statistically similar levels of subjective sexual arousal; there was no interaction

between sex and film clip,  $F(2, 34) = 1.82, p = .18$ , no main effect of sex,  $F(1, 34) = 2.07, p = .17$ , and no main effect of film clip,  $F(2, 34) = 0.24, p = .79$ .

To test whether the pattern of habituation, novelty, and dishabituation differed by sex a 2 (sex) X 13 (trial) mixed design ANOVA was conducted using the standardized peak minus baseline scores as the dependent variable. Habituation was assessed using a 2 (sex) X 9 (repeated stimulus trials) mixed design ANOVA. Novelty effects were examined by comparing mean responses for novel stimulation trials 10-11(Na-Nb) with the mean responses for trials 8-9 (H8-H9) via planned contrasts. Planned contrasts were also used to assess dishabituation by comparing mean responses for dishabituation trials 12-13 (D1-D2) with mean responses for trials 8-9 (H8-H9). The same analyses were used for subjective reports of sexual arousal, perceived genital arousal, and attention.

## **Results**

### **Sample Characteristics**

Twenty-two men and 21 women participated in all components of the study. The final sample consisted of 20 men and 20 women with a mean age of 22.5 ( $SD = 2.6$ ) and 21.3 ( $SD = 2.4$ ) respectively (two men and one woman did not produce a genital response during any sexual stimulus and were thus excluded). The majority of men and women were heterosexual (95% and 100% respectively) and were in dating relationships, engaged, or married at the time of testing (65% and 70% respectively); the remainder were single. Most of the men and women were Caucasian (80% and 95% respectively) and were currently attending university or had completed a university degree (90% and 95% respectively). Men and women did not differ significantly on any of these factors.

Seventy-five percent of the women were using some form of hormonal contraceptives at the time of testing.

### **Genital Responses**

Figure 2.1 shows the mean standardized genital responses for men and women during repeated stimulation (H1-H9), novel stimulation (Na-Nb) and dishabituation trials (D1-D2). The figure shows that men and women had decreasing genital responses with repeated stimulus trials and an increase with novel stimulation. The mixed design ANOVA using standardized genital responses across the 13 trials (H1-D2) revealed no significant interaction between trial and sex,  $F(8.18, 310.66) = 0.97, p = .46, \eta^2 = .025$ , suggesting that men and women exhibited similar patterns of genital response. The significant main effect of trial (H1-D2),  $F(8.18, 310.66) = 10.75, p < .0001, \eta^2 = .22$ , revealed that genital responses changed significantly across trials (Greenhouse-Geisser corrected values are reported when Mauchly's assumption of sphericity was not met. The Greenhouse-Geisser correction adjusts the degrees of freedom to account for unequal variance, resulting in more conservative significance values).

A mixed design ANOVA for habituation trials (H1-H9) revealed no significant interaction between trial and sex,  $F(5.49, 208.48) = 0.89, p = .50, \eta^2 = .023$ , suggesting that men and women exhibited similar decreases in their genital responses across habituation trials. The significant main effect of trial  $F(5.49, 208.48) = 11.15, p < .0001, \eta^2 = .23$ , confirms that genital responses changed significantly during repeated exposure.

Planned contrasts using the error term from the omnibus ANOVA revealed that the mean genital responses for trials Na and Nb (introduction of novel stimuli) were significantly higher than the mean responses for trials H8 and H9,  $F(1, 468) = 47.78, p$

<.0001,  $\eta^2 = .55$ , suggesting that novel stimulation led to an increase in genital responding among participants. Planned contrasts revealed that the mean genital responses for trials D1 and D2 (repeated stimulus reinstated) were not significantly higher than for trials H8 and H9,  $F(1, 468) = 0.66$ ,  $p = .42$ ,  $\eta^2 = .017$ , showing no dishabituation among participants.

### **Subjective Sexual Arousal**

Figure 2.2 shows that subjective reports of sexual arousal decreased during repeated stimulation (H1-H9), increased during novel stimulation (Na-Nb), and subsequently decreased during dishabituation trials (D1-D2) in both men and women. The mixed design ANOVA revealed no significant interaction between trial and sex,  $F(5.13, 195.02) = 2.04$ ,  $p = .07$ ,  $\eta^2 = .051$ , and a significant main effect of trial,  $F(5.13, 195.02) = 34.88$ ,  $p < .0001$ ,  $\eta^2 = .48$ . Examination of subjective sexual arousal during habituation trials (H1-H9) revealed a significant interaction between trial and sex,  $F(3.69, 140.14) = 2.62$ ,  $p = .04$ ,  $\eta^2 = .064$ . The effects of habituation on subjective reports of arousal were thus assessed separately by sex. A repeated-measures ANOVA revealed a significant effect of trial on men's subjective sexual arousal across habituation trials (H1-H9),  $F(2.84, 53.96) = 21.43$ ,  $p < .0001$ ,  $\eta^2 = .53$ , and on women's subjective sexual arousal as well,  $F(3.70, 70.30) = 12.81$ ,  $p < .0001$ ,  $\eta^2 = .40$ .

Planned contrasts revealed that the mean subjective sexual arousal responses for men and women for trials Na and Nb were significantly higher than the mean responses for trials H8 and H9,  $F(1, 468) = 185.56$ ,  $p < .0001$ ,  $\eta^2 = .83$ , suggesting that novel stimulation increased subjective sexual arousal. There was no evidence of dishabituation

of subjective sexual arousal, as tested by planned contrasts comparing mean responses for trials D1 and D2 to mean responses for H8 and H9,  $F(1, 468) = 2.51, p = .11, \eta^2 = .06$ .

Similar results were obtained when using perceived genital arousal as the dependent variable rather than subjective sexual arousal. The only difference was that the mixed design ANOVA did not reveal a significant interaction between trial (H1-H9) and sex, meaning that men and women exhibited a similar decline in perceived genital arousal across habituation trials.

### **Attention**

Figure 2.3 shows the attention ratings for men and women during repeated stimulation (H1-H9), novel stimulation (Na-Nb), and dishabituation trials (D1-D2). Attention decreased with repeated stimulation, was restored through novel stimulation, and declined again with the reintroduction of the repeated stimulus. A mixed design ANOVA revealed no interaction between trial and sex,  $F(5.19, 197.53) = 0.43, p = .84, \eta^2 = .011$ . Attention changed significantly across the 13 trials (H1-D2),  $F(5.19, 197.53) = 40.62, p < .0001, \eta^2 = .52$ . Attention across habituation trials (H1-H9) was similar among men and women,  $F(4.54, 172.49) = 0.41, p = .83, \eta^2 = .011$ , decreasing significantly  $F(4.54, 172.49) = 29.73, p < .0001, \eta^2 = .44$ .

The mean attention ratings for trials Na and Nb were significantly higher than the mean attention ratings for trials D1 and D2,  $F(1, 468) = 257.75, p < .0001, \eta^2 = .87$ , suggesting that novel stimulation led to an increase in attention. The mean attention ratings for trials D1 and D2 were not significantly higher than for trials H8 and H9,  $F(1, 468) = .93, p = .34, \eta^2 = .023$ , providing no evidence for dishabituation of attention.

### **Additional Analyses Controlling for Attention**

To investigate the effects of self-reported attention on genital responses, a mixed design ANCOVA was performed with standardized genital responses as the dependent variable, and self-reported attention as the covariate. There was no significant interaction between trial and sex when controlling for attention,  $F(12, 300) = 1.08, p = .38, \eta^2 = .041$ , and no significant effect of trial (H1-D2),  $F(12, 300) = 1.2, p = .28, \eta^2 = .046$ . Examination of genital responses when controlling for attention for the habituation trials revealed no significant interaction between trial and sex  $F(5.35, 155.26) = 0.70, p = .63, \eta^2 = .024$  and no significant main effect of trial,  $F(5.35, 155.26) = 1.90, p = .09, \eta^2 = .062$ . Examination of mean responses for trials Na and Nb and trials H8 and H9 whilst controlling for attention revealed no novelty effect,  $F(1, 36) = 0.08, p = .78, \eta^2 = .002$ . Similarly, examination of mean responses for trials D1 and D2 and trials H8 and H9 revealed no effect of dishabituation when controlling for attention,  $F(1, 36) = 0.06, p = .81, \eta^2 = .002$ .

### **Additional Analyses using other Scoring Methods for Genital Responses**

Repeated-measures ANOVAs using unstandardized peak minus baseline genital responses (performed separately by sex) yielded the same results as standardized data. We conducted additional analyses using standardized and unstandardized peak minus session (rather than trial) baseline genital responses, where session baseline was derived from the peak genital response during the last 60 s of the 300 s beach scene presentation. These additional analyses were performed to account for the fact that trial baseline values could change across trials. The same results were obtained using this alternate scoring method. Analyses were conducted using standardized and unstandardized mean (rather than peak) minus baseline genital responses and produced the same results. Regardless of

the scoring methods used, similar patterns of genital responses were found for both men and women consistent with habituation and novelty, and a lack of dishabituation.

### **Discussion**

Repeated exposure to the same erotic stimulus caused a diminution of genital responses in both men and women. Habituation was not limited to physiological responses, as subjective reports of sexual arousal and perceived genital arousal followed a similar decline. Contrary to the prediction of the preparation hypothesis that women's genital responses would be more resistant to repeated exposure to an erotic stimulus than men's genital responses, men and women showed statistically similar patterns of genital responding to repeated stimulation and to novel stimulation. Neither sex showed a dishabituated response when re-exposed to the habituated stimulus. This study is the first to find no sex difference in the patterns of habituation of genital responses when men and women are tested with the same experimental design. The patterns of habituation across the three measures of sexual response were strikingly similar. It is thus possible that this fundamental form of learning affects the sexes similarly.

These results replicate the previous findings of short-term habituation and novelty in men (Koukounas & Over, 1993; 1999; 2000; 2001; Lalumière & Quinsey, 1996; O'Donohue & Geer, 1985). Habituation was obtained using a modified version of a design known to elicit habituation in men (Koukounas & Over, 1993). The current study produced the same pattern of habituation in men using only nine repetitions of an erotic stimulus, similar to other studies that have used fewer trials to elicit habituation (Lalumière & Quinsey, 1996). The design used in the current study was also sufficient in eliciting similar habituation in women in fewer trials than previously reported (Both et

al., 2011; Meuwissen & Over, 1990). It should be noted that the modified study design was unsuccessful in eliciting dishabituation in either men or women. Other studies that have observed dishabituation have not used a return to baseline condition after novel stimulation, and so it is possible that dishabituation was in fact residual arousal from novel stimulation rather than arousal generated by the reintroduction of the original repeated stimulus (Koukounas & Over, 1993; 1999; 2000; 2001). Evidence of dishabituation may also be exaggerated by using the initial baseline to the neutral stimulus as the comparison rather than the trial baseline as used in the current study.

The current results fail to support the prediction from the preparation hypothesis that women's genital responses would be more resistant to repeated exposure to an erotic stimulus than men's. The preparation hypothesis suggests that reliable and swift genital responding serves the function of preparing the genitals for possible sexual activity. It is possible that the decrease in genital responding across repeated exposure means that the women had become sufficiently aroused or lubricated for sexual activity and, as such, sustained genital responses would be unnecessary. The pronounced effect of novel stimuli on women's genital responses, however, nullifies this possibility; if sufficient lubrication had been achieved, then we would not expect to see any effect of novel stimulation. Additionally, the lack of dishabituation in the present study suggests longevity of the habituation response in women, again failing to support the prediction from the preparation hypothesis.

