CHANGES IN VAGINAL pH AND LUBRICATION IN RESPONSE TO SEXUALLY COERCIVE STIMULI

by

GAVIN SCOTT VANCE

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Oakland University
Rochester, Michigan

Doctoral Advisory Committee:

Todd K. Shackelford, Ph.D., Chair
Jennifer Vonk, Ph.D.
Virgil Zeigler-Hill, Ph.D.

ABSTRACT

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Adviser: Todd K. Shackelford, Ph.D.

Women's genital response to sexual stimuli is cue non-specific, such that women display similar levels of genital arousal in response to preferred and non-preferred sexual stimuli, which is discordant with their subjective reports of sexual arousal. One explanation for this phenomenon is the *preparation hypothesis*, which proposes that women's genital response to sexual stimuli evolved to be cue non-specific to reduce injury to the vaginal walls during both consensual and non-consensual intercourse (i.e., sexual coercion, forced copulation, or rape). Consistent with the preparation hypothesis, women display genital arousal (including vasocongestion and vaginal lubrication) in response to audio stimuli depicting rape. However, over human evolutionary history, rape imposed special and severe adaptive costs on women, notably loss of control over mate choice and, potentially, rearing without co-parental support a child whose sire is of unknown genetic quality. The *spermicidal hypothesis of vaginal acidity* proposes that women's cue non-specific genital responsivity evolved to prevent fertilization by sexually coercive men of unknown genetic quality. Women's vaginal pH, which changes over the ovulatory cycle, and in response to sexual stimulation, may afford a mechanism

by which women prevent fertilization by rape. The current research employed a within-subjects design to compare changes in vaginal lubrication and pH in response to different audio stimuli to investigate whether women have evolved a physiological mechanism (i.e., production of more acidic vaginal pH) to avoid fertilization by rape. The main goal of the present research was to determine the effect of coercive versus consensual sexual stimuli on women's genital arousal. Specifically, I predicted that women would produce more acidic (i.e. lower pH) vaginal lubricant in response to sexually coercive audio stimuli than to neutral, sexually consensual, and violent non-sexual audio stimuli. An additional goal of this research was to replicate and extend previous research by testing the effect of different audio stimuli on vaginal lubrication. Therefore, I also predicted that women would produce more vaginal lubrication in response to a sexually coercive audio stimulus than to neutral and violent non-sexual audio stimuli, but less lubrication in response to a sexually consensual audio stimulus. Results largely failed to support the predictions of the present study; however, several significant interactions emerged from the repeated-measures ANCOVA. Namely, the effect of experimental condition on amount of vaginal lubrication, and changes in vaginal pH depended on women's fertility status. Discussion offers potential explanations for these interactions, addresses the many limitations faced by the present study (e.g., potentially inaccurate assessments of pH and fertility), and outlines a path forward for future research regarding changes in vaginal pH.

TABLE OF CONTENTS

ABSTRACT iii

LIST OF TABLES vii

LIST OF FIGURES viii

CHAPTER ONE
REVIEW OF THE LITERATURE 1

Adaptive Costs of Rape 1

The Preparation Hypothesis 4

Theoretical and Empirical Problems with the Preparation Hypothesis 6

Changes in Vaginal Acidity 9

CHAPTER TWO
OVERVIEW OF THE CURRENT STUDY 13

Method 15

Participants 15

Procedures 16

Materials 18

CHAPTER THREE
DATA ANALYSIS AND RESULTS 26

Data Analysis 26

Results 27

CHAPTER FOUR
GENERAL DISCUSSION 38

TABLE OF CONTENTS—Continued

Limitations and Future Directions 41

Conclusion 45

APPENDICES

A. IBR Approval Letter 48

B. IBC Approval Letter 51

C. Surveys 53

D. Neutral Stimulus Transcript 72

E. Consensual Stimulus Transcript 74

F. Non-Sexual Violence Stimulus Transcript 76

G. Rape Stimulus Transcript 78

REFERENCES 80

LIST OF TABLES

Table 1	Alpha reliabilities for study variables	25
Table 2	ANCOVA – Manipulation check items (stimuli assessment)	29
Table 3	ANCOVA – Manipulation check items (emotional reactions)	29
Table 4	Intercorrelations and Descriptive Statistics for Intake Variables	30
Table 5	Intercorrelations and Descriptive Statistics for Return Session Variables	31
Table 6	ANCOVA – pH Change	33
Table 7	2X2 ANCOVA – pH Change	33
Table 8	2X2X2 ANCOVA – pH Change	33
Table 9	Descriptive Statistics for Tampon Mass	36
Table 10	ANCOVA – Tampon Mass	36
Table 11	2X2 ANCOVA – Tampon Mass	36
Table 12	2X2X2 ANCOVA Tampon Mass	36

LIST OF FIGURES

Figure 1	Change in Vaginal pH Across Experimental Conditions	34
Figure 2	Change in Vaginal pH Across Fertility Status and Experimental Condition	34
Figure 3	Tampon Mass Across Experimental Conditions	37
Figure 4	Tampon Mass Across Fertility Status and Experimental Condition	37

CHAPTER ONE

REVIEW OF THE LITERATURE

Adaptive Costs of Rape

Rape is a devastating event that negatively impacts the lives of over 100,000 women annually, in the United States alone (Statista, 2021). Rape imposed severe adaptive costs on ancestral women including injury, loss of protection and investment from a long-term partner, and perhaps most significantly, the circumvention of female choice of a sire for their offspring (Thornhill, 1996; Wilson & Mesnick, 1997). Circumventing a woman's sire choice would have been detrimental to female ancestral reproductive success because women (relative to men) contribute greater obligatory investment in offspring (Trivers, 1972). In a worst-case scenario, a woman who is raped becomes pregnant by a man of unknown or undesirable genetic quality, losing control over both her choice of sire and the timing of a pregnancy. Thus, an evolutionary perspective predicts that women have evolved psychological adaptations that motivate the performance of rape avoidance behaviors (e.g., McKibbin et al., 2009; McKibbin et al., 2011).

Women's psychological pain following rape may be produced by evolved mechanisms that motivate them to avoid rape in the future (Thornhill & Thornhill, 1990a, b, & c; 1991). Thornhill and Thornhill (1990a, b, & c; 1991) further argued that the amount of psychological pain experienced by women varies with the circumstances of the rape, with more reproductively costly rapes producing greater psychological pain. For example, Thornhill and Thornhill (1990a) found that long-term partnered women

experienced greater psychological pain following rape than unpartnered women, and suggested that this may be due to the increased costs of rape for women with long-term male partners. Specifically, the male partner of a woman who is raped may perceive the rape as infidelity, or otherwise as an indication of paternity uncertainty, and as a result be more likely to abandon his partner. Further, Thornhill and Thornhill (1990b) observed that women experienced more psychological pain following rape by a stranger than following rape by a friend or family member, which suggests that women may be especially psychologically motivated to avoid rape by men of unknown genetic quality.

Previous research suggests that women are motivated to perform behaviors that reduce their risk of rape. McKibbin and colleagues (2009) developed the Rape Avoidance Inventory to assess women's performance of behaviors intended to reduce the risk of rape and, using act nomination and principal components analysis, identified 69 items representing four components of rape avoidance behavior: Avoid Strange Men (e.g., "avoid men with a reputation for forcing themselves on women" and "be aware of my surroundings when in public"), Avoid Appearing Sexually Receptive (e.g., "avoid wearing revealing clothes" and "avoid teasing men by making sexual comments"), Avoid Being Alone (e.g., "stay around other people when I go out" and "walk with someone to my car"), and Awareness of Surroundings/Defensive Preparedness (e.g., "carry a knife" and "check behind me when walking"). Studies of individual differences in performance of rape avoidance behaviors suggest that rape imposed a greater threat to reproductive success for ancestral women under certain conditions. Specifically, women who are more physically attractive, in a committed intimate relationship, and virginal (i.e., no previous sexual experience) report performing more rape avoidance behaviors (McKibbin et al.,

2011; Prokop, 2013). Men prefer physically attractive sexual partners (Shackelford et al., 2005) and, therefore, more attractive women perceive themselves to be at greater risk of rape than less attractive women. Men in many cultures also prefer virginal women as long-term partners (Buss, 1989); thus, virginal women may be more motivated to avoid rape than non-virginal women to preserve their mate value. Women in committed intimate relationships may perform more rape avoidance behaviors for the same reason that such women experience more psychological pain following rape (Thornhill & Thornhill, 1990a): because being raped may result in desertion by their romantic partner.

Avoiding rape and avoiding fertilization by rape are two related, yet distinct, adaptive problems, as a woman who is raped may still be able to avoid fertilization by rape and the associated adaptive costs. Whereas some research has investigated women's psychological adaptations to avoid rape (e.g., McKibbin et al., 2009; 2011) comparatively little attention has been directed to the study of female physiological adaptations to prevent fertilization by rape. However, research in nonhuman animals suggests the possibility of physiological adaptations to prevent fertilization by rape. In a review of rape in nonhuman animals, Crawford and Galdikas (1986) argued that, if fertilization by rape resulted in lower quality offspring, on average, then there would have been selective pressure on females to evolve adaptations to prevent fertilization by rape. Crawford and Galdikas suggested that, because only 50% of forced copulations in scorpionflies result in fertilization (compared to 100% of cases in which a nuptial gift is presented), females may have evolved an internal (e.g., chemical or physiological) adaptation to prevent fertilization via forced copulation. Crawford and Gladikas did not specify the mechanism by which females might prevent fertilization via rape; however, a study investigating

bovine sperm motility in different chemical environments found that motility decreased in lower pH environments in a laboratory setting (Rizvi et al., 2009), which suggests that acidic vaginal environments may reduce the likelihood of fertilization via reduced sperm motility. Although this study was not framed as an investigation of physiological adaptations to prevent fertilization by rape in bovines, it provides evidence consistent with the potential of acidic vaginal environments to prevent fertilization via rape. It is possible that similar mechanisms exist to prevent fertilization by rape in human females; however, little research has investigated the existence of such mechanisms.

There is a dearth of research investigating behavioral adaptations to avoid rape or physiological adaptations to prevent fertilization by rape in non-humans. And although there is research investigating psychological adaptations to avoid rape in humans (e.g., rape avoidance behaviors; McKibbin et al., 2009), there is a similar dearth of research investigating physiological adaptations to prevent fertilization by rape in humans. One hypothesis, however, argues that women's genital arousal and subsequent lubrication may function, in part, to prevent or reduce vaginal injury during rape.

The Preparation Hypothesis

The *preparation hypothesis* proposes that women's automatic, cue non-specific genital arousal is an evolved response that functions to protect the vaginal lumen from injury (e.g., vaginal tearing) during sexual intercourse, and specifically, to avoid damage sustained during rape (Suschinsky & Lalumiere, 2011a). Although the suggestion that women's automatic, cue non-specific genital response facilitates non-injurious sex had been proposed previously (e.g., Chivers, 2005), Suschinsky and Lalumiere (2011a) were the first to test this hypothesis using nonconsensual sexual stimuli.

Suschinsky and Lalumiere (2011a) present several lines of evidence in support of the preparation hypothesis. First, previous research has observed a discordance between women's subjective self-reports of sexual arousal and their genital arousal to the same sexual stimuli. When exposed to auditory depictions of a violent sexual assault, women reported low levels of sexual arousal, while simultaneously producing genital responses similar to those produced in response to auditory depictions of consensual sexual intercourse (i.e., increased vasocongestion; Suschinksy & Lalumiere, 2011a). To assess sex differences in patterns of genital arousal, Suschinksy and Lalumiere compared the distribution of responses to all stimuli containing sexual content to a theoretical, flat model, and found that the pattern of arousal for men was less uniform than the pattern of arousal for women. That women showed a relatively more uniform pattern of arousal suggests evidence of women's cue non-specific genital arousal in response to sexual stimuli, whether depicting consensual sex or nonconsensual sex. However, it should also be noted that women's genital response to the stimuli containing consent, sexual content, and no violence was, on average, higher than their genital responses to the three conditions devoid of sexual content, and to the non-consensual, non-violent sex condition. Suschinsky and Lalumiere also calculated Spearman rank-order correlations by combining all four conditions containing sexual content to determine the concordance between genital arousal and subjective arousal for men and women, and found that men's genital arousal and subjective arousal (r = .77) were more strongly correlated than for women (r = .18). The correlations found by Suschinsky and Lalumiere were attributable, in part, to women producing higher genital arousal relative to their subjective arousal in response to the nonconsensual sexual stimuli. These patterns of discordance between

women's genital arousal and subjective arousal are consistent with the results of previous studies (e.g., Chivers et al., 2004; 2007; Dawson et al., 2013) indicating discordance between women's genital arousal and subjective arousal. Chivers et al. (2004, 2007), and Dawson and colleagues (2013) also found support for the second line of evidence presented in support of the preparation hypothesis: the cue-nonspecificity of women's genital arousal. Third, similar to men, women's genital arousal is more responsive to sexual stimuli than to non-sexual stimuli (Huberman & Chivers, 2015), indicating that the presence of sexual content is necessary (although perhaps not sufficient) to produce a genital response in women. That women's genital arousal is not responsive to non-sexual stimuli further suggests that women's genital response evolved to prepare the vagina for sex, rather than to become aroused indiscriminately. Finally, women's genital arousal to sexual stimuli is not only automatic, but relatively rapid, and women's genital arousal precedes their self-reported sexual arousal (Huberman et al., 2017). According to the preparation hypothesis, the rapid onset of genital arousal in response to sexual stimuli functions to ensure the vagina is sufficiently lubricated before sex begins, to thereby reduce the risk of vaginal injury associated with intercourse. Thus, the literature addressing women's genital response to different types of stimuli (i.e., sexual, non-sexual, coercive, and consensual) is consistent with the preparation hypothesis. Nevertheless, a number of challenges to the preparation hypothesis have yet to be addressed.

Theoretical and Empirical Problems with the Preparation Hypothesis

The preparation hypothesis has been the target of some skepticism and critique. One potential problem for the preparation hypothesis is that the cue-specificity in

women's genital response has been investigated primarily by assessing vasocongestion (i.e. blood flow within the vaginal walls), which is presumed to be an indicator of lubrication (Levin, 2003) and lubrication, in turn, is presumed to be an indicator of genital arousal. However, lubrication has rarely been assessed directly (Lalumiere et al., 2020). When lubrication has been assessed directly, the observed patterns of lubrication did not match the observed patterns of vasocongestion (Sawatsky et al., 2018). Specifically, Sawatsky and colleagues (2018) observed greater cue-specificity in women's genital response when assessing lubrication, such that women produced greater lubrication in response to preferred sexual stimuli, even though vasocongestion showed the expected pattern of cue-nonspecificity. Further, recent research has endeavored to improve methods of directly assessing vaginal lubrication. In particular, Handy and Meston (2020) used Schirmer Tear Test strips and observed increased lubrication in response to sexual stimuli, in addition to observing moderate agreement between lubrication and self-reported arousal. These findings present a challenge to the preparation hypothesis, which posits that women's cue-nonspecific genital arousal facilitates vaginal lubrication, which protects the vaginal lumen from injury during sexual intercourse.

In a response to Lalumiere and colleagues' (2020) review of the empirical status of the preparation hypothesis, Clephane and colleagues (2020) raised several questions which, they argue, must be answered to assess the ability of the preparation hypothesis to explain cue non-specificity in women's genital response. Chief among these is whether the degree of injury sustained during intercourse (consensual or otherwise) is sufficient to account for the cue non-specific genital arousal observed in women. If injury sustained

during intercourse (e.g., vaginal tearing) did reduce fertility, for example, then any adaptation that protected the vagina from injury during intercourse would have been selected for over human evolutionary history. However, whether the costs imposed by vaginal injury would have been severe enough to produce an adaptation is difficult to test empirically. Further, although women do experience greater vaginal injury during rape (Slaughter et al., 1997), vaginal injury also commonly occurs during consensual intercourse (Astrup et al., 2012).

There is also a theoretical hurdle that the preparation hypothesis has not addressed. Parental investment theory (Parker, 1979; Trivers, 1972) suggests that rape is costly to women primarily because it circumvents their control over when and with whom they have children. Of course, physical injury also can be detrimental to a woman's reproduction, especially if the injuries result in death or complicate future pregnancies. However, when directly comparing the costs of each, the circumvention of sire choice may be more detrimental to a woman's reproduction than mild to moderate physical injury (McKibbin et al., 2009; Thornhill, 1996). Thus, if natural selection has produced a physiological adaptation in response to the selective pressures imposed by rape, prevention of fertilization via rape may have been prioritized over prevention of vaginal injury. Further, because cervical mucus facilitates the migration of sperm from the upper vagina to the cervix (Suarez & Pacey, 2006), producing lubricant prior to sexual assault may be disadvantageous, as it would increase the risk of fertilization resulting from rape—unless the lubricant contained spermicidal properties.

Following these theoretical issues and criticisms of the preparation hypothesis, I hypothesize that, considering the severe adaptive costs of fertilization via rape, women

have evolved physiological adaptations to avoid fertilization by a sexually coercive male. Specifically, women may prevent fertilization via rape by lowering their vaginal pH, thus reducing the motility of any sperm inseminated via rape. This hypothesis is not necessarily in conflict with the preparation hypothesis. It is possible that women produce lubricant in response to sexually coercive stimuli to facilitate changes in vaginal acidity sufficient to reduce sperm motility. Alternatively, women's reproductive physiology could have simultaneously evolved to prevent injury sustained during rape, and to prevent fertilization via rape. However, the adjustment of vaginal pH in response to external stimuli (e.g., a threatening situation) is not well-researched, and most studies measuring women's genital response to coercive sexual stimuli have not directly assessed lubrication (Lalumiere et al., 2020). The following section reviews literature addressing pH changes in vaginal lubricant before presenting the aims, hypotheses, and predictions of the present study.