Presumably, any genital response during the final trial (H9) of the repeated erotic film clip would be consistent with the preparation hypothesis and the maintenance of genital responding in women. It is possible that the magnitude of the genital response

need not be consistent across repeated stimulus presentations, but simply large enough to facilitate sufficient vaginal lubrication to provide protection (Suschinsky & Lalumière, 2011b). Peak and mean genital responses during the final habituation trial were compared with the peak and mean genital responses during the final 60 s of the presentation of a beach scene used during the adaptation period to determine whether women showed any residual genital responses after nine presentations of the same erotic film clip. There were no significant differences between either peak or mean genital responses during the final habituation trial compared to the baseline stimulus ( $p = .08$  and  $p = .38$ , respectively). This suggests that women were responding to a sexual stimulus as if it were a neutral, non-sexual stimulus, providing additional evidence that repeated exposure to the same erotic stimulus leads to the cessation of a genital response and presumably lubrication, inconsistent with a preparatory response.

The current study design, namely the use of the same erotic stimulus repeatedly, may not, however, provide the best test of the preparation hypothesis of women's genital responses. Attentional commitment may have important implications for the preparation hypothesis of women's genital responses. In order for women to maintain a preparatory genital response to a sexual stimulus, it is necessary that the stimulus be attended to. If women shift what they attend to during repeated exposure, for instance, from the genitals to the peripheral details of a stimulus, then the decrease in genital response may not be attributable to habituation per se, but rather reflect the fact that the stimulus is no longer perceived as sexual. Information-processing models of sexual responses posit that when a stimulus elicits sexual meaning for the individual, attention further enhances the processing of sexual meaning, maintaining genital responses and facilitating subjective

sexual arousal (Janssen, Everaerd, Spiering, & Janssen, 2000; Laan & Janssen, 2007). Genital and subjective responses can be inhibited if sexual stimuli are processed as non-sexual (Janssen et al., 2000). It is possible that repeated exposure to a stimulus causes changes in the appraisal of that stimulus, which in turn affects attentional commitment and genital and subjective responses (Laan & Janssen, 2007).

The results of the current study provide some support for an information-processing model of genital responses (Janssen et al., 2000). Attention in the current study appeared to play a significant role in modulating habituation effects, such that repeated exposure to a stimulus resulted in less attentional commitment. Similar to other research, self-reported attention mimicked the pattern of physiological responding (Both et al., 2011; Koukounas & Over, 1993; 1999; 2000; 2001) and statistically controlling for attention resulted in the elimination of habituation and novelty effects. Studies using secondary tasks to assess attention report that as habituation of genital responding occurs, responses to the secondary task become more rapid, as a result of the erotic stimulus demanding less attentional resources (Koukounas & Over, 1993; 2000). It may be tempting to presume that sexual responses decrease as a consequence of decreased attentional commitment, but this relationship may be merely correlational. It is also possible that participants paid less attention to the erotic stimulus as a result of lessening sexual responses. To disentangle this relationship and determine causality would require assessing the effects of manipulation of either attention or sexual responses independently on the other.

To date, no studies have successfully maintained attentional commitment across repeated exposure to an erotic stimulus in men or women (Both et al., 2011; Koukounas

& Over, 2000; 2001). Successful maintenance of attention may preclude habituation of genital response from occurring in both sexes by causing the stimulus to maintain erotic saliency. Manipulation of the level of absorption in the stimulus has not been found to be effective in preventing habituation effects in men or women (Both et al., 2011; Koukounas & Over, 2001). Inspection of our data revealed that five men and four women reported that they maintained attention during the habituation trials. Interestingly, all of these participants exhibited patterns of genital responding consistent with habituation, despite sustained attention. The use of a secondary task would provide a more valid indication of whether or not attention was truly maintained in those participants.

The use of the same erotic stimulus to test for habituation has low ecological validity. Outside of the laboratory, men and women are rarely exposed to the exact same stimulus repeatedly; rather, sexual encounters may be constrained by the same partner, same activity, or same location, but may not necessarily follow an identical pattern each time. A better test of the preparation hypothesis may be to use repeated exposure to the same male actor or to use slightly varied stimuli that would maintain erotic saliency and presumably attention for the participant. The preparation hypothesis would predict a sex difference in habituation of genital responses in these conditions, such that women's genital responses would be more resistant to repeated exposure. Future studies should attempt to manipulate attention and investigate the role of appraisal in order to extricate the relationship between learning, sexual responses, and attentional commitment. Research using other technologies to assess attention, such as eye-tracking, in concert with PPG and VPP may aid in explaining the cognitive processes involved in the processing of visual stimuli mediating sexual responses.



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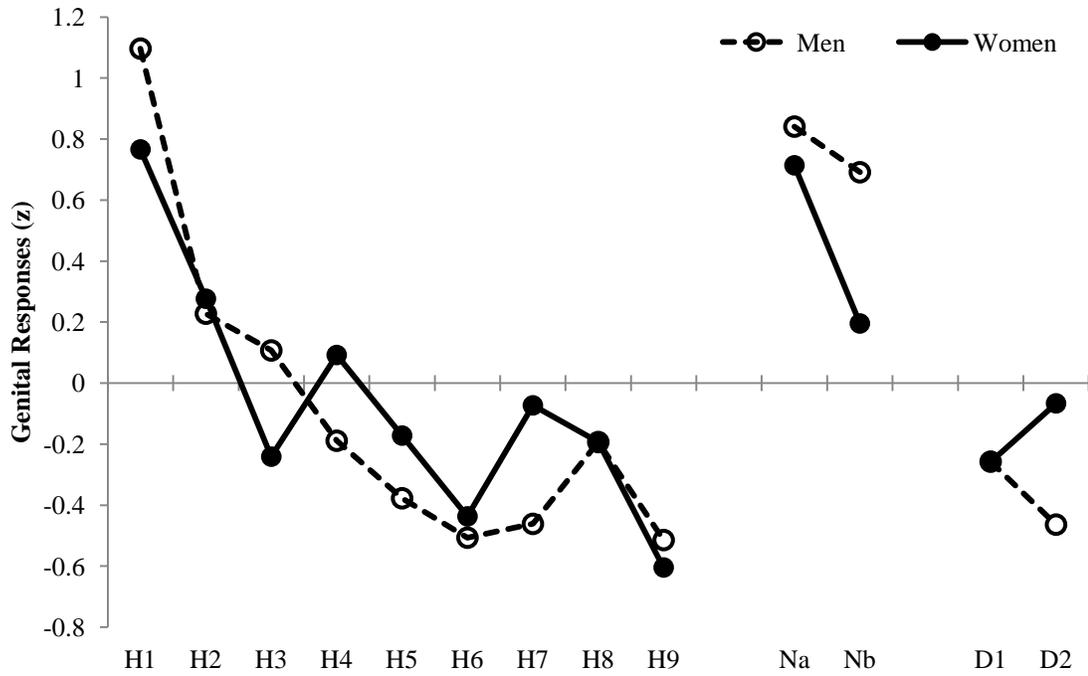


Figure 2.1 Standardized peak-minus-baseline changes in genital responses in men and women during habituation trials (H1-H9), novelty trials (Na-Nb), and dishabitation trials (D1-D2).

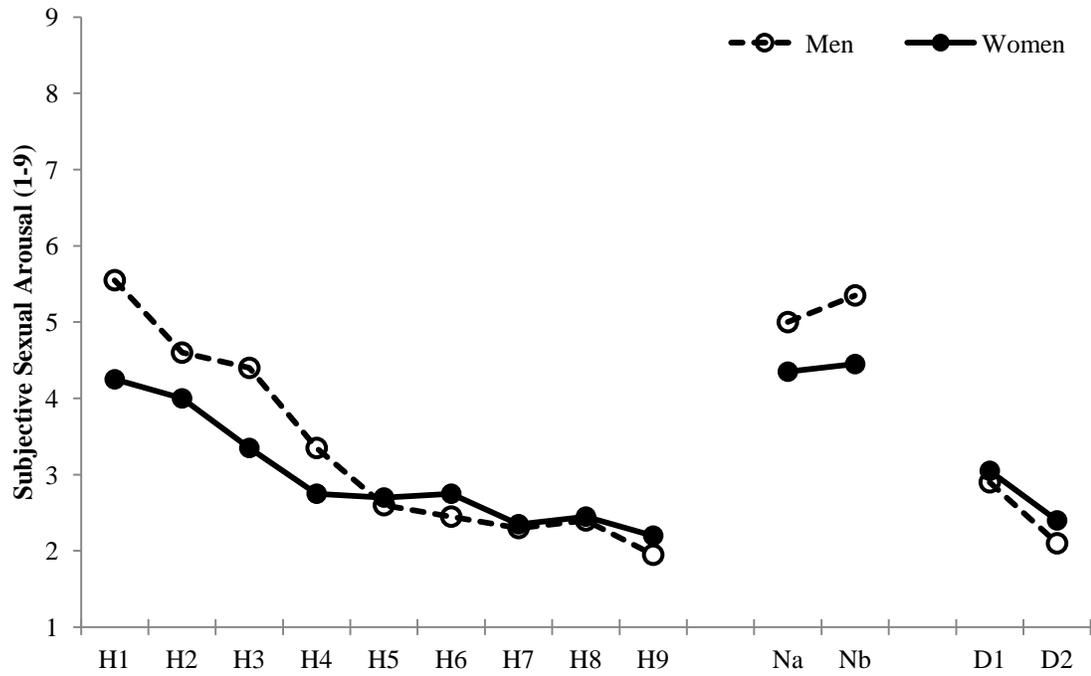


Figure 2.2 Subjective sexual arousal ratings for men and women during habituation trials (H1-H9), novelty trials (Na-Nb), and dishabituation trials (D1-D2).

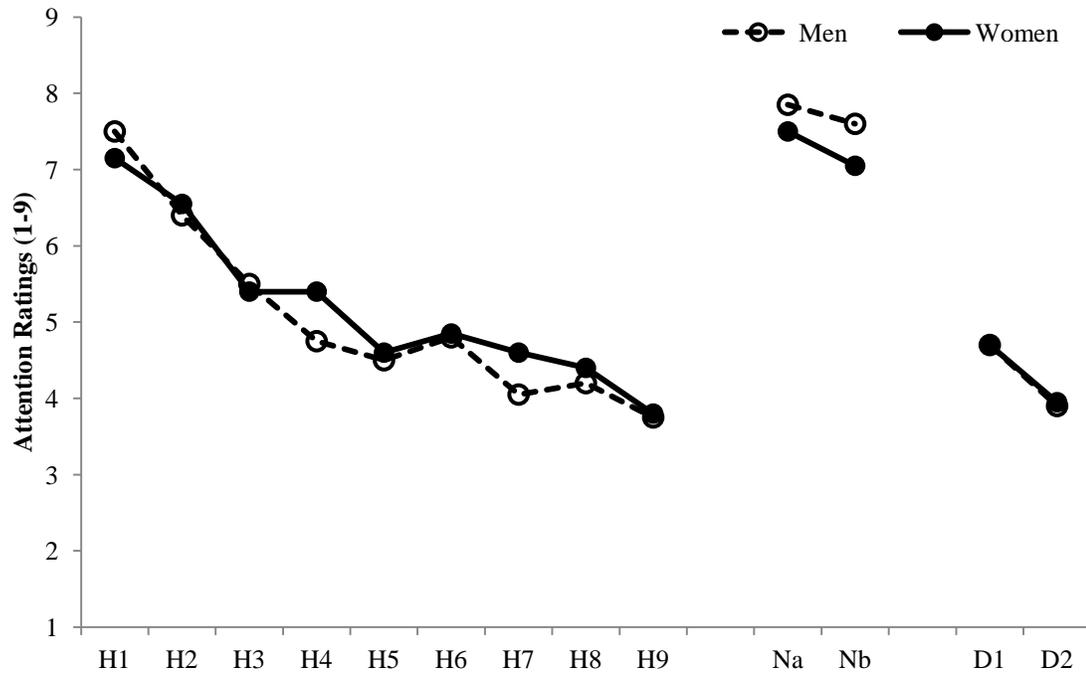


Figure 2.3 Attention ratings for men and women during habituation trials (H1-H9), novelty trials (Na-Nb), and dishabituation trials (D1-D2).

## **CHAPTER THREE**

### **Can Habituation of Sexual Responses be Elicited in Men and Women when Attentional Commitment is Maintained?**

#### **Abstract**

Studies investigating men and women separately suggest that men's genital responses habituate to sexual stimuli and that women's do not (or not to the same degree) and that attention is highly correlated with these changes. The preparation hypothesis asserts that women's genital responses occur automatically in the presence of sexual cues to protect them from injuries that may occur during penetration. It follows that women should not habituate as completely as men because the costs of not responding to sexual cues are likely higher for women than they are for men. The aims of the current study were to examine whether habituation can be elicited when attention is maintained and if a sex difference would be observed. Unlike previous studies of habituation that used the same stimulus to elicit habituation, we aimed to maintain attention and elicit habituation using slightly varied stimuli. Thirty-six heterosexual men and women were presented with one neutral stimulus trial, nine trials of the same couple (habituation), two trials of different couples (novelty), and two trials of the familiar couple (dishabituation). Genital responses were measured using circumferential phallometry and vaginal photoplethysmography. Post-stimulus ratings of sexual arousal and attention were recorded. Results showed habituation of genital but not subjective sexual responses in men and women. Attention remained high, but controlling for changes in attention eliminated habituation effects. Women did not exhibit greater resistance to habituation, despite evidence of residual genital responses. The role of attention in sexual responses is discussed.

## Introduction

It is unclear whether there is a sex difference in the habituation of genital responses. Based on the *preparation hypothesis*, Dawson, Suschinsky, and Lalumière (under review) predicted that habituation should be more difficult to produce in women than in men because the costs of not responding to sexual cues are higher for women (e.g., injury to the genital tract adversely affecting reproductive health) than for men (e.g., the loss of one sexual opportunity). The preparation hypothesis suggests that women's genital responses are elicited in the presence of any salient sexual cues in order to protect the genitals from injuries that could occur as a result of sexual activity (Chivers, 2005; Laan, 1994; van Lunsen & Laan, 2004). Dawson et al. reported that when women were repeatedly exposed to the same sexual stimulus, they ceased to produce a genital response altogether, inconsistent with the preparation hypothesis. Similar to other studies, statistically controlling for the diminution in attention eliminated the effects of repeated exposure on genital responses (Both, Laan, & Everaerd, 2011; Koukounas & Over, 1993). The authors concluded that a more appropriate test of the preparation hypothesis would require the maintenance of attention during repeated exposure to the same stimulus.

Studies exploring the role of cognitive factors report that attention plays a significant role in physiological and psychological sexual responses (e.g., Janssen, Everaerd, Spiering, & Janssen, 2000). For example, men are able to generate or inhibit an erection whilst exposed to a sexual stimulus through the use of such cognitive strategies as fantasy or distraction (Lalumière & Earls, 1992; Laws & Rubin, 1969). Women are also able to increase their genital and subjective arousal responses under demand conditions (Laan, Everaerd, Van Aanhoud, & Rebel, 1993). Men and women exhibit

significantly weaker genital responses when under the influence of cognitive distraction (e.g., dichotic listening and visually-presented arithmetic tasks) during the stimulus presentation, compared to when they are able to focus their attention solely on the stimulus (Adams, Haynes, & Brayer, 1985; Geer & Fuhr, 1976; Salemink & van Lankveld, 2006). The results of these studies suggest that attentional commitment has an influence on genital and subjective sexual responses. These studies identify factors that may contribute to the diminution of genital response during habituation. For instance, during repeated exposure to the same stimulus participants may become distracted by non-sexual elements in the stimulus, thus becoming less absorbed, resulting in genital responses of successively smaller magnitudes (Over & Koukounas, 1995). Not surprisingly, novel stimulation would reverse this effect, increasing absorption (i.e., attention) and subsequently genital response magnitude; this pattern is precisely what is typically found in habituation studies (e.g., Dawson et al., under review; Koukounas & Over, 1993; 1999; 2000; 2001).

Some studies of habituation have intentionally manipulated absorption by instructing participants to adopt either a *participant* or *spectator* observational stance. In the participant observational stance, participants imagine themselves as actors or participants in the stimulus, a task that is assumed to require a high degree of attention or absorption in the stimulus. In the spectator observational stance, participants imagine themselves as passive observers or spectators of the activities in the stimulus, a task assumed to require a lower degree of attention or absorption (Both et al., 2011; Koukounas & Over, 2001). The aim of manipulating absorption is to determine whether or not habituation can be elicited when the participant remains highly absorbed in the

stimulus (Both et al., 2011; Koukounas & Over, 2001). Neither observational stance has proven effective in precluding habituation of genital or subjective arousal in either sex (Both et al., 2011; Koukounas & Over, 2001). Other habituation studies have employed secondary tasks during the stimulus presentation to assess attention, such as time taken to respond to a tone (Koukounas & Over, 1999), dot (Laan & Everaerd, 1995), or the magnitude of an eyeblink startle to a 50 ms burst of white noise (Koukounas & Over, 2000). These studies demonstrate a positive relationship between genital response and attention. As genital responses decrease with repeated exposure, responses to the secondary task become more rapid, indicative of decreased attention or absorption in the sexual stimulus.

All habituation studies to date have relied on using the same erotic stimulus (film clip, audio story, or slide) to elicit habituation. Whilst the use of the same stimulus ensures that the content remains consistent across trials, it does not ensure that the stimulus is perceived the same way during repeated exposure (Laan & Everaerd, 1995; Meuwissen & Over, 1990). Studies investigating the role of attention on sexual responses suggest that the perception or processing of the stimulus has a strong influence on the subsequent generation of genital and subjective sexual responses (de Jong, 2009).

The aim of the current study was to determine whether habituation of genital responses can be elicited when a high degree of attention is maintained. In line with the preparation hypothesis, we predicted that a sex difference in habituation of genital response would emerge if attention remains high. The stimuli for the current study involved the same couple engaging in slightly different sexual activities in an attempt to maintain erotic saliency and participant attention.

## Method

### Participants

Twenty-two men and 20 women were recruited from university and college campuses using posters and an advertisement in the university student newspaper. To be eligible for the study, they were required to be between 18 and 30 years of age, not exclusively same-sex attracted, sexually-experienced, and free from sexual dysfunctions and mental illnesses. Participants were ineligible for the current study if they had participated in a previous study on habituation in our laboratory. Women were tested during all phases of the menstrual cycle (excluding menses; based on menstrual cycle information collected in the questionnaire) and women who were using hormonal contraceptives were included ( $n = 12$ ).

The final sample consisted of 18 men and 18 women with a mean age of 20.8 ( $SD = 2.4$ ) and 20.2 ( $SD = 1.9$ ) respectively. There was no sex difference with respect to age,  $t(34) = 0.85$ ,  $p = .40$ . Participants were excluded if they did not produce a genital response during a sexual stimulus (three men and one woman) or if their data were unreliable due to movement artifacts (one man and one woman). Most of the men (17) and women (15) reported a heterosexual sexual orientation, with one man and three women reporting a bisexual orientation. At the time of testing, the majority of men were single (67%) and the remainder were in relationships (dating or engaged; 33%). In women, the majority were in relationships (dating, engaged, or married; 67%) and the remainder were single (33%).

### Materials

**Audiovisual Stimuli.** The stimuli used for the adaptation period consisted of: a non-sexual stimulus used to acclimatize participants to the experimental setting (still-image of a beach scene – 300 s), a low-intensity erotic film clip to avoid potential floor effects (i.e., genital responses to the habituation stimulus needed to be significantly greater than to the low-intensity stimulus; nude female exercising – 60 s), and a non-sexual stimulus to which habituated genital responses could be compared (home renovation talk show – 60 s). The experimental stimuli consisted of three different 280 s audiovisual segments were used as sexual stimuli for the study. Each film involved male-female couples engaging in penile-vaginal intercourse in the same three positions. Eleven different 60 s trials were extracted from each of the original 280 s film segments with 40 s overlap between each trial (e.g., 0-60 s, 20-80 s, 40-100 s.... 220-280 s). Three different films were used to ensure that the findings would not be limited to a particular film.

**Physiological Recordings.** Men's genital responses were measured using mercury-in-rubber strain gauges (D. M. Davis, New Jersey). Changes in electrical output were sampled on a continuous basis throughout each trial at a rate of 10 samples/s, low-pass filtered (to 0.5 Hz), and digitized (40 Hz) using a Limestone Technologies Inc. (ODESSA, ON) DataPac\_USB and Preftest software, Version 10. This recording was transformed into mm of circumference. Prior to use, each gauge was calibrated over six 5-mm steps using a plastic cone.

Genital response in women was measured using a vaginal photoplethysmograph (VPP; Technische Handelsonderneming Coos, The Netherlands) assessing changes in vaginal pulse amplitude (VPA). The data were sampled on a continuous basis throughout each trial at a rate of 10 samples/s, band-pass filtered (0.5 Hz to 10 Hz), and digitized (40

Hz). A placement device attached to the cable of the VPP was used to ensure the correct depth and orientation of the light detector once inserted (Laan, Everaerd, & Evers, 1995). An experimenter blind to the trial number visually inspected the penile response curves and the waveforms and removed all identifiable movement artifacts prior to data analysis.

**Post-stimulus Questions.** After each trial, participants answered four questions (using a keypad) that appeared in a fixed order on the computer screen. Participants were asked to rate how sexually aroused they had felt during the previous film clip, how aroused their genitals had felt, how much attention they paid to the film clip, and how similar the film clip was compared to the film clip directly preceding it. Participants were asked to answer the questions using a 9-point scale, with 1 being the lower end (i.e., *there was no arousal/paid no attention/the film clip was not at all similar*) and 9 being the higher end (i.e., *there was a maximal level of arousal/highest level of attention/the film was extremely similar*).

**Questionnaires.** Biographic and sexual history information were collected with a paper-and-pencil questionnaire.

## **Procedure**

The Human Subject Research Committee at the university reviewed and approved all experimental procedures according to the ethical guidelines of the Canadian Tri-Council Policy Statement.

**Screening.** Interested participants responded to advertisements via email and received information regarding the study procedure. Eligibility was determined during a phone or email interview. Participants who met the eligibility criteria and who were still interested in the study (95%) scheduled an appointment in the laboratory. Participants

were asked to avoid engaging in any form of sexual activity for 24 hours prior to testing, and to avoid all forms of physical exercise in the hour before testing (Meston & Gorzalka, 1996). Participants were also asked to refrain from using alcohol, tobacco, cold medications, and recreational drugs on the day of testing.

**Experimental Procedure.** The experimental procedure followed that of a previous study (see Dawson et al., under review). Communication between participants and the experimenter was enabled through an intercom system and text messages appearing on the computer monitor. All stimuli were presented on a 17-inch computer monitor situated approximately five feet from participants at eye-level. The adaptation period allowed participants to get comfortable with the genital device and experimental setting and consisted of three stimuli: a non-sexual stimulus, a low-intensity erotic film clip, and a non-sexual stimulus (home renovation talk show - 60 s). Once participants had returned to baseline (or a maximum of five minutes had passed), the habituation stimuli were presented following one of two conditions (ordered or randomized, see below). To avoid any potential expectancy effects on genital responses, inter-stimulus intervals were an average of 90 s (a random selection of 60, 90, and 120 s for each trial), during this time participants answered the post-stimulus questions. There was another return to baseline (or a maximum of five minutes) inter-stimulus interval following the presentation of the second novel film clip (Nb) before the dishabituation trials. After all stimuli had been presented, participants received instructions on the computer screen to remove the genital gauge and place it into a sealable plastic bag, re-dress, and complete the questionnaire. The experimenter rejoined participants in the experimental room upon their completion of the questionnaire. Participants were debriefed about the purpose of

the study and received \$40 (CAD) as a compensation for their time. The entire experimental session took approximately two hours to complete.