Changes in Vaginal Acidity

The ability of the vaginal environment to prevent fertilization by sexually coercive males is predicated on the existence of spermicidal properties in the vagina, and indeed, there is evidence of such properties. Vaginal potential of hydrogen (pH) is more acidic than the preferred environment for human sperm (Owen & Katz, 2005), and varies across time and across ovulatory cycle phase (Garcia-Closas et al., 1999; Linhares et al., 2011). pH is a measure of ion concentration that ranges from 0 to 14 (Sörensen, 1909). A pH of 7 indicates a neutral substance (e.g., pure water), with lower pH values indicating higher acidity, and higher pH values indicating higher alkalinity. A healthy human vaginal environment is more acidic than neutral (pH = 3.8-4.5; Linhares et al., 2011).

Women's vaginal pH fluctuates, and is affected by several biological factors, including presence of lactobacilli, estrogen, ovulatory cycle phase, menopausal status, and age (Garcia-Closas et al., 1999; Linhares et al., 2011). In particular, vaginal pH varies with ovulatory cycle phase. As women approach the most fertile phase of their ovulatory cycle, and estrogen is peaking, vaginal pH is typically at its lowest, or most acidic (Eschenbach et al., 2000). Vaginal pH has also been observed to change in response to sexual stimulation such that clitoral self-stimulation resulted in an increase in the pH of vaginal lubricant (Wagner & Levin, 1984). That women's vaginal pH is more acidic than the ideal environment for sperm, and that vaginal pH changes over time and in response to sexual stimulation suggests that vaginal acidity may play a role in differentially facilitating fertilization depending on the presence of sexual stimulation and over different phases of the ovulatory cycle.

Human ejaculate is of a relatively alkaline constituency (pH of 7.19-8.47; Owen & Katz, 2005) and has buffering capacities that maintain a near-neutral pH in the vaginal environment (Owen & Katz, 2005). Further, diseases of the seminal vesicles, which are responsible for producing the alkaline seminal fluid, are commonly associated with male fertility problems (Dagur et al., 2016), which suggests that seminal fluid plays an important role in protecting sperm against the acidic vaginal environment. The acidity of the vaginal environment may be a byproduct of humans' high-starch diets, as suggested by Miller and colleagues (2016), or it may be an adaptation to protect against infection (Stumpf et al., 2013). An alternative, or perhaps additional explanation for the acidity of women's vaginal environment, relative to non-human mammals, is that it functions to reduce the motility of sperm. The relatively acidic vaginal environment, and the relative

alkalinity and buffering capacities of an ejaculate, may be evidence of an ongoing, intersexual arms race between men and women over human evolutionary history. If women were able to shift the pH of their vaginal environment before intercourse, they could reduce sperm motility, thereby reducing the chances of fertilization by sexually coercive men of uncertain or undesirable genetic quality. Baker and Bellis (1993) argued that women may have physiological adaptations to select the sperm of some men over others for fertilization during periods of double-mating. Specifically, Baker and Bellis observed that, for women who mated with two or more men concurrently, these women self-reported higher copulatory orgasm frequency with the extra-pair partner (relative to their socially monogamous partner). Further research from Baker and Bellis has shown that copulatory orgasm increases the volume of ejaculate that is transferred into the woman's cervix from her upper vagina (measured using estimates of inseminated sperm, and volume of flowback). In a literature review of female reproductive fluid, Gasparini and colleagues (2020) argued that female reproductive fluid might play a role in sperm competition. Specifically, Gasparini and colleagues present evidence (e.g., Fitzpatrick et al., 2020) to suggest that, in both human and non-human species, female reproductive fluid increases the velocity, longevity, and attraction of sperm inseminated by preferred males. On the other hand, if women have evolved physiological adaptations to prevent fertilization by certain men, it is odd that rape is twice as likely to result in fertilization compared to consensual sexual intercourse (Coleman, 2015; Gottschall & Gottschall, 2003; Holmes et al., 1996). Presumably, if this hypothetical adaptation were functioning as intended, fertilization would be *less* common following rape than consensual sexual intercourse. However, evolutionary arms races are characterized by an ever-shifting

relationship between opposing forces (in this case, men and women) such that, at certain points in evolutionary history, one side may have an advantage over the other. Such may be the case at the current point in history, with men producing ejaculates that are capable of protecting sperm from the acidic vaginal environment. However, there are other potential explanations for the greater risk of fertilization following rape (e.g., sexually coercive males may produce higher quality ejaculates, or may specifically target victims in the most fertile phase of the ovulatory cycle; Baker & Bellis, 1995).

Lalumiere and colleagues (2020) argued that women's genital response to sexual stimuli (whether consensual or coercive) should be rapid if it is to protect the vagina from injury. So too should any changes in vaginal pH closely follow cues to sexual coercion if pH shifts are to reduce the motility of sperm and, therefore, the risk of fertilization. Data addressing the speed of pH changes in the vaginal environment are sparse, and rates of pH change have not been directly measured. However, one study, measuring the speed of change in the vaginal pH of rats, recorded that, after being exposed to an NH_4Cl solution and reaching a trough of 6.9 pH, vaginal acidity returned to the baseline of 7.4 pH within 4 minutes (Zhang et al., 2019). Another study, focusing on the effects of clitoral self-stimulation in humans, found that changes in vaginal pH, although small, occurred after as little as 1.9 minutes of sexual self-stimulation (Wagner & Levin, 1984). It therefore seems defensible to tentatively conclude that, except for cases in which the woman is unconscious, or when rape and ejaculation occur very quickly, women's vaginal environment is able to shift pH rapidly enough to reduce the motility of sperm introduced by sexually coercive men and, therefore, to reduce the likelihood of fertilization.

CHAPTER TWO

OVERVIEW OF THE CURRENT STUDY

The main goal of the current research was to test the effect of different audio stimuli on the acidity of women's vaginal environment. Considering the adaptive costs associated with fertilization by rape (McKibbin et al., 2009; Thornhill, 1996), women may have evolved an internal, physiological mechanism to prevent fertilization by rape. The *spermicidal hypothesis of vaginal acidity* predicts that, in response to a sexually threatening scenario, women's vaginal pH should decrease to prepare for the insemination of sperm by a sexually coercive male. To test this novel hypothesis, women were presented with audio stimuli depicting consensual sex, nonconsensual sex, nonsexual violence, and a neutral (nonsexual and nonviolent) interaction between a man and a woman. I predicted that (1) relative to the other audio stimuli, women would produce the lowest (i.e. most acidic) vaginal pH in response to the audio stimulus depicting rape and, (2) relative to the neutral audio stimulus and the audio stimulus depicting consensual sex, women would produce lower vaginal pH in response to the audio stimulus depicting non-sexual violence. Because even a non-sexual violent assault may, from the perspective of female evolved psychology, portend a potential rape, women should produce a physiological response similar to that produced by an overtly sexual threat.

An additional goal of the present study was to replicate and extend previous research by testing the effect of different audio stimuli on women's vaginal lubrication.

The *preparation hypothesis* predicts that women will produce vaginal lubrication in anticipation of rape to reduce injury to their vagina. Many of the previous studies investigating women's genital response to coercive sexual stimuli have not assessed lubrication directly (e.g., Chivers et al., 2004; Suschinsky & Lalumiere, 2011a) and those few that have assessed lubrication directly reported patterns of lubrication that are inconsistent with patterns of vasocongestion (Sawatsky et al., 2018). In addition to measuring vaginal acidity, vaginal lubrication was assessed in the current research using a novel method of measurement (i.e. using tampons to absorb vaginal lubrication, and recording their mass to measure the amount of lubrication produced in response to different stimuli). I predicted that, (3) relative to the neutral audio stimulus, women would produce more vaginal lubrication in response to the audio stimulus depicting rape; however, (4) relative to the audio stimulus depicting consensual sex, women would produce *less* vaginal lubrication in response to the audio stimulus depicting rape. Predictions 3 and 4 are consistent with the findings of Sawatsky and colleagues (2018) who observed that women's vasocongestion increased in response to a sexually threatening stimulus, but was still lower than the vasocongestion produced in response to a consensual sexual stimulus. In a review and critique of the preparation hypothesis, Clephane and colleagues (2020) raised concerns about the potential confounding effects of previous sexual assault experience on women's genital response to sexual stimuli, citing research (e.g., Rellini et al., 2011) suggesting that, whereas sexual trauma survivors associate sexual stimuli with a potential threat, women with no sexual assault experience more strongly associated sexual stimuli with pleasure. Therefore, the present study assessed and controlled for the sexual assault experiences of participants.