### **Design**

A 2 x 2 x 14 mixed design was employed, with sex and stimulus condition (ordered and randomized) as the between-subjects factors and trial as the within-subjects factor. Participants were randomly assigned to the stimulus condition and the three films were counterbalanced among participants. In the *ordered* stimulus condition, participants were exposed to nine presentations of similar 60 s film clips presented in chronological sequence (derived from a 280 s segment of a film). For example, during trial one participants saw the first 0-60 s of the film segment, during trial two participants saw the 20-80 s of the film segment and so on, up to trial nine (180-240 s of the film segment). The nine trials were followed by two 60 s film clips, each from different films (i.e., different actors, different locations, same activities) to test for the effect of novelty subsequent to habituation and to eliminate fatigue as an explanation for the decrease in responses (200-260 s and 220-280 s of the different film segments). Following this, two 60 s film clips from the original film segment were used to test for dishabituation (200-260 s and 220-280 s respectively). Dishabituation refers to a recovered response following novel stimulation (Domjan, 2004). In the *randomized* stimulus condition, participants were exposed to nine presentations of 60 s film clips (derived from a 280 s segment of a film), but in a random sequence (i.e. not chronological). Participants were then presented with two 60 s trials from two different film segments (novelty) followed by the remaining two 60 s trials from the original film segment (dishabituation).

### **Data Preparation**

Genital responses were calculated two different ways: Using the peak genital response elicited during the trial minus the baseline response at trial onset and using the mean genital response for the trial minus the baseline response at trial onset. These two calculations (peak minus baseline and mean minus baseline) were highly correlated for men (.89) and women (.84). In order to be able to compare the genital responses of men and women, it was necessary to standardize the peak (or mean) minus baseline genital scores into *z*-scores within-subjects (Harris, Rice, Quinsey, Chaplin, & Earls, 1992). Post stimulus subjective responses were not standardized.

Separate one-way analyses of variance (ANOVA) using the unstandardized peak minus baseline genital responses during the first two trials (H1 and H2) as the dependent variable and film clip (film 1, 2, 3) as the independent variable were used to determine whether the films differed in their ability to elicit a genital response for each sex. The films elicited similar genital response for men,  $F(2, 17) = 1.53, p = .25$ , and women,  $F(2, 17) = 1.04, p = .38$ . A mixed design ANOVA revealed statistically similar levels of subjective sexual arousal for the three film clips; there was no interaction between sex and film clip,  $F(2, 35) = 1.93, p = .16$ , no main effect of sex,  $F(1, 35) = 0.08, p = .78$ , and no main effect of film clip,  $F(2, 35) = 1.12, p = .34$ .

## Results

### Genital Responses

Figure 3.1 shows the mean standardized genital responses for men and women during the neutral trial (Neutral), repeated stimulation trials (H1-H9), novel stimulation trials (Na-Nb), and dishabituation trials (D1-D2). The mixed design ANOVA using standardized peak minus baseline genital responses across the 14 trials (Neutral-D2)

revealed no significant interaction between trial, sex, and stimulus condition,  $F(8.05, 257.65) = 1.09, p = .37, \eta^2 = .033$ . There was no significant interaction between trial and sex,  $F(8.05, 257.65) = 1.57, p = .13, \eta^2 = .047$ , or trial and stimulus condition,  $F(8.05, 257.65) = 1.00, p = .43, \eta^2 = .030$ , suggesting that genital response patterns were similar for both men and women (see Figure 3.1). Genital responses changed significantly across trials,  $F(8.05, 257.65) = 10.08, p < .001, \eta^2 = .24$ . (Greenhouse-Geisser corrected values are reported when Mauchly's assumption of sphericity was not met. The Greenhouse-Geisser correction adjusts the degrees of freedom to account for unequal variance, resulting in more conservative significance values.).

To examine whether patterns of habituation (H1-H9) differed by sex and stimulus condition, a mixed design ANOVA for only habituation trials was conducted. There was no significant 3-way interaction,  $F(5.51, 176.37) = 1.16, p = .33, \eta^2 = .035$ , and no significant interaction between trial and sex,  $F(5.51, 176.37) = 0.90, p = .49, \eta^2 = .027$ , or trial and stimulus condition,  $F(5.51, 176.37) = 0.85, p = .53, \eta^2 = .026$ . Habituation was confirmed by a significant main effect of trial,  $F(5.51, 176.37) = 6.60, p < .0001, \eta^2 = .17$ . Figure 3.1 depicts a distinct decline in genital responding for men and women.

Planned contrasts (using the error term from the omnibus ANOVA) revealed a significant novelty effect on genital responses. Mean responses for trials Na and Nb (novel stimuli introduced) were higher than the mean responses for trials H8 and H9,  $F(1, 416) = 11.95, p < .001, \eta^2 = .19$ . Genital responses for trials D1 and D2 (habituation stimulus reinstated) were not significantly higher than for trials H8 and H9,  $F(1, 416) = 0.0007, p = .98, \eta^2 = .000$ , inconsistent with dishabituation.

Habituated genital responses (using unstandardized peak minus baseline values; H9) were significantly greater than genital responses for the neutral trial for men,  $F(1, 17) = 9.25, p < .01, \eta^2 = .35$ , and women  $F(1, 17) = 30.12, p < .0001, \eta^2 = .64$ , suggesting that men and women were still producing a genital response after habituation had been elicited. To provide a comparison to Dawson et al. (under review), analyses were conducted using unstandardized peak and mean genital responses for H9 compared to the peak and mean genital responses for the final 60 s of the 300 s adaptation stimulus (i.e. beach scene). Men's peak genital responses for H9 were marginally greater than their baseline genital response,  $F(1, 17) = 3.30, p = .09, \eta^2 = .16$ , and their mean genital responses were significantly greater for H9 compared to baseline,  $F(1, 17) = 10.12, p = .005, \eta^2 = .37$ . Both peak and mean genital responses in women were significantly greater for H9 than for baseline,  $F(1, 17) = 8.14, p = .01, \eta^2 = .32$ , and  $F(1, 17) = 34.56, p < .0001, \eta^2 = .67$ , respectively.

Returning to the main analyses, using mean minus baseline rather than peak minus baseline yielded the same pattern of results. Likewise, separate repeated-measures ANOVAs for each sex using unstandardized peak minus baseline and mean minus baseline genital responses yielded a pattern consistent with habituation, novelty, and no dishabituation. To account for the fact that trial baseline values could change across trials, additional analyses were performed using standardized and unstandardized peak minus session and mean minus session (rather than trial) baseline genital responses. Session baseline was obtained from the peak and the mean genital response during the last 60 s of the 300 s beach scene presentation. Patterns consistent with habituation and novelty were observed using all of these additional scoring methods in men and women.

## Subjective Sexual Arousal

The 3-way interaction from the mixed design ANOVA for subjective sexual arousal was not significant,  $F(8.12, 259.95) = 0.79, p = .61, \eta^2 = .021$ , and there was no significant interaction between trial and sex,  $F(8.12, 259.95) = 0.69, p = .70, \eta^2 = .024$ , or sex and stimulus condition,  $F(1, 32) = 0.28, p = .60, \eta^2 = .009$ . There was a significant interaction between trial and stimulus condition,  $F(8.12, 259.95) = 2.09, p = .04, \eta^2 = .061$ ; therefore, subjective responses were analyzed separately by condition for the 14 trials. Figure 3.2 shows the pattern of subjective sexual arousal for men and women across the 14 trials in the ordered stimulus condition and in the randomized stimulus condition separately. There was a main effect of trial for the ordered stimulus condition,  $F(13, 221) = 17.13, p < .0001, \eta^2 = .50$ , and for the randomized stimulus condition,  $F(5.93, 100.85) = 19.87, p < .0001, \eta^2 = .54$ , suggesting that the different trials elicited different degrees of subjective sexual arousal.

A mixed design ANOVA using habituation trials (H1-H9) revealed no significant 3-way interaction,  $F(5.00, 159.90) = 0.89, p = .49, \eta^2 = .027$ , and no significant interaction between trial and sex,  $F(5.00, 159.90) = 0.96, p = .45, \eta^2 = .029$ , or sex and stimulus condition,  $F(1, 32) = 0.17, p = .68, \eta^2 = .005$ . There was a significant interaction between trial and stimulus condition,  $F(5.00, 159.90) = 2.29, p = .05, \eta^2 = .067$ . Habituation of subjective sexual arousal was analyzed separately by stimulus condition, revealing a near significant effect for the ordered condition,  $F(4.21, 71.56) = 2.27, p = .07, \eta^2 = .12$ , and no significant effect for the random condition,  $F(4.10, 69.62) = 1.07, p = .38, \eta^2 = .059$ , suggesting that subjective sexual arousal was maintained during habituation trials in both stimulus conditions.

For the ordered condition, planned contrasts revealed a significant novelty effect,  $F(1, 208) = 20.16, p < .0001, \eta^2 = .56$ , but no dishabituation effect,  $F(1, 208) = 0.68, p = .41, \eta^2 = .041$ . For the randomized condition, there was no novelty effect,  $F(1, 208) = 0.81, p = .37, \eta^2 = .048$ , or dishabituation effect,  $F(1, 208) = 0.20, p = .65, \eta^2 = .013$ . Analyses using perceived genital arousal rather than subjective sexual arousal produced similar results.

### **Attention**

A mixed design ANOVA for self-reported attention revealed no significant 3-way interaction,  $F(6.07, 211.43) = 1.23, p = .29, \eta^2 = .037$ , and no significant interaction between trial and sex,  $F(6.07, 211.43) = 0.52, p = .91, \eta^2 = .016$ , trial and stimulus condition,  $F(6.07, 211.43) = 0.34, p = .93, \eta^2 = .010$ , or sex and stimulus condition,  $F(1, 32) = 0.58, p = .45, \eta^2 = .018$ , suggesting that attention ratings were similar for men and women in both stimulus conditions. Attention changed significantly across the 14 trials,  $F(6.61, 211.43) = 10.86, p < .0001, \eta^2 = .25$ , as can be seen in Figure 3.3 whereby attention increased with the presentation of the sexual stimulus on trial 2 (H1) and decreased slightly thereafter until the presentation of novel stimuli (Na-Nb) where attention increased again.

Habituation of attention was examined for habituation trials (H1-H9). There was no significant 3-way interaction,  $F(5.03, 161.09) = 0.87, p = .50, \eta^2 = .027$ , and no significant interaction between trial and sex,  $F(5.03, 161.09) = 0.53, p = .76, \eta^2 = .016$ , trial and stimulus condition,  $F(5.03, 161.09) = 0.46, p = .81, \eta^2 = .014$ , or sex and stimulus condition,  $F(1, 32) = 0.87, p = .35, \eta^2 = .027$ . There was a main effect of trial,

$F(5.03, 161.09) = 4.48, p = .001, \eta^2 = .12$ , suggesting that attention changed significantly for habituation trials.

Planned contrasts revealed a significant novelty effect,  $F(1, 416) = 25.81, p < .0001, \eta^2 = .45$ , suggesting that novel stimulation led to an increase in attention. The mean attention ratings for trials H8 and H9 were significantly higher than for trials D1 and D2,  $F(1, 416) = 4.34, p = .04, \eta^2 = .12$ , providing no evidence for dishabituation of attention.