Method

Participants

Data were secured from an initial sample of 81 women recruited via Oakland University's SONA human subjects pool, and who participated in exchange for research participation credits. Of the 45 participants who completed all four sessions, two were excluded because they began menstruating during one of their sessions, and the pH of their vaginal environment could not be measured. The final sample consisted of 43 participants. Participants were between 18 and 35 years old (M = 20.77, SD = 3.58) and not currently pregnant. Participants were not excluded for use of drugs, alcohol, birth control, or sexual activity; however, participants were asked to reschedule their sessions if they reported any drug use, alcohol consumption, or sexual activity within 24 hours of participation. The sample was largely heterosexual, with 26 participants (60.5%) reporting that they were 'exclusively heterosexual', and the remaining 17 participants reporting *mostly heterosexual, bisexual,* or *other.* Twenty-two participants reported that they were not currently using any form of hormonal birth control. Thus, 21 participants (48.8%) reported using some form of hormonal birth control, such as oral contraceptives (i.e., the pill) or an IUD. Twenty-two participants (51.1%) reported that they were currently in a committed, romantic relationship. Of the participants who reported being in a relationship, the average relationship length was 21.52 months (SD = 18.08, range = 0 months – 6 years). The ethnic distribution of participants was 60.5% Caucasian, 16.3% African American, 4.7% Asian, 7% Hispanic, 7% Middle Eastern, and 4.7% other.

Procedure

This study consisted of four separate sessions, each of which was conducted by a female research assistant to reduce participant anxiety and increase psychological comfort. For each session, participants inserted a tampon into their vagina, listened to a brief audio story, removed the tampon, left the sample to be collected by the researcher, completed a brief survey, and provided a saliva sample (for future hormonal analyses not related to the current dissertation). Participants also inserted a pH strip into their vagina before and after listening to the audio story.

Procedures for Session 1: Participants were given the consent form at the beginning of the first session. Participants were asked whether they had engaged in any sexual activity or drug and alcohol use within the past 24 hours, and whether they were currently menstruating or suffering from vaginal infection (e.g., yeast infection or bacterial vaginosis). If participants indicated that they had engaged in any sexual activity, drug or alcohol use, or were currently menstruating or had a vaginal infection, they were asked to reschedule their first session. Participants were also asked whether they were currently pregnant. Those who indicated that they were currently pregnant would not be able to reschedule within this study's timeframe, and thus, would not be able to participate. However, no participants were disqualified for reporting that they were pregnant. Qualifying participants were then asked to complete a brief intake survey, which included a measure of sexual assault experiences, general fear, fear of crime, self-perceived likelihood of victimization, positive and negative affect, frequency of consensual sexual experiences, a questionnaire for determining menstrual cycle status (Appendix B; see Materials) and several demographic items (e.g., age, race, and

relationship status). After completing this survey, participants were given a Playtex Sport tampon with a plastic applicator, and a strip of NutraBlast feminine pH testing paper. Participants were then asked to go into the bathroom, gently dab the outside of their labia to remove any excess moisture, insert the pH strip, remove the pH strip, and place it in a plastic biohazard bag. Participants in the present study were asked to insert pH strips directly into their own vaginas before and after listening to the audio stimuli because previous research has documented a small increase (of about 0.3 pH units) in the acidity of vaginal lubricant following exposure to air (O'Hanlon et al., 2013). After inserting the first pH test strip and placing it in a biohazard bag, but before exiting the bathroom, participants inserted the tampon. When the participants returned from the bathroom, they were given a small bottle of water and asked to drink all of it. After 10 minutes, participants were given a straw and a saliva vial and were asked to provide 1 milliliter of saliva (saliva samples were collected for future hormonal analyses not related to the current dissertation). Participants completed the other parts of this study during this 10-minute waiting period. Researchers escorted participants to a private room where the participant listened to the audio stimulus after the researcher had left. Participants exited the room once the story was over, returned to the bathroom, removed the tampon, placed it in a specimen cup, and placed the cup in a paper bag. Participants also inserted and removed another pH strip, which they then placed in another plastic biohazard bag. Participants left the paper bag containing the tampon, and the plastic bag containing the pH strip, in the bathroom to later be collected by the researcher. When participants returned to the private room, they completed another questionnaire containing a modified version of the Rape Avoidance Inventory, a revised version of the Fear of Rape scale, the

Fear of Crime scale, the Likelihood of Victimization scale, and a series of questions gauging their opinion of the story (e.g., “How sexually arousing was the story?”, “How disturbing was the story?”). At the end of the first session, participants scheduled their remaining sessions, and were reminded to refrain from all sexual activity, drugs, and alcohol 24 hours prior to each of the remaining sessions. Researchers measured the mass of the tampon and recorded the pH of both testing strips after participants had left the lab.

Procedures for Sessions 2-4: Procedures for sessions 2-4 were similar to those described for session 1 (except for signing the consent form and completion of the intake survey, which occurred only for the initial session). At the end of the final session, participants were informally debriefed by the research assistant. During the debriefing, researchers explained the nature and purpose of the research and gave participants the opportunity to ask questions or voice concerns. Participant were also given a list of counseling resources, including contact information for Oakland University's counseling center in the form of a brochure.

Materials

Audio Stimuli

The audio stimuli used in the current study have been used previously to assess the concordance between women’s vasocongestion and subjective sexual arousal (Suschinsky & Lalumiere, 2011a, 2011b) and were originally developed by Harris and colleagues (2008) to assess the effect of consensual, violent, and sexual cues on men’s genital arousal. Each of the audio stories is about two minutes long. Each story is narrated by a woman and is told from the first-person perspective of the woman in each story. The condition order for each of the four sessions was randomized so that

participants did not experience the audio stories in the same order. Participants who completed each of the four sessions listened to all of the audio stories and only listened to one story per session.

Neutral Stimulus. The neutral stimulus used for the present study does not contain sexually explicit or threatening content, and describes a female travel agent helping a man book a vacation (Appendix C).

Consensual Sex. The consensual stimulus describes a consensual sexual encounter between male and female coworkers (Appendix D).

Non-Sexual Violence. The non-sexual violence stimulus describes a threatening, non-sexual encounter in which a man violently attacks a woman who lives on the same floor of his dorm room (Appendix E).

Rape. The rape stimulus describes a coercive, non-consensual, sexual encounter between a man and woman who have known each other for a few weeks and have just spent a night out together (Appendix F).

Vaginal Assessment Materials

Lubrication. The amount of lubrication produced by participants in response to the audio story was assessed by recording the mass of a Playtex Sport tampon inserted by the participant. Tampons were massed using a granular scale after participants had finished listening to the audio story. Although it would have been ideal to weigh the tampon before and after it was used by the participant to measure *change* in mass, this would have required research assistants to remove the plastic applicator and plastic packaging that comes with each tampon. In addition to sanitary concerns related to researchers handling materials that participants would insert into their vaginas, removing

the tampon from the plastic applicator would also have made it more difficult for participants to insert the tampon. Thus, prior to data collection, a box of tampons were individually massed (without the plastic applicator or packaging) to determine the average mass of Regular Playtex Sport tampons.

pH. Vaginal pH was measured twice per session for each participant (for a total of eight measurements for each participant). Vaginal pH was assessed using feminine pH test strips (NutraBlast, Pompano Beach, Florida, USA). Participants were asked to insert one pH test strip directly into their vagina and remove it before they inserted the tampon and listened to the audio stimulus. Once participants had listened to the story and removed the tampon, they inserted and removed a second pH test strip in order to measure the change in vaginal pH in response to the story. Similar to other types of pH testing paper, the pH strips used in the current study change color after being exposed to vaginal fluid, and NutraBlast pH paper comes with a color-coded key for determining the acidity of vaginal fluid. Early in the process of data collection for the current study, members of the research team raised concerns about the interrater reliability of reading these pH strips, and determining where they aligned with the color-coded key. Thus, researchers began taking pictures of each pH testing paper, which would later be independently rated by members of the research team. Three independent raters provided assessments for 166 different pictures of pH testing paper. Interrater reliability was acceptable (weighted Kappa range: 0.60-0.69). One of the research assistants only provided ratings for 88 different pictures. With four independent raters and 88 cases, weighted Kappa ranged from 0.53-0.73.

Survey Materials

Assessment of Auditory Stimuli/Manipulation Check. Manipulation check items were used to assess the effectiveness of the auditory stimuli in eliciting the desired emotional response from participants (Appendix B). Participants responded to seven questions regarding their opinion of the audio story (e.g., "The story made me uncomfortable") and responded using a 6-point scale ranging from 1 (*not at all*) to 6 (*very much*). Participants then responded to 11 questions regarding their emotional reaction to the story (e.g., sexual arousal, calm, anxious) and responded using a 9-point scale ranging from 1 (*emotion not present*) to 9 (*emotion definitely present*). Six of the 11 items assessing participants' emotional reactions were used by Suschinksy and Lalumiere (2011a) in a study using the same audio stimuli used in the current study. Five additional items were included to capture a broader range of emotional reactions to the audio stimuli (i.e., fear, anger, disgust, sadness, indifference).