### **Additional Analyses Controlling for Attention**

To investigate the effects of self-reported attention on genital responses, a mixed design ANCOVA was performed with standardized genital responses as the dependent variable and self-reported attention as the covariate across the 14 trials (Neutral-D2). There was no significant 3-way interaction when controlling for attention,  $F(13, 234) = .827, p = .63, \eta^2 = .044$ . There was no significant interaction between trial and sex,  $F(13, 234) = 1.40, p = .16, \eta^2 = .072$ , or trial and stimulus condition,  $F(13, 234) = 1.25, p = .28, \eta^2 = .062$ , and no significant effect of trial,  $F(13, 234) = 1.19, p = .31, \eta^2 = .027$ . The results were similar when examining habituation trials, novelty, and dishabituation, in that controlling for attention eliminated all prior significant effects.

### **Perceived Similarity of Stimuli Across Habituation Trials**

Figure 3.4 shows the perceived similarity ratings for men and women in both stimulus conditions across the 13 trials. Inspection of Figure 3.4 suggests that men and women did not perceive the habituation stimuli as being the exact same across trials and that the novel films (Na and Nb) were perceived as being less similar, relative to the habituation stimuli. To assess whether or not participants perceived differences in the

habituation stimuli, a mixed design ANOVA was conducted using perceived similarity ratings. Trials H2 to H9 were used as the dependent variable because similarity ratings for H1 were almost always perceived as “dissimilar” (H1 was preceded by a non-sexual neutral stimulus). There was no significant 3-way interaction,  $F(4.99, 159.70) = 1.94, p = .09, \eta^2 = .057$ , and no significant interaction between trial and stimulus condition,  $F(4.99, 159.70) = 0.86, p = .51, \eta^2 = .026$ , or sex and stimulus condition,  $F(1, 32) = 0.059, p = .81, \eta^2 = .002$ , for similarity ratings. There was a significant interaction between trial and sex,  $F(4.99, 159.70) = 2.83, p = .02, \eta^2 = .081$ , thus, perceived similarity was analyzed separately by sex. Men’s similarity ratings did not change across habituation trials,  $F(3.37, 57.27) = 1.24, p = .31, \eta^2 = .068$ . Women’s similarity ratings changed across habituation trials,  $F(3.56, 60.51) = 3.50, p = .02, \eta^2 = .17$ , in that repeated exposure produced ratings of less similarity. Planned contrasts revealed that the novel films were perceived as less similar than the habituation films for men,  $F(1, 208) = 187.87, p < .0001, \eta^2 = .31$ , and for women,  $F(1, 208) = 207.01, p < .0001, \eta^2 = .28$ .

#### **Comparison with Dawson et al. (under review)**

To examine whether or not the use of slightly different stimuli (rather than the exact same stimulus) affected the patterns of genital responding in men and women, we compared the genital response patterns in the current study (Study 2) with the response patterns from an earlier study (Study 1; Dawson et al., under review). We also compared the patterns of attention from the two studies to determine if the stimuli used in the current study were more effective in maintaining participant attention.

Figure 3.5 shows the genital response patterns for men and women in Study 1 and Study 2. Genital response patterns were examined using a mixed design ANOVA with

sex and study as the between-subjects factors and the 13 trials (H1-D2) as the within-subjects factor. Genital responses for Study 2 were standardized across 13 trials (i.e., without the inclusion of the neutral stimulus) to ensure a proper comparison with Study 1. There was no significant 3-way interaction between trial, sex, and study,  $F(9.23, 664.64) = 1.30, p = .23, \eta^2 = .018$ , and no significant interaction between trial and sex,  $F(9.23, 664.64) = 1.51, p = .14, \eta^2 = .021$ , or trial and study,  $F(9.23, 664.64) = 1.50, p = .14, \eta^2 = .020$ . There was a significant main effect of trial,  $F(9.23, 664.64) = 13.92, p < .0001, \eta^2 = .16$ , suggesting that genital responses changed significantly across the 13 trials.

Habituation of genital responses (H1-H9) was similar across the two studies for men and women. There was no significant 3-way interaction,  $F(6.42, 461.89) = 0.80, p = .58, \eta^2 = .011$ , and no significant interaction between trial and sex,  $F(6.42, 461.89) = 0.72, p = .64, \eta^2 = .010$ , or trial and study,  $F(6.42, 461.89) = 1.01, p = .42, \eta^2 = .014$ . The main effect of trial,  $F(6.42, 461.89) = 17.14, p < .0001, \eta^2 = .19$ , is evidence of habituation of genital responses in both studies.

Figure 3.5 depicts the attention ratings of men and women in both studies. Examination of attention across the 13 trials (H1-D2) revealed no significant 3-way interaction,  $F(6.22, 447.66) = 0.40, p = .87, \eta^2 = .005$ , and no significant interaction between trial and sex,  $F(6.22, 447.66) = 0.59, p = .75, \eta^2 = .008$ , or study and sex,  $F(1, 72) = 0.01, p = .92, \eta^2 = .000$ . There was a significant interaction between trial and study,  $F(6.22, 447.66) = 10.38, p < .0001, \eta^2 = .13$ , such that the two studies produced different patterns of attention. The significant main effect of study for attention ratings,  $F(1, 72) = 14.67, p < .0001, \eta^2 = .17$ , and inspection of Figure 3.5 both suggest that attention was greater in Study 2.

Habituation of attention was also examined, revealing no significant 3-way interaction,  $F(5.03, 361.80) = 0.28, p = .93, \eta^2 = .004$ , and no significant interaction between trial and sex,  $F(5.03, 361.80) = 0.65, p = .67, \eta^2 = .009$ , or study and sex,  $F(1, 72) = .046, p = .83, \eta^2 = .001$ . There was a significant interaction between trial and study,  $F(5.03, 361.80) = 7.07, p < .0001, \eta^2 = .089$ , and a main effect of study,  $F(1, 72) = 17.34, p < .0001, \eta^2 = .19$ , such that attention during habituation trials in Study 2 was greater than attention in Study 1.

Table 3.1 indicates the extent to which genital responses and attention changed across trials (habituation, novelty, and dishabituation) in Study 1 and Study 2. The effect sizes ( $\eta^2$ ) are given with and without controlling for self-reported attention as a covariate. Table 1 shows that the magnitudes of the effects for genital responses and attention are smaller in Study 2 compared to Study 1.

### **Discussion**

The results of the present study replicate those of Dawson et al. (under review) in that the genital responses of men and women declined significantly and similarly during repeated exposure. Also, genital responses increased when both sexes were presented with novel stimuli and neither sex exhibited a dishabituated genital response. These patterns were robust to a variety of scoring methods and likely reflect a true pattern of responding. As in the earlier study, controlling for the shifts in attention across the trials accounted for the change in genital responding in men and women alike. There were, however, several differences between the findings of the current study and those of the previous study. First, habituated genital responses were greater in magnitude than the response to the neutral stimulus, unlike the earlier study in which we found that there was

a cessation of genital responding. Second, the patterns of attention were different across the two studies, such that attention was higher and did not decrease to the same extent in the current study. Third, men's and women's subjective sexual arousal and perceived genital arousal did not decline across trials despite the significant decrease in genital responses.

Habituated genital responses were significantly greater in magnitude compared to responses to the neutral and baseline stimuli, indicating that men and women were still producing a genital response after habituation was elicited. Other habituation studies have not examined whether or not genital responses are completely extinguished during habituation (Both et al., 2011; Koukounas & Over, 1993; 1999; 2000; 2001), so we are unable to determine whether the study by Dawson et al. (under review) was unique in this regard. Given the plateau in genital response patterns from H6 onwards, it seems unlikely that additional trials would have eliminated genital responses in either sex using slightly varied stimuli. Although not statistically significant, inspection of Figure 3.5 suggests that habituation of genital responses were less pronounced for women in the current study compared to the earlier study and also compared to men (Dawson et al., under review). This suggests that women's genital responses might be more resistant to habituation when attentional commitment is high and when using stimuli that better reflect a sexual encounter, in line with the prediction from the preparation hypothesis. The genital response at H9 in both sexes may have been facilitated by maintained subjective sexual arousal or higher attention in the current study.

The design used in the current study was insufficient to fully maintain attentional commitment, so we are unable to address whether habituation can be elicited or if a sex

difference exists in genital response patterns when attention is fully maintained. However, a higher degree of attention was obtained in the current study compared to the previous study that relied on using the same sexual stimulus to elicit habituation. Similar to other studies, controlling for attention accounted for the changes in genital responses (Both et al., 2011; Dawson et al., under review; Koukounas & Over, 1993; 2000; 2001). Caution should be taken when theorizing about the direction of this effect, because it is also possible that changes in the magnitude of genital response influence attention. However, the genital response patterns from the two studies were statistically similar, which may provide insight as to the direction of this relationship. If the direction of this effect is genital responses influencing attention, then we would expect similar patterns of attention across the two studies, but this was not the case.

The lack of habituation for subjective sexual arousal despite significant decreases in genital responding and attention is surprising, especially for the men, who tend to have highly concordant responses (Chivers, Seto, Lalumière, Laan, & Grimbos, 2010). Researchers investigating the relationship between genital responses and self reported sexual arousal (i.e., *sexual concordance*) suggest a reliable sex difference, such that the two responses in men exhibit a strong positive correlation ( $r = .66$ , based on 81 samples, 1,732 men), and in women exhibit a smaller, but still positive correlation ( $r = .26$ , based on 108 samples, 2,345 women). The pattern of subjective sexual arousal may have been affected by the stimuli used to elicit habituation: It is possible that subjective sexual arousal was maintained due to the slight differences in the stimuli, allowing the film clip to maintain erotic saliency despite declining genital responses. The similarity ratings for

each trial indicate that men and women perceived the stimuli as slightly different from one another which may have contributed to sustained subjective sexual arousal.

Sustained subjective arousal to the same sexual target is reminiscent of the reported sexual satisfaction of some individuals in long-term relationships. Rather than sexual satisfaction decreasing with time, couples who engage in a variety of sexual activities report experiencing greater sexual satisfaction (Greeley, 1991). In the current study, the stimuli depicted the same couple engaged in intercourse in a variety of sexual positions, and it is possible that this contributed to the maintenance of subjective sexual arousal. Some researchers have suggested that low sexual desire may be the result of habituation to sexual cues (Both et al., 2011; O'Donohue & Plaud, 1991). The maintenance of subjective sexual arousal in the current study has potential implications for the treatment of low sexual desire (e.g., hypoactive sexual arousal disorder). Based on the current findings, treatments incorporating variation in sexual activity rather than sexual partners may have a positive influence on one's experience of sexual arousal.

As mentioned, men and women exhibited discordant patterns of genital response and subjective sexual arousal as habituation was elicited. More specifically, genital responses declined across trials whilst subjective reports of sexual arousal were maintained in both men and women. The results of the current study suggest that attention to sexual stimuli may affect these two response systems differently. Laboratory studies of category-specificity indeed demonstrate that men produce genital responses when their preferred sexual cues are presented, whereas women produce genital responses when any sexual cue is presented. Depending on whether or not those cues are preferred or non-preferred, subjective sexual arousal may be present or absent (Chivers &

Bailey, 2005; Chivers, Rieger, Latty, & Bailey, 2004; Suschinsky & Lalumière, 2011a; 2011b). Most studies reporting discordance in women find a pattern opposite to what was found in the current study, in that there is usually an absence of subjective sexual arousal in the presence of a genital response (Chivers & Bailey, 2005; Chivers et al., 2004; Suschinsky & Lalumière, 2011a; 2011b). Other studies have reported discordance similar to the pattern found in the current study, in that men and women report being aroused in the absence of a genital response (Terry, Suschinsky, Lalumière, & Vasey, 2012), suggesting that these two responses are controlled by different pathways or systems.

This discordance between genital response and subjective sexual arousal along with the change in attention is contrary to what would be predicted from an information-processing model of sexual arousal (Janssen et al., 2000). This model incorporates two pathways: unconscious and conscious. The unconscious pathway is responsible for generating a genital response to sexual stimuli, whereby the integration of sexual meanings in implicit memory and motor response triggers an automatic genital response. The conscious pathway is responsible for subjective sexual arousal, whereby the presence or absence of a genital response and the appraisal of sexual stimuli (e.g., as sexual or non-sexual, positive or negative) orients attention to the stimulus leading to subjective sexual arousal (Janssen et al., 2000). The finding that men and women reported being equally aroused in the presence and absence of a genital response is inconsistent with this model. Moreover, if men and women derive part of their subjective sexual arousal from their genital responses (i.e., in a feedback loop), then it seems peculiar that an individual could be producing significantly different genital responses whilst reporting that they are equally subjectively sexually aroused with each exposure. Similarly, Basson's (2000)

model of women's sexual arousal purports that mental arousal (subjective arousal) facilitates genital responses, but not necessarily the other way around. The results of the current study do not support the notion that subjective sexual arousal always influences genital responses in this manner, given that subjective sexual arousal was maintained while genital responses decreased significantly.

It may have been more appropriate to use a continuous measure of subjective sexual arousal while genital responses were being assessed to better interpret the discordance observed in the current study. For instance, given that the last 20 s of each trial contained novel content (in the ordered condition), it is possible that post stimulus ratings were especially affected by the novel content while genital responses were not. Continuous assessment of subjective sexual arousal (i.e., subjective sexual arousal recorded continuously throughout the stimulus presentation) would have allowed a better examination of the relationship between the stimulus content used in the current study and subjective sexual arousal. Similarly, simultaneous assessment of visual attention may have also provided useful insight into this relationship. Models incorporating the synchrony (or asynchrony) of these related responses may lead to greater understanding of sexual concordance in men and women and any associated sex differences. Continuous measures of subjective sexual arousal were not used in the current study because they have been found to cause distraction and inhibit men's genital responses which would bias the response patterns in favor of habituation (Chivers et al., 2010; Wincze, Venditti, Barlow, & Mavissakalian, 1980). The use of more objective measures of attention and cognitive processes, such as eye-tracking and brain-imaging, could help to elucidate the findings of the current study as to what components of the stimulus were being attended

to under these conditions. Understanding the role of attention on the various sexual responses may lead to a more comprehensive and accurate information-processing model of arousal.

Overall the data suggest that the genital responses of men and women are subject to learning processes. Specifically, repeated exposure to the same stimulus does not result in the same magnitude of genital response each time, but rather, genital responses decrease systematically after first exposure. Despite significant changes in genital response magnitude across trials, women exhibited a residual genital response after habituation had been elicited, consistent with the prediction from the preparation hypothesis. However, this pattern was also true for men, perhaps demonstrating that complete extinction of genital responses is difficult to produce, especially when subjective sexual arousal remains high. Attention to sexual cues appeared to play an important role in the production and inhibition of genital responses. The lack of agreement between genital and subjective sexual responses in the current study is surprising and is opposite to the pattern reported in the majority of studies investigating sexual concordance (Chivers et al., 2010) and is not consistent with what would be predicted from an information-processing model (Janssen et al., 2000). Future research should investigate the role of attentional strategies when inducing sexual responses in the laboratory and the subsequent effect on sexual concordance. Understanding the role of attention to sexual stimuli may lead to greater understanding of individuals who suffer from difficulties producing genital and subjective sexual responses.

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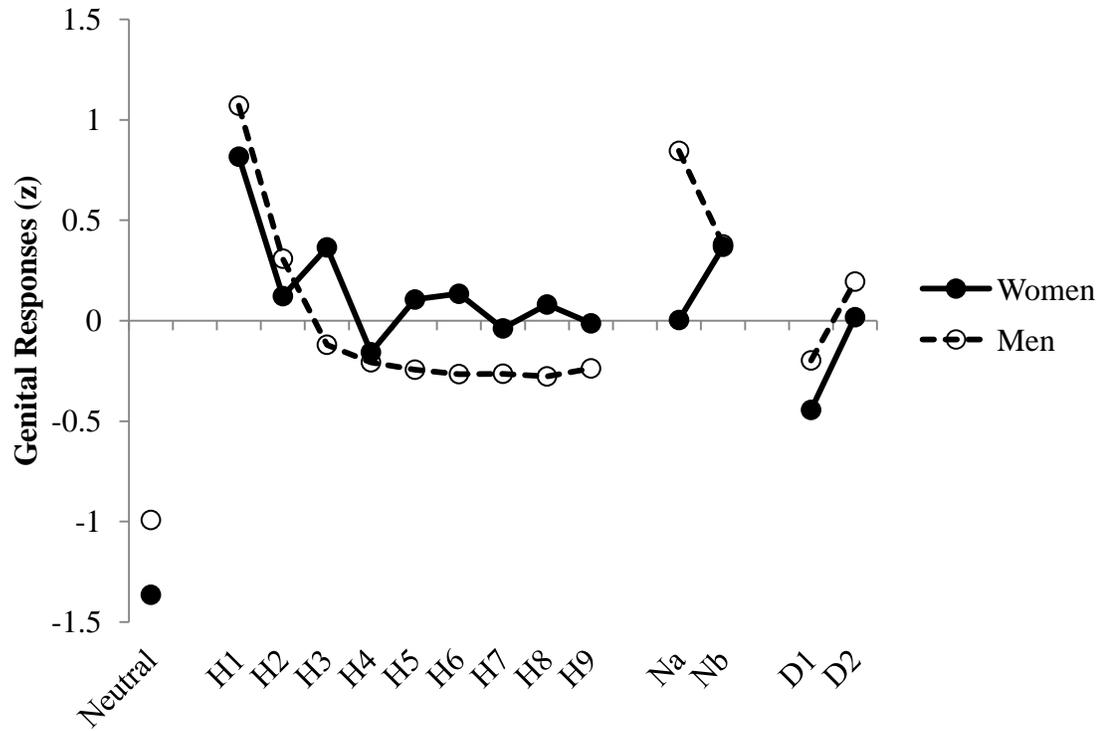


Figure 3.1 Standardized peak-minus-baseline changes in genital responses in men and women during neutral trial, habituation trials (H1-H9), novelty trials (Na-Nb), and dishabituation trials (D1-D2).

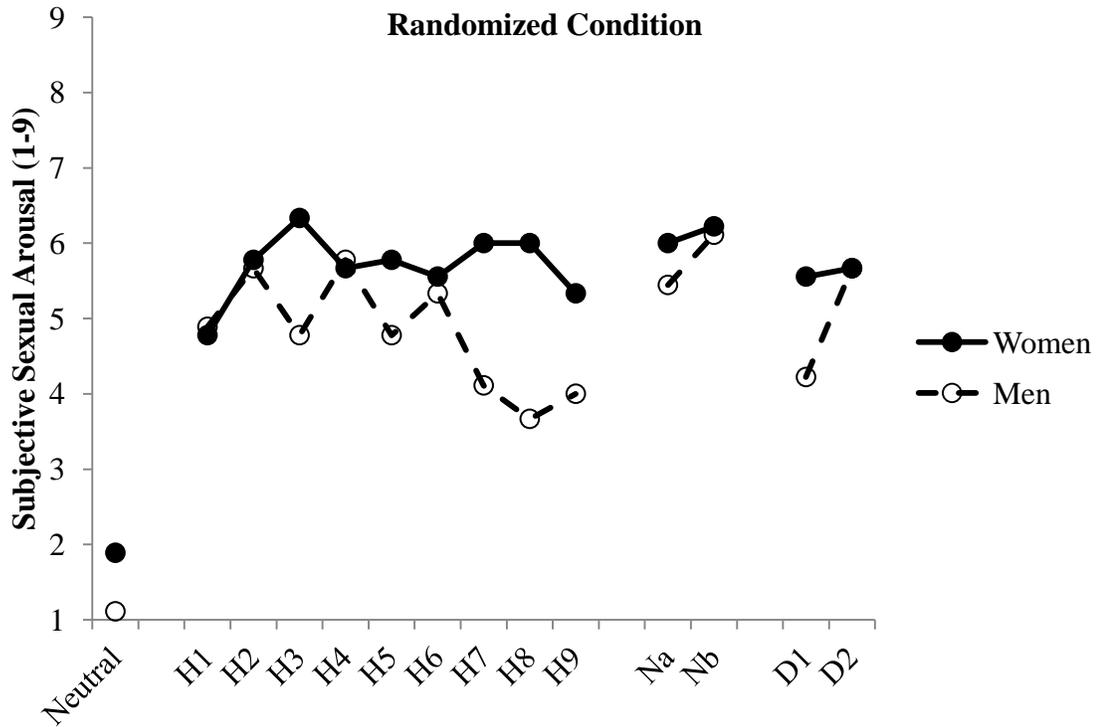
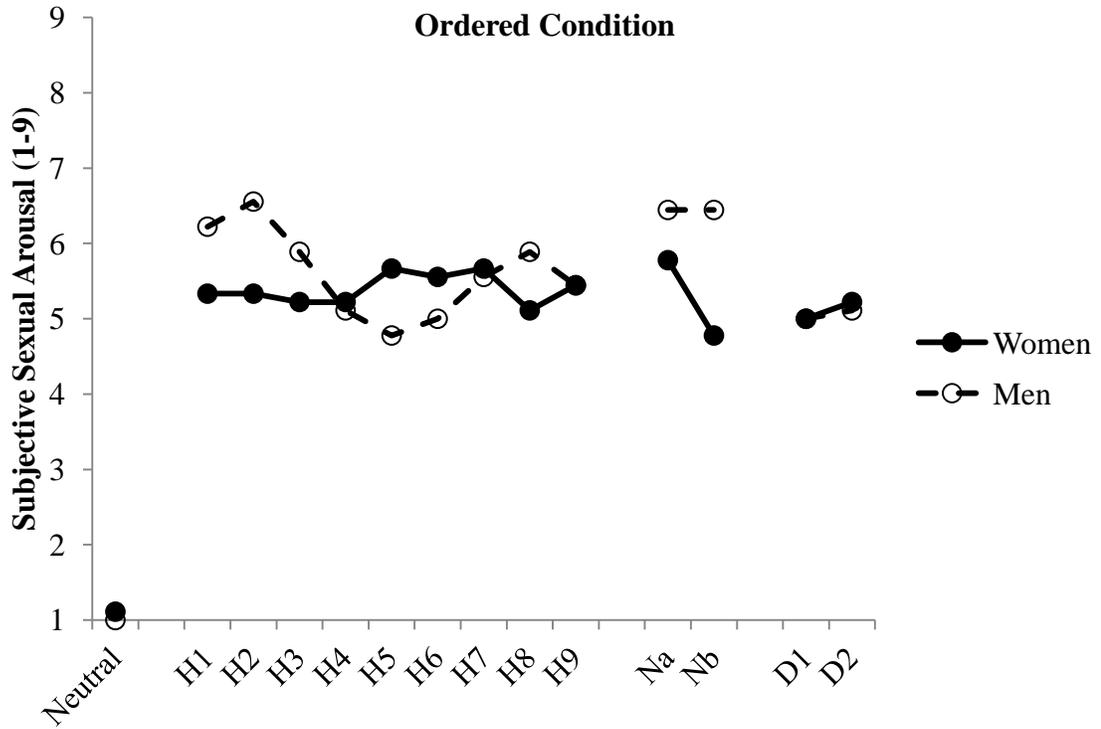


Figure 3.2 Subjective sexual arousal ratings for men and women in the ordered and randomized conditions during neutral trial, habituation trials (H1-H9), novelty trials (Na-Nb), and dishabituation trials (D1-D2).