Importance of Rape Avoidance Behaviors. A modified version of the Rape Avoidance Inventory (McKibbin et al., 2009) was used to assess women's perceived importance of performing rape avoidance behaviors (Appendix B; 69 items; e.g. "It is important that I avoid men with a reputation for forcing themselves on women"). Participants responded to each question using a 6-point scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Alpha reliability for all variables (at intake, and for each stimulus condition) are reported below, in Table 1.

Body Mass Index. To control for the potential influence of body mass index (BMI) on changes in vaginal acidity and lubrication, women self-reported their height and weight, which were then used to calculate BMI for each woman.

To control for the possibility that individual differences in fear of sexual assault or non-sexual crime might produce differences in introital lubrication or vaginal pH, participants completed the Fear of Rape Scale - Short-Form, the Fear of Crime Scale, and the Likelihood of Victimization Scale.

Fear of Rape. A modified version of the Fear of Rape Scale was used to assess participants' fear of rape (Appendix B; α = 0.92 – 0.93; five items; e.g. "I am afraid of being sexually assaulted"; Senn & Dzinas, 1996). Participants responded to each question using a 5-point scale ranging from 1 (*always*) to 5 (*never*).

Fear of Crime. The Fear of Crime Scale was used to assess participants' fear of violent, non-violent, and sexual crimes (Appendix B; α = 0.94 – 0.95; 10 items; e.g. "Having someone break into your home while you are away" and "Being attacked by someone with a weapon"; Chadee, 2003). Participants responded to each question using a 4-point scale ranging from 1 (*very unafraid*) to 4 (*very afraid*).

Likelihood of Victimization. The Likelihood of Victimization Scale was used to assess how likely participants think they are to be the victim of various crimes (Appendix B; α = 0.88 – 0.93; Chadee, 2003). This scale contains the same 10 items as the Fear of Crime Scale, but asks participants to respond using a 4-point scale ranging from 1 (*very unlikely*) to 4 (*very likely*).

Coercive Sexual Experiences. The Sexual Experiences - Short-Form Victimization Survey was used to assess participants' experience with various forms of sexual coercion (Appendix B; Koss et al., 2007). The Sexual Experiences – Short-Form Victimization Survey has not been independently validated, but the original Sexual Experiences Victimization Survey upon which it was based has shown consistently

acceptable reliabilities ($\alpha \approx 0.70$; e.g., Cecil & Matson, 2006; Koss et al., 1996). This survey contains seven items referring to different forms of sexual assault (e.g. "A man put his penis into my vagina, or someone inserted fingers or objects without my consent) and each of these seven items asks participants to address the method(s) by which this form of assault occurred (five methods for each type of assault; e.g., "by: Taking advantage of me when I was too drunk or out of it to stop what was happening"). Participants were asked to indicate how frequently each type of sexual assault occurred via each method (1) during the past 12 months ($\alpha = 0.95$ [nine items excluded for zero variance]) and (2) since the age of 14 years ($\alpha = 0.96$ [one item excluded for zero variance]) using a 4-point scale (0, 1, 2, and 3+ times). Participants were also asked three additional questions that more plainly address whether they have experienced sexual assault: "Did any of the experiences described in this survey happen to you one or more times?" ("yes"; "no"); "What was the sex of the person who did them to you?" ("I reported no experiences"; "Female only"; "Male only"; "Both females and males"); and "Have you ever been raped?" ("yes"; "no").

Trait Fear. The Trait Fear Scale was used to assess participants' general level of fear (Appendix B; $\alpha = 0.95$; 44 items; e.g., "It bothers me to be in new situations where things are uncertain"; Kramer et al., 2020). Participants responded to each item using a 4-point scale ranging from 1 (*true*) to 4 (*false*).

Positive and Negative Affect Schedule. The Positive and Negative Affect Schedule Short-Form (PANAS; Watson et al., 1988) was used to assess the extent to which participants have felt positive ($\alpha = 0.83$) and negative ($\alpha = 0.89$) emotions over the past week (Appendix B; 20 items; e.g., distressed, excited, enthusiastic). Participants

responded to each item using a 5-point scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*).

Frequency of Sexual Experiences. Participants' frequency of consensual sexual experiences was assessed using two items: "Over the past month, how frequently have you had sex, on average?" and "Over the past month, how frequently have you masturbated, on average?" (Appendix B). Participants responded to each question using a 5-point scale (0 times per week; 1-2 times per week; 3-5 times per week; 6-7 times per week; 8+ times per week).

Menstrual Cycle Questionnaire. To control for the influence of menstrual cycle phase on vaginal lubrication and pH, participants completed a 9-item questionnaire designed to determine their approximate position within their menstrual cycle (Nicolas & Welling, 2017; Appendix B). Based on participants' responses to this questionnaire during the initial, intake session, a menstrual cycle calculator was used to determine whether any of a participant's four sessions fell within their high fertility or low fertility window. Of the 43 participants who completed all four sessions and did not start menstruating during one of their sessions, 18 participants likely misinterpreted one of the questions on the menstrual cycle questionnaire. Specifically, one of the questions asked participants "What is the usual length of your menstrual cycle? That is, what is the typical number of DAYS between the first day of menstrual blood flow in one month to the first day of menstrual blood flow in the next month?". Despite efforts to word this item explicitly to avoid confusion, 18 participants provided answers of "8" or less, which suggests that they interpreted this question as "for how many days do you typically experience menstrual blood flow?". Because it is extremely unlikely that 18 women have

a *typical menstrual cycle* of eight days or less, values for these women were changed to 28 (the typical length of the ovulatory cycle for most women) and the confidence for this estimate was changed to 1 (*least confident*) so that it would have less influence on the calculator used to estimate high and low fertility.

Table 1
Alpha Reliabilities for Study Variables

	α
Intake	
Fear of Crime	0.94
Likelihood of Victimization	0.88
Coercive Sexual Experiences	0.97
Trait Fear	0.95
Positive Affect	0.83
Negative Affect	0.89
Neutral Condition	
Fear of Crime	0.94
Likelihood of Victimization	0.93
Fear of Rape	0.92
Importance of Rape Avoidance	0.97
Consensual Condition	
Fear of Crime	0.94
Likelihood of Victimization	0.93
Fear of Rape	0.93
Importance of Rape Avoidance	0.97
Violence Condition	
Fear of Crime	0.95
Likelihood of Victimization	0.93
Fear of Rape	0.93
Importance of Rape Avoidance	0.97
Rape Condition	
Fear of Crime	0.94
Likelihood of Victimization	0.91
Fear of Rape	0.92
Importance of Rape Avoidance	0.97

CHAPTER THREE

DATA ANALYSIS AND RESULTS

Data Analysis

A repeated-measures ANCOVA was conducted to test for differences in vaginal acidity across the stimulus conditions while controlling for ovulatory cycle phase, previous sexual assault experience, fear of crime, self-perceived likelihood of victimization, positive and negative affect, trait fear, BMI, use of birth control, frequency of sexual activity, and frequency of masturbation. Pairwise comparisons using Bonferroni corrections for alpha inflation (with α set to 0.05) were conducted to determine whether vaginal acidity had the largest decrease in response to the rape audio stimulus condition (Prediction 1), and to determine whether the decrease in vaginal pH was greater in the non-sexual violence audio stimulus condition relative to the neutral or consensual sex audio stimulus conditions (Prediction 2).

A repeated-measures ANCOVA was also conducted to test for differences in the amount of lubrication produced in response to the different stimulus conditions while controlling for ovulatory cycle phase, previous sexual assault experience, fear of crime, self-perceived likelihood of victimization, positive and negative affect, trait fear, BMI, use of birth control, frequency of sexual activity, and frequency of masturbation. Pairwise comparisons using Bonferroni corrections for alpha inflation (with α set to 0.05) were conducted to determine whether women produced more lubrication in response to the rape audio stimulus condition than the neutral audio stimulus condition (Prediction 3), and to determine whether women produced more lubrication in response to the

consensual sex audio stimulus condition than the rape audio stimulus condition (Prediction 4).

One goal of the present study was to determine the effect of experimental condition on changes in vaginal acidity while controlling for ovulatory cycle phase. However, because ovulatory cycle phase varied across sessions (and, therefore, across experimental conditions), high fertility and low fertility status for each participant had to be determined for each of the four experimental conditions (two dummy-coded variables per condition, for a total of eight variables). Fertility status was dummy-coded such that women who participated in an experimental condition during their high fertility phase received a value of 1 (e.g., high fertility during consensual condition = 1), whereas women who participated *outside* of their high fertility phase received values of 0. Low fertility status was similarly dummy-coded. Thus, women who received values of "0" for both high and low fertility for a given experimental condition were neither in the high fertility or low fertility phase of their ovulatory cycle. Additionally, interaction terms were created and entered as covariates (e.g., interaction 1 = pH change in response to the neutral condition * high fertility phase during the neutral condition). These interaction terms were then entered as covariates in the repeated-measures ANCOVAs.

Results

Manipulation Checks. Mauchly's test indicated that the assumption of sphericity was violated ($\chi^2 = 57.85$, $p < .001$); thus, the following results are reported using Greenhouse-Geisser corrected degrees of freedom and *p*-values. Repeated-measures ANCOVAs and pairwise comparisons revealed significant differences in self-reported sexual arousal across audio conditions, $F(2.06, 40) = 107.31$, $p < .001$, partial $\eta^2 = 0.72$.

Specifically, participants rated the consensual sex audio condition as more sexually arousing relative to the neutral [$t(3) = 12.87$, $p < .001$], rape [$t(3) = 9.61$, $p < .001$], and violence [$t(3) = 14.18$, $p < .001$] audio conditions. However, it is worth noting that women also reported more sexual arousal in response to the rape audio condition relative to both the neutral [$t(3) = 3.73$, $p = .003$], and violence [$t(3) = 4.16$, $p < .001$) audio conditions.

A similar pattern emerged for women's self-reported genital arousal, $F(1.57, 40) = 44.52$, $p < .001$, partial $\eta^2 = 0.52$. Specifically, participants rated the consensual sex audio condition as eliciting more genital arousal relative to the neutral [$t(3) = 7.65$, $p < .001$], rape [$t(3) = 5.95$, $p < .001$], and violence [$t(3) = 7.79$, $p < .001$] audio conditions. Again, women reported more genital arousal in response to the rape audio condition relative to both the neutral [$t(3) = 3.34$, $p = .010$], and violence [$t(3) = 3.47$, $p = .007$] audio conditions.

Repeated-measures ANCOVA also revealed significant differences in women's self-reported emotional distress across audio conditions, $F(3, 40) = 234.01$, $p < .001$, partial $\eta^2 = 0.85$. Specifically, women reported that the rape audio condition was more emotionally upsetting than the neutral [$t(3) = 17.04$, $p < .001$], and consensual [$t(3) = 15.61$, $p < .001$] audio conditions. Similarly, women reported that the violence audio condition was more emotionally upsetting than the neutral [$t(3) = 22.72$, $p < .001$], and consensual [$t(3) = 17.67$, $p < .001$] audio conditions. However, there was no significant difference between the rape and violence audio conditions [$t(3) = -0.96$, $p = .172$]. ANCOVA results for the remaining manipulation check items are presented in Tables 2 and 3.

Table 2

ANCOVA – Manipulation Check Items (Stimuli Assessment)

"The story was…"	*df*	*SS*	*F*	η^2
Sexually Arousing †	2.06, 40	281.37	107.31***	0.72
Emotionally Upsetting	3.00, 40	623.37	234.01***	0.85
Disgusting †	2.40, 40	632.42	188.94***	0.82
Difficult to Finish †	2.58, 40	260.42	101.07***	0.57
Uncomfortable	3.00, 40	370.37	77.34***	0.65

Note: † indicates a violation of the sphericity assumption (Greenhouse-Geisser Values used). *p < .05 **p < .01 ***p < .001

Table 3

ANCOVA – Manipulation Checks (Emotional Reactions)

	df	*SS*	*F*	η^2
Sexual Arousal †	1.45, 40	471.40	81.61***	0.66
Genital Arousal †	1.57, 40	219.47	44.52***	0.52
Fear †	1.89, 40	563.55	57.42***	0.58
Anger †	1.76, 40	1003.27	86.26***	0.67
Disgust †	2.38, 40	1268.67	114.57***	0.73
Anxious †	2.48, 40	410.06	36.44***	0.47
Calm †	2.55, 40	563.09	39.64***	0.49
Pleasant †	2.18, 40	588.54	67.91***	0.62
Unpleasant †	2.37, 40	1052.06	81.27***	0.66
Sadness †	1.95, 40	793.74	85.26***	0.67
Indifference †	2.49, 40	91.47	4.92**	0.12

Note: † indicates a violation of the sphericity assumption (Greenhouse-Geisser Values used). *p < .05 **p < .01 ***p < .001

Intercorrelations and descriptive statistics for all variables measured during the intake survey are presented in Table 4. Intercorrelations and descriptive statistics for all variables measured during the follow-up (i.e., post-stimulus) survey, with scores averaged across all four sessions, are presented in Table 5.

Table 4

Intercorrelations and Descriptive Statistics for Intake Variables

	1	2	3	4	5	6	7	8	9
1. Coercive Sexual Experiences	—								
2. Trait Fear	.02	—							
3. Positive Affect	-.07	.46**	—						
4. Negative Affect	.25	-.37*	-.19	—					
5. Fear of Crime	-.01	-.38*	-.31*	.28	—				
6. Likelihood of Victimization	.19	-.17	-.09	.37*	.49***	—			
7. BMI	-.09	-.04	-.25	-.05	-.04	.07	—		
8. Frequency of Sex	-.22	-.06	-.27	.27	.16	.19	.09	—	
9. Frequency of Masturbation	.25	-.08	-.27	.34*	.14	.12	.23	.03	—
Mean	1.22	2.39	3.17	2.41	3.11	1.99	25.90	1.79	1.98
Standard Deviation	0.35	0.55	0.68	0.83	0.67	0.54	5.81	0.97	0.77

Note: $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 5

Intercorrelations and Descriptive Statistics for Return Session Variables

	1	2	3	4	5	6	7	8	9
1. Tampon Mass	—								
2. pH Change	-.05	—							
3. ASM	-.12	.16	—						
4. AASR	-.25	.10	.70***	—					
5. ABA	.04	.10	.72***	.61***	—				
6. AS/DP	-.07	.08	.71***	.53***	.76***	—			
7. Fear of Crime	.02	.23	.40**	.24	.63***	.46**	—		
8. Likelihood of Victimization	-.04	.15	.18	.14	.50***	.49***	.69***	—	
9. Fear of Rape	-.32*	-.15	.43**	.33*	.56***	.60***	.59***	.61***	—
Mean	2.21	-0.06	5.53	3.88	4.54	4.91	2.89	2.15	3.32
Standard Deviation	0.21	0.20	0.44	1.03	0.86	0.76	0.70	0.59	0.96

Note: Values for each variable represent averaged scores across all four sessions. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Results of Repeated-Measures ANCOVA for pH Change. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2 = 3.71$, $p = .592$); thus, the following results are reported using uncorrected degrees of freedom and *p*-values. The results of the repeated-measures ANCOVA revealed no significant main effect of experimental condition on change in vaginal pH, $F(3, 32) = 1.18$, $p = .320$, partial $\eta^2 = 0.03$. However, there were significant interaction effects between the violence stimulus condition and high fertility status, $F(3, 32) = 3.54$, $p = .017$, partial $\eta^2 = 0.09$, and the violence stimulus condition at low fertility, $F(3, 32) = 3.62$, $p = .016$, partial $\eta^2 = 0.10$. No other significant interaction effects emerged. The results for all main and interaction effects are presented in Table 6.

A 2 (sexual content present, sexual content not present) by 2 (violence, no violence) repeated measures ANCOVA, and a 2 (sexual content present, sexual content not present) by 2 (violence, no violence) by 2 (taking hormonal birth control, not taking hormonal birth control) mixed measures ANVOCA were also conducted. No significant effects emerged from either of these analyses. The results of these analyses are presented in Tables 7 and 8.

Results of Pairwise Comparisons for pH Change. Pairwise comparisons were conducted to investigate differences in vaginal pH across experimental conditions. Bonferroni correction for alpha inflation (with α set to 0.05) was used to adjust for multiple comparisons. The pairwise comparisons revealed no significant differences between experimental conditions.

Table 6
ANCOVA – pH Change

	df	*SS*	*F*	η^2
Stimulus Condition	3, 32	0.37	1.18	0.03
Interaction Effects				
High Fertility x Neutral	3, 32	0.27	0.89	0.09
High Fertility x Consensual	3, 32	0.04	0.14	0.04
High Fertility x Violence	3, 32	1.09	3.54*	0.09
High Fertility x Rape	3, 32	0.65	2.10	0.06
Low Fertility x Neutral	3, 32	0.38	1.22	0.04
Low Fertility x Consensual	3, 32	0.01	0.04	0.00
Low Fertility x Violence	3, 32	1.12	3.62*	0.10
Low Fertility x Rape	3, 32	0.77	2.49	0.07

Note: *$p < .05$ **$p < .01$ ***$p < .001$

Table 7
2X2 ANCOVA – pH Change

	df	*SS*	*F*
Sex	1, 42	0.12	1.30
Violence	1, 42	0.33	2.25
Sex * Violence	1, 42	0.00	0.01

Note: *$p < .05$ **$p < .01$ ***$p < .001$

Table 8
2X2X2 ANCOVA – pH Change

	df	*SS*	*F*
Sex	1, 41	0.11	1.24
Violence	1, 41	0.32	2.18
Sex * Violence	1, 41	0.00	0.01
Sex * Birth Control	1, 41	0.11	1.24
Violence * Birth Control	1, 41	0.01	0.07
Sex * Violence * Birth Control	1, 41	0.01	0.10