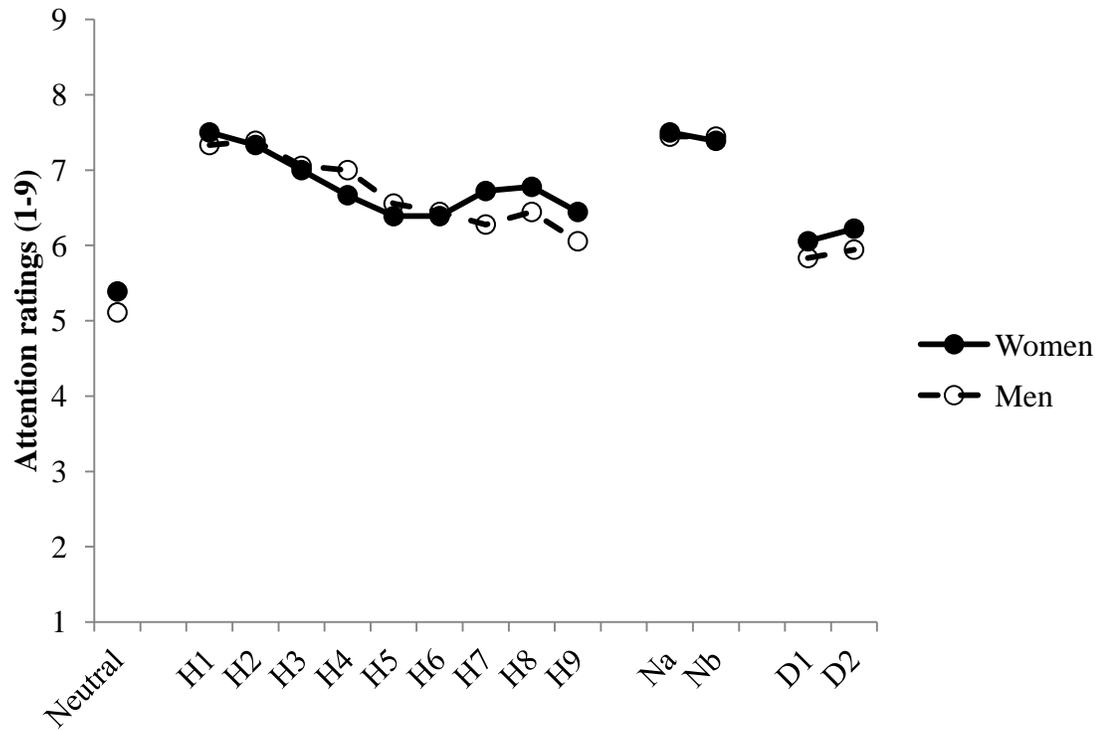


Figure 3.3 Attention ratings for men and women during neutral trial, habituation trials (H1-H9), novelty trials (Na-Nb), and dishabituation trials (D1-D2).

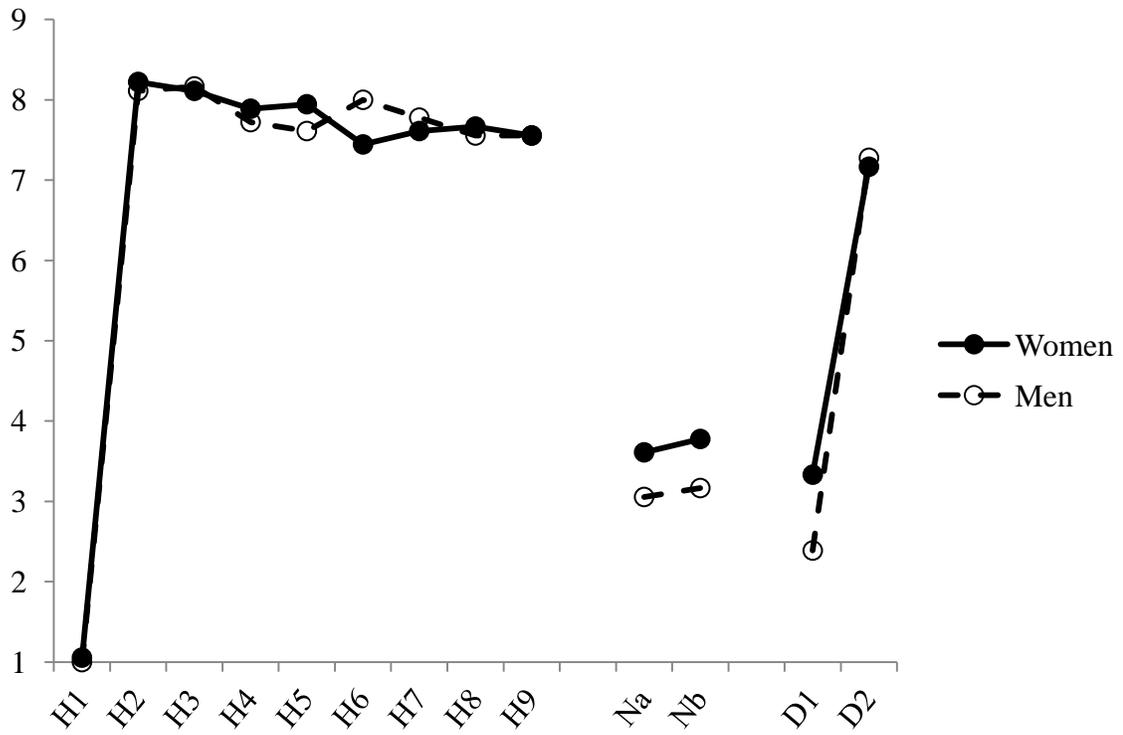


Figure 3.4 Perceived similarity of the films clips for men and women during habituation trials (H1-H9), novelty trials (Na-Nb), and dishabituation trials (D1-D2).

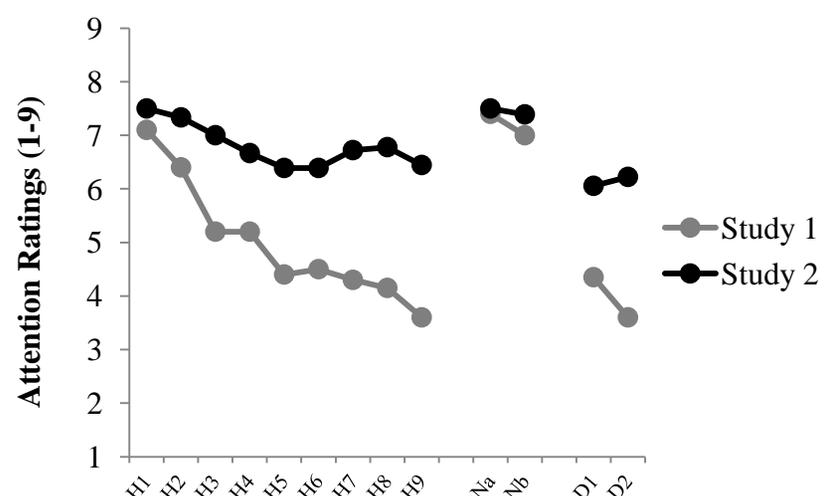
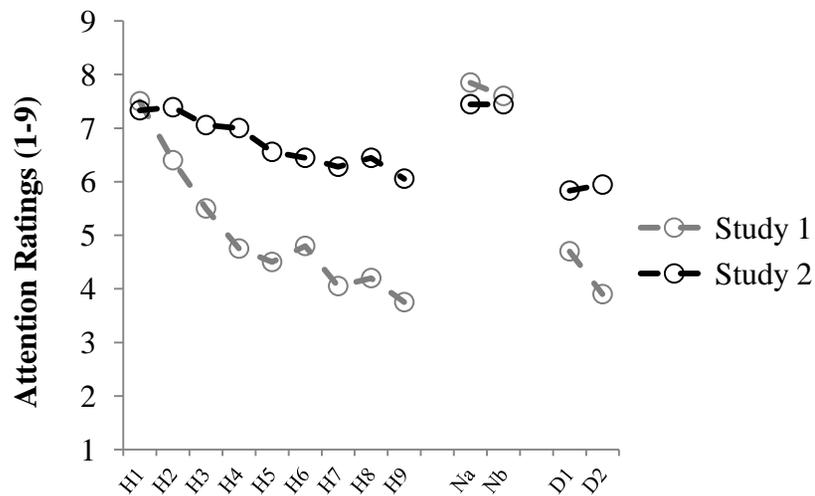
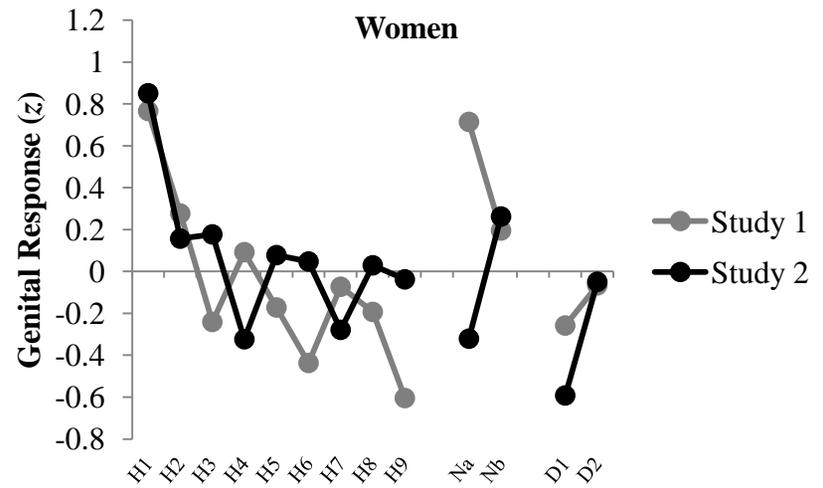
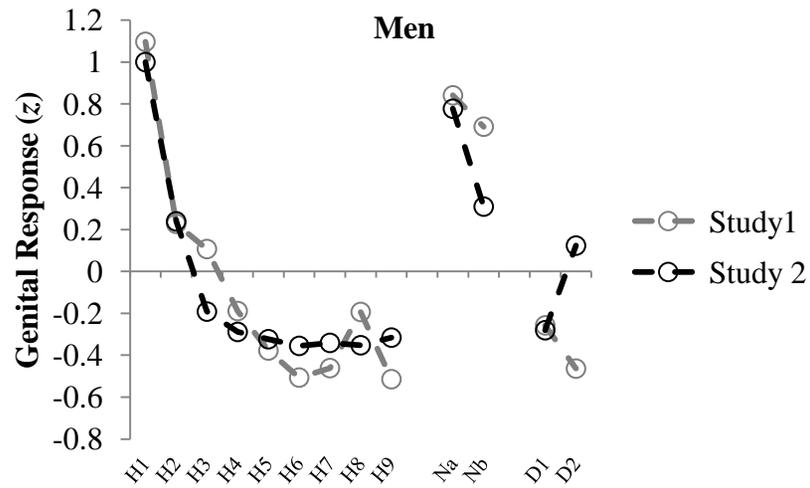


Figure 3.5 Comparison of data from Study 1 (Dawson et al., under review) and Study 2 (current study) for genital responses and attention ratings during habituation trials (H1-H9), novelty (Na-Nb), and dishabituation trials (D1-D2)

	Study 1	Study 2
<i>Effect Sizes for genital responses</i>		
Habituation Trials (H1-H9)	0.227	0.171
Trials H8-H9 vs. trials Na-Nb	0.551	0.124
Trials H8-H9 vs. trials D1-D2	0.017	0.001
<i>Effect sizes for attention</i>		
Habituation Trials (H1-H9)	0.439	0.123
Trials H8-H9 vs. trials Na-Nb	0.839	0.446
Trials H8-H9 vs. trials D1-D2	0.023	0.120
<i>Effect sizes for genital responses with adjustment for attention</i>		
Habituation Trials (H1-H9)	0.062	0.028
Trials H8-H9 vs. trials Na-Nb	0.002	0.010
Trials H8-H9 vs. trials D1-D2	0.002	0.003

Table 3.1 Effect sizes ( $\eta^2$ ) associated with habituation, novelty, and dishabituation trials in Study 1 (Dawson et al., under review) and Study 2 (current study), with and without adjustment for self-reported attention.