Note: *$p < .05$ **$p < .01$ ***$p < .001$

Figure 1

Change in Vaginal pH Across Experimental Conditions

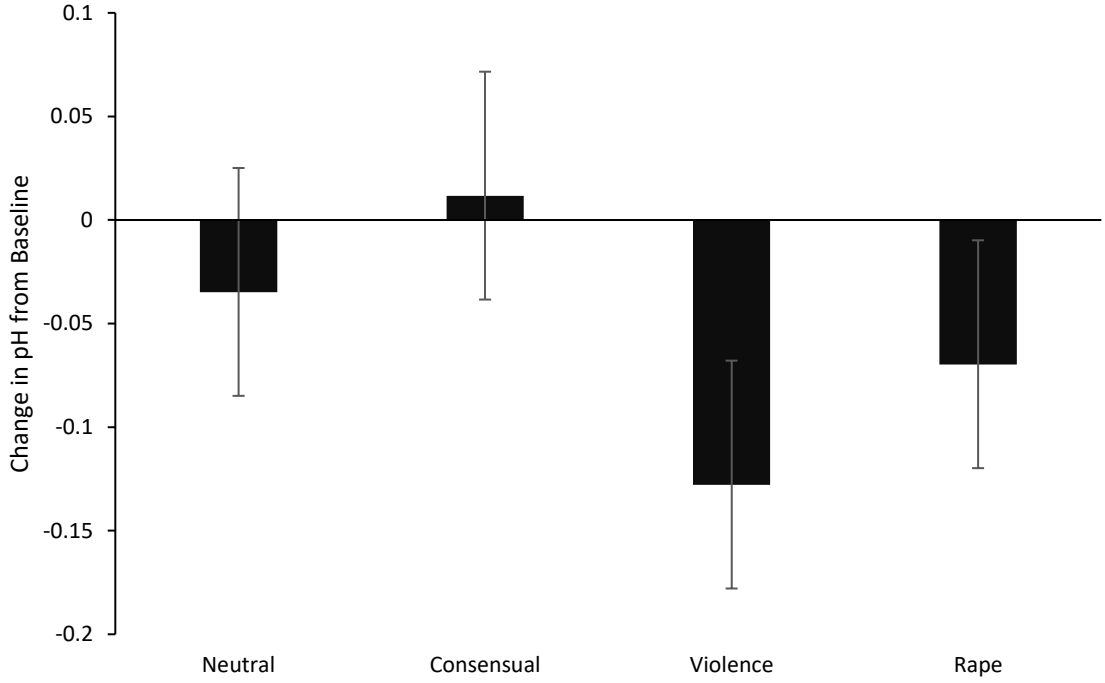
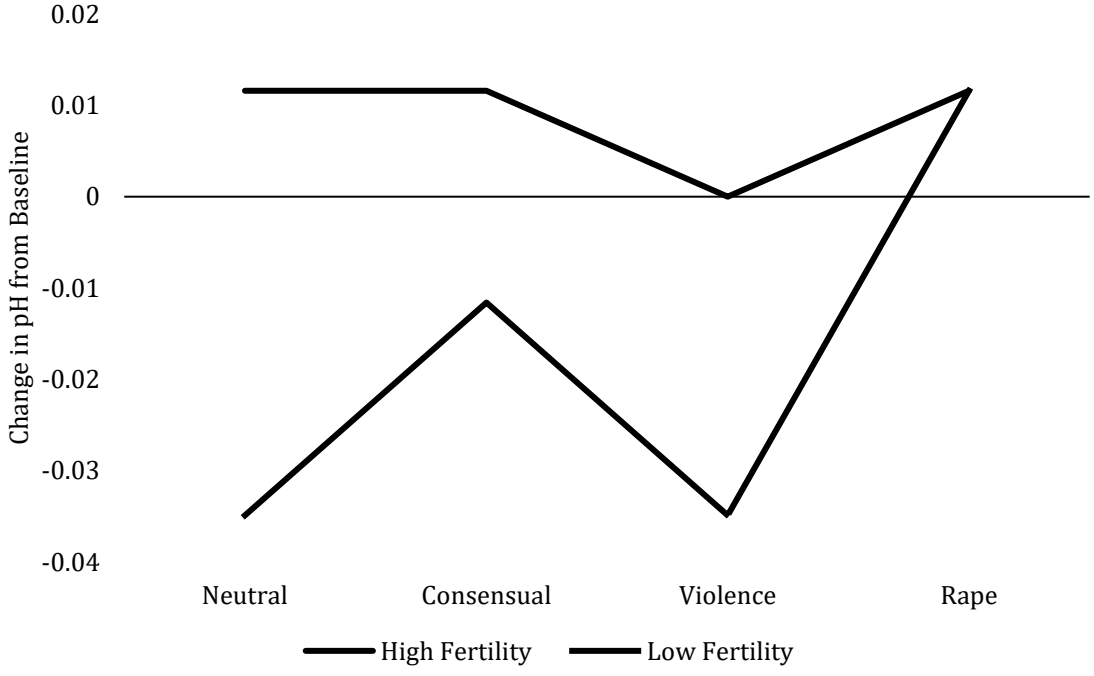


Figure 2

pH Change Across Fertility Status and Experimental Condition



Results of Repeated-Measures ANCOVA for Tampon Mass (Lubrication). Descriptive statistics for tampons used in the present study, as well as descriptive statistics for a comparison group of 15 dry, unused tampons are presented in Table 9. Mauchly's test indicated that the assumption of sphericity was not violated ($\chi^2 = 9.71$, $p = .084$); thus, the following results are reported using uncorrected degrees of freedom and *p*-values. The results of the repeated-measures ANCOVA revealed no significant main effect of experimental condition on tampon mass, $F(3, 32) = 1.56$, $p = .203$, partial $\eta^2 = 0.04$. Only one significant interaction effect emerged between experimental condition and high fertility during the sexual coercion stimulus, $F(3, 32) = 5.04$, $p = .003$, partial $\eta^2 = 0.13$. The results for all main and interaction effects are presented in Table 10.

A 2 (sexual content present, sexual content not present) by 2 (violence, no violence) repeated measures ANCOVA, and a 2 (sexual content present, sexual content not present) by 2 (violence, no violence) by 2 (taking hormonal birth control, not taking hormonal birth control) mixed measures ANVOCA were also conducted. No significant effects emerged from either of these analyses. The results of these analyses are presented in Tables 11 and 12.

Results of Pairwise Comparisons for Tampon Mass (Lubrication). Pairwise comparisons were conducted to investigate differences in tampon mass across experimental conditions. Bonferroni correction for alpha inflation (with α set to 0.05) was used to adjust for multiple comparisons. The pairwise comparisons revealed no significant differences between experimental conditions.

Table 9

Descriptive Statistics for Tampon Mass

	N	*M*	*SD*	Min.	Max.	Range
Study Tampons	172	2.21	0.30	1.50	3.56	2.06
Unused Comparison	15	1.82	0.13	1.64	2.11	0.47

Table 10

ANCOVA – Tampon Mass

	df	*SS*	*F*	η^2
Stimulus Condition	3, 32	0.26	1.56	0.04
Interaction Effects				
High Fertility x Neutral	3, 32	0.12	0.70	0.02
High Fertility x Consensual	3, 32	0.02	0.09	0.00
High Fertility x Violence	3, 32	0.16	0.95	0.03
High Fertility x Rape	3, 32	0.84	5.04**	0.13
Low Fertility x Neutral	3, 32	0.16	0.98	0.03
Low Fertility x Consensual	3, 32	0.14	0.85	0.02
Low Fertility x Violence	3, 32	0.27	1.61	0.04
Low Fertility x Rape	3, 32	0.11	0.69	0.02

Note: *$p < .05$ **$p < .01$ ***$p < .001$

Table 11

2X2 ANCOVA – Tampon Mass

	df	*SS*	*F*
Sex	1, 42	0.12	1.98
Violence	1, 42	0.07	0.95
Sex * Violence	1, 42	0.04	0.98

Note: *$p < .05$ **$p < .01$ ***$p < .001$

Table 12

2X2X2 ANCOVA – Tampon Mass

	df	*SS*	*F*
Sex	1, 41	0.12	1.96
Violence	1, 41	0.06	0.91
Sex * Violence	1, 41	0.04	0.97
Sex * Birth Control	1, 41	0.01	0.09
Violence * Birth Control	1, 41	0.07	0.99
Sex * Violence * Birth Control	1, 41	0.00	0.09