## CHAPTER FOUR

### **Habituation of Sexual Responses: Implications and Directions for Future Research**

The studies presented in this thesis examined the effect of repeated exposure to sexual stimuli on the sexual responses of men and women using the same experimental design. Based on the preparation hypothesis, it was hypothesized that women's genital responses would be more resistant to habituation than men's. This prediction was based on the differential costs involved with not producing a genital response in the presence of sexual cues. Contrary to this prediction, the first study revealed no sex difference in patterns of genital responding. Both men and women showed patterns consistent with habituation and novelty effects. Interestingly, after habituation was elicited, women ceased to produce a genital response altogether, again inconsistent with the preparation hypothesis. As in other studies, attentional commitment shifted across trials and appeared to play an important role in the generation of genital response in both sexes (Both, Laan, & Everaerd, 2011; Koukounas & Over, 1993; 1999; 2000; 2001).

In the second study we attempted to maintain attention to provide a more ecologically sound test of habituation and the preparation hypothesis, using stimuli intended to better reflect a sexual encounter. We predicted that when attention was maintained, women would not habituate to the same degree as men. Like the first study, there was no sex difference in genital response patterns. In Study Two, the magnitude of the habituated genital response was greater than the response to a neutral stimulus for both men and women, indicative of residual genital responses. Surprisingly, subjective sexual arousal for men and women was maintained during repeated exposure. Attention

was higher in Study Two, but similar to Study One attentional commitment declined across trials and controlling for changes in attention eliminated the habituation and novelty effects.

### **Do Sexual Responses Habituate?**

The two studies provide the first empirical support for the habituation of sexual responses of men and women using the same experimental design. Rather surprisingly, there was no sex difference in patterns of habituation. The patterns reported in both studies suggest that habituation in men and women is a true phenomenon because the patterns were robust to a variety of scoring methods and were not limited to a particular stimulus. The use of the same sexual stimulus and slightly varied sexual stimuli to elicit habituation produced similar patterns of genital responses. However, the use of slightly varied sexual stimuli did not eliminate genital responses and precluded habituation of subjective sexual arousal.

The habituation design used in Study One completely eliminated genital responses in men and women. Other responses and processes thought to covary with changes in genital responses (e.g., subjective sexual arousal and attention) followed similar patterns of decline. Study Two revealed that complete extinction of genital response is difficult to produce using slightly varied stimuli. One possibility is that the residual genital response in Study Two was the result of maintained subjective arousal and greater attention to the stimulus. The results from the two studies taken together suggest that decreases in other responses (e.g., subjective sexual arousal) and processes (e.g., attention) may be required to completely eliminate genital responses.

### **The Role of Attention in the Excitation and Inhibition of Sexual Responses**

Similar to other studies of habituation, attention appeared to mimic the genital response patterns of men and women (Both et al., 2011; Koukounas & Over, 1993; 1999; 2000; 2001). Both studies produced habituation of attention, and statistically controlling for changes in attention resulted in the elimination of habituation and novelty effects. Previous studies have demonstrated that these two responses are correlated but not necessarily causally related (for a review see Over & Koukounas, 1995). Comparison of the responses in the two studies provides some evidence of causality, such that decreases in attentional commitment lead to diminution of genital response.

In both studies some participants did not produce habituation of attention. In Study One, five men and four women maintained attentional commitment across repeated stimulus trials, but inspection of their genital responses revealed habituation in all cases. In Study Two, a greater number of individuals maintained attention (seven men and eight women): All of the men and four of the women produced genital response patterns consistent with habituation. Interestingly, four of the women produced genital responses that did not decline with repeated exposure, inconsistent with habituation. This finding provides initial evidence that some women may be more resistant to habituation than others and that a sex difference may emerge if attention remains committed.

### **Implications for the Preparation Hypothesis**

The preparation hypothesis suggests that women's genital responses function to ready them for sexual encounters (Chivers, 2005; Laan, 1994; van Lunsen & Laan, 2004). The results of Study One did not support the prediction that women's genital responses would be resistant to the effects of repeated exposure: Firstly, there was no sex difference in habituation patterns, and secondly, genital responding ceased altogether,

likely offering limited (or negligible) protection. We suggested that the use of the same stimulus lacked ecological validity, and was perhaps not the most appropriate test of the preparation hypothesis. We also concluded that attention to the stimulus would be necessary in order to produce a preparatory genital response.

Study Two aimed to address the limitations of Study One by using stimuli intended to better represent a sexual encounter. It was predicted that the slightly different stimuli would retain erotic saliency and attention for the participants, thus providing a better test of the preparation hypothesis. In addition to the change in stimuli, we also included an extra neutral stimulus trial (after the adaptation stimuli) to which habituated genital responses could be better compared. Attention was significantly higher in Study Two, but the procedure was insufficient in precluding habituation of genital responses. Habituated genital responses were greater in magnitude than responses to a neutral stimulus, in support of a preparatory genital response. However, this pattern was also true for men, and may therefore reflect a residual response in both sexes rather than a preparatory genital response specific to women. Comparison of genital responses and attention for men and women across the two studies suggests that women may be slightly more resistant to repeated exposure when attention is maintained, consistent with the hypothesis. Post-hoc examination of individual patterns of genital response also suggests individual differences in ability to habituate.

The results of the two studies taken together do not support the notion that women's genital responses are more resistant to the effects of repeated exposure than men's genital responses. The preparation hypothesis would predict that women should only produce a preparatory genital response when cues are attended to and perceived as

sexual. A parsimonious explanation for the diminution (in Studies One and Two) and extinction (in Study One) of genital responding in both men and women, is that it is the result of the stimulus no longer being perceived or appraised as sexual. Laan and Everaerd (1995) reported that repeated exposure resulted in a decrease in positive affect in women, suggesting that emotional experience or appraisal of stimuli change as a function of experience. Similarly, Meuwissen and Over (1990) reported a significant decrease in the vividness of imagery during habituation of genital responses. Koukounas and Over (1993; 1999) reported that repeated exposure resulted in less absorption in the stimulus. These studies illustrate that changes in genital responses are related to changes in stimulus appraisal and information-processing, and provide a basis to argue that habituation of genital responses is caused by changes in information-processing in both sexes.

An alternative explanation is that women's genital responses are contingent on the threat of sexual activity rather than the mere presence of sexual activity alone. Repeated exposure to the same couple engaging in sexual activities may suggest that the female participant is unlikely to become a sexual target, resulting in genital responses of smaller magnitudes. Exposure to novel stimuli would cause a restoration in genital responding because the threat of becoming a sexual target resurfaces with a new couple. Consistent with this explanation, when the familiar couple was reintroduced (dishabituation) women's genital responses did not increase, potentially because the perceived sexual threat remained low. Examining women's genital response patterns to the same man engaging in sexual activities with many different women (high threat condition) versus the same man and woman paired together (low threat condition) may elucidate what

drives habituation in women. The preparation hypothesis would predict that women should maintain a genital response in the high threat condition because the risk of becoming a sexual target is high.

It is possible that men and women respond similarly during repeated exposure to sexual stimuli due to changes in information-processing, but that the function of habituation differs between the sexes. Consistent with sex differences in category-specificity, men's genital responses may habituate to the specific features of a sexual target to motivate proceptivity towards new sexual partners, whereas women's genital responses may be less affected by the features of a sexual stimulus, instead modulating genital responses based on the perceived risk of becoming a sexual target. This pattern of response is consistent with the strategies used by men and women when viewing erotic stimuli. For instance, when viewing sexual stimuli men tend to objectify the female actor, whereas women tend to project themselves into the stimulus (Rupp & Wallen, 2008). Researchers investigating the gaze patterns of individuals when viewing sexual stimuli demonstrate that men and women focus on different features of the stimulus. Specifically, men spend more time viewing female faces, whereas women spend more time viewing the contextual details of the stimulus (Rupp & Wallen, 2007). Future habituation studies should examine the role of visual attention and scanning strategies to determine whether men and women focus on different aspects of the stimulus during repeated exposure and how this affects genital and subjective sexual responses.

Examining habituation using other measures of genital responses, such as thermal imaging, whereby direct comparisons can be made between men and women, may further elucidate whether the patterns of habituation are truly similar between the sexes.

Assessing the degree of lubrication in women during habituation may be a better test of the preparation hypothesis. It is unclear at this time what magnitude of vaginal pulse amplitude is necessary to produce lubrication and whether residual genital blood flow denotes residual vaginal lubrication. It may also be interesting to explore measures of fear or anxiety (e.g., galvanic skin responses) during habituation to determine whether women perceive sexual stimuli as threatening and if this changes during repeated exposure.

### **Concluding Remarks**

The results of these two studies provide the first empirical evidence that men and women are similarly affected by repeated exposure to sexual stimuli. The results also provide evidence for the use of penile plethysmography and vaginal photoplethysmography as comparable measures of genital responses, in that both devices were capable of detecting changes in genital responses across trials. Consistent with previous research, attentional commitment was highly correlated with habituation of genital responding (Both et al., 2011; Koukounas & Over, 1993; 1999; 2000; 2001). Interestingly, the results from Study Two suggest that attention may influence genital and subjective sexual responses differently. Future research should explore what, if anything, mediates these effects.

Whilst the current studies produced similar patterns of habituation in men and women, no studies have investigated between-session effects or long-term habituation in men and women using the same design. Evidence for long-term habituation of genital responses has been found in men (Plaud, Gaither, Henderson, & Devitt, 1997), such that men respond less vigorously between sessions when presented with the same sexual stimulus. No studies have investigated long-term habituation in women. It is possible that

a preparatory genital response may function to preclude long-term habituation from occurring, such that genital responses are restored between-sessions. Investigation into long-term habituation may provide insight into the cause of some life-long and acquired sexual dysfunctions (Plaud et al., 1997).

It may be enlightening to investigate changes in genital responding at an individual rather than at a group level. All of the habituation studies have performed analyses at the group level (see Over & Koukounas, 1995). Exploring habituation at an individual level may also lead to the discovery of correlates of the likelihood to habituate. For instance, a person's sex drive or patterns of visual interest may influence the likelihood of habituation occurring. Understanding these correlates may elucidate the causes of some atypical sexual preferences and sexual dysfunctions. For example, many paraphiliacs report recurring sexual imagery and fantasy throughout their lives without the imagery or fantasy losing saliency (Levine, Risen, & Althof, 1990; Weinberg, Williams, & Calhan, 1994). Developing an understanding of why some sexual stimuli maintain saliency for individuals may aid in the development of better sexual therapies for individuals who potentially habituate too readily, such as those suffering from low sexual desire (e.g., hypoactive sexual desire disorder; Both et al., 2011). Understanding the process by which habituation occurs may lead to more effective treatments for individuals who have difficulty habituating to sexual stimuli (e.g., paraphiliacs).

Overall, the findings of this thesis add to the growing body of literature examining the role of learning on the sexual responses of men and women (Both et al., 2008a; Both et al., 2008b; Hoffmann, 2012; Hoffmann, Janssen, & Turner, 2004; Hoffmann, Peterson, & Garner, 2012; Lalumière & Quinsey, 1998; O'Donohue & Plaud, 1994). Similar to

studies of habituation, the majority of studies investigating conditioning of sexual responses have examined men and women separately. However, when testing men and women using the same conditioning design, Hoffmann et al. (2004) demonstrated that both men and women showed evidence of classically conditioned genital responses in the laboratory. With regard to habituation, the similar patterns of genital responses of men and women might then reflect the broader phenomenon that men's and women's genital responses are equally malleable and similarly subject to learning processes. Understanding the impact of learning can be used to inform treatments for sexual dysfunction. Studies of habituation and its related processes provide an opportunity to further develop information-processing models of sexual arousal from which sexual function and dysfunction can be better understood (Janssen, Spiering, Everaerd, & Janssen, 2000).

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