Note: *$p < .05$ **$p < .01$ ***$p < .001$

Figure 3

Tampon Mass Across Experimental Conditions

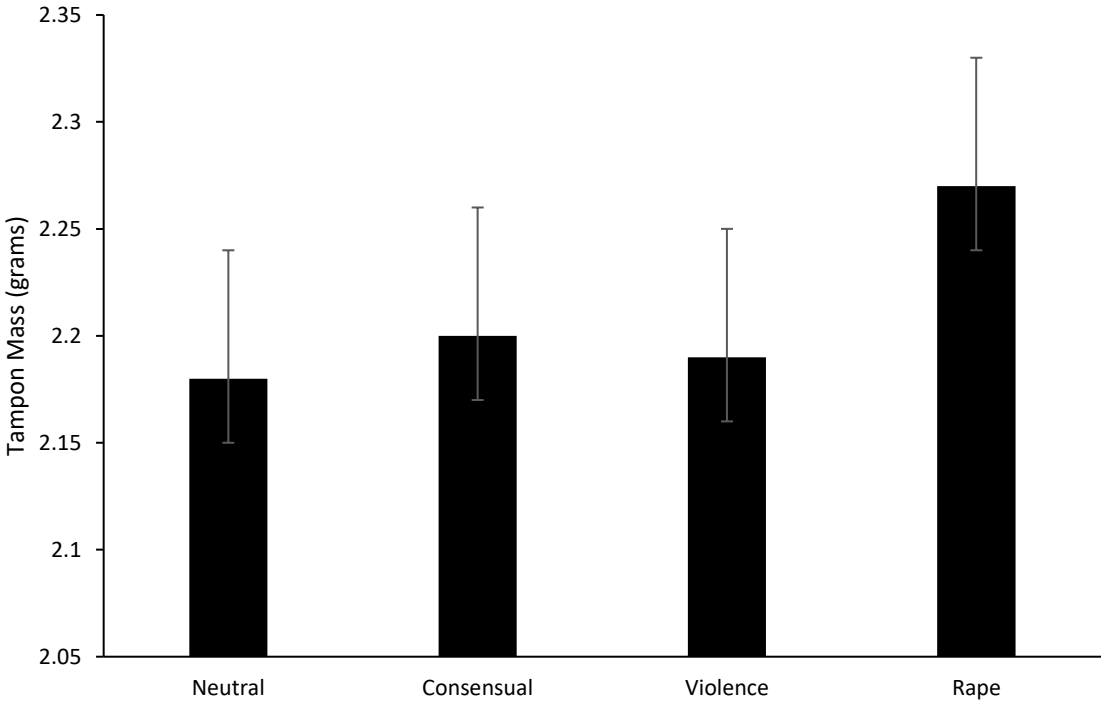
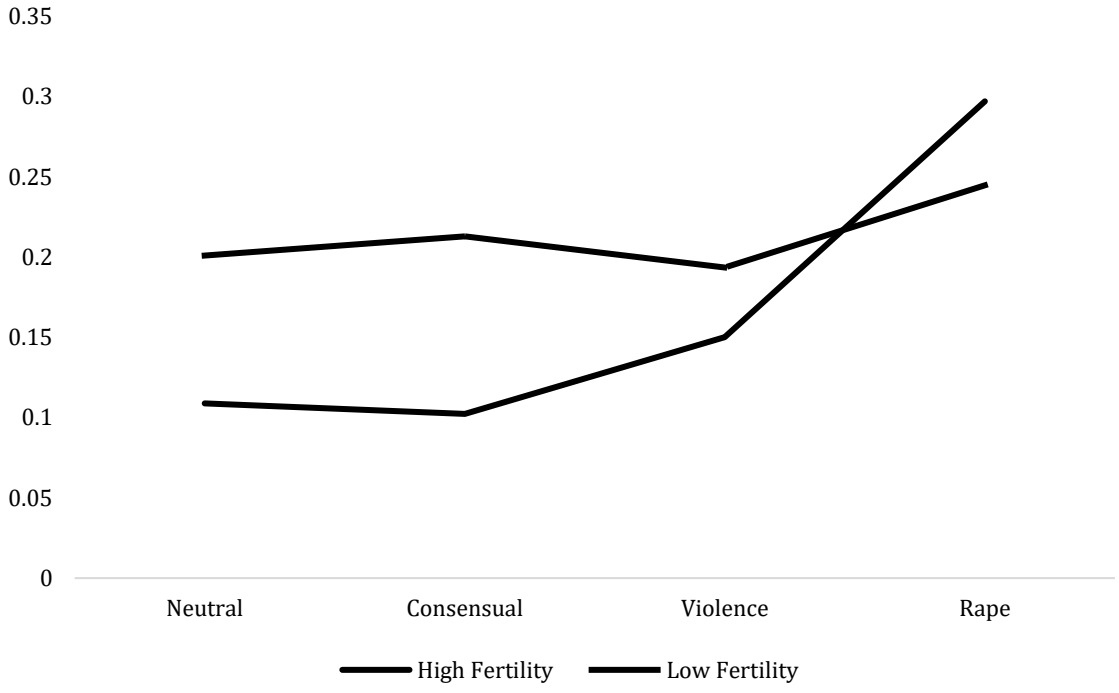


Figure 4

Tampon Mass Across Fertility Status and Experimental Condition



CHAPTER FOUR

GENERAL DISCUSSION

The results of the present study largely failed to support predictions derived from the spermicidal hypothesis of vaginal acidity. Specifically, exposure to the sexually coercive stimulus did not cause a larger decrease in pH relative to other audio stimuli (Prediction 1). Exposure to the non-sexual violence stimulus did elicit a larger decrease in pH relative to all other stimuli (Prediction 2); however, this difference did not reach statistical significance. Tampon mass (and presumably, vaginal lubrication) was greater in the sexual coercion stimulus condition relative to the neutral stimulus condition (Prediction 3), but again, this difference failed to reach statistical significance. Finally, tampon mass was not greater in the consensual stimulus condition relative to the sexual coercion stimulus condition (Prediction 4).

Although the results of the present study were largely null, a small number of significant interactions emerged that may provide useful insights. Namely, exposing women to stimuli depicting non-sexual violence may elicit changes in vaginal pH, but this effect appears to depend on the woman's fertility status. One potential explanation for this interaction is that women in the high fertility phase of their ovulatory cycle may be more sensitive to cues of violence, and that such cues are able to elicit changes in vaginal acidity only when conception risk is greatest. Although this interaction emerged only for the non-sexual violence condition, it may still provide support for the spermicidal hypothesis of vaginal acidity. Specifically, stimuli depicting non-sexual violence may serve a similar function as stimuli depicting non-violent rape, such that

both indicate the possibility of sexual assault. It may be that the chemical composition of the vaginal environment changes in response to specific environmental stimuli, but in the present study, only the non-sexual violence stimulus was sufficient to evoke such a response. That is, changes in vaginal acidity may be the downstream result of other biochemical processes, such as the fear experienced in response to threatening situations, but the rape stimulus did not elicit sufficient fear to result in a shift of vaginal pH. Indeed, participants in the present study reported greater fear in response to the non-sexual violence stimulus than they did to the rape stimulus; however, this difference was not statistically significant. Still, such an emotional response may be more readily elicited during the fertile phase of the ovulatory cycle, as the risk of fertilization from a coercive man is more likely during high fertility. Previous research supports the idea that naturally cycling women may be more sensitive to threats of sexual coercion during the high fertility phase of their cycle (e.g., Garver-Apgar et al., 2007; Petralia & Gallup, 2002; Ryder et al., 2020). Further, certain properties of the vaginal environment fluctuate over the ovulatory cycle, and have been shown to impact vaginal acidity (Garcia-Closas et al., 1999; Linhares et al., 2011). Thus, the significant interaction between women's fertility status and the non-sexual violence stimulus provides partial support for the spermicidal hypothesis of vaginal acidity, and may be worthy of further investigation.

If the present study's measure of tampon mass accurately captured the amount of vaginal lubrication produced in response to different stimulus conditions, then women in the present study produced more vaginal lubrication in response to the sexual coercion stimulus than any other stimulus condition. This difference did not reach statistical significance; however, the direction of these null results, and indeed, the lack of

significant differences, runs counter to what has been observed using measures of both vasocongestion (Chivers et al., 2004; Suschinsky & Lalumiere, 2011a) and vaginal lubrication (Sawatsky et al., 2018). The preparation hypothesis predicts that women's physiological arousal evolved to be cue nonspecific to lubricate the vaginal lumen and reduce injury sustained during a potential rape. However, the interaction effect that emerged in the present study suggests that women's vaginal lubrication in response to coercive stimuli may depend on whether they are in the high fertility phase of their ovulatory cycle. This finding is somewhat at odds with what would be expected from the preparation hypothesis. That is, if women's physiological arousal evolved to be cue-nonspecific to protect against vaginal tearing during rape, this response should persist across the ovulatory cycle. Further, this interaction effect also seems to contradict what would be expected from the spermicidal hypothesis of vaginal acidity. Unless the excess lubrication produced in response to cues of rape during high fertility also contained more spermicidal properties (e.g., greater acidity), this response seems potentially disastrous to women's control over mate choice, as greater lubrication might increase the likelihood of conception by a sexually coercive male (e.g., Suarez & Pacey, 2006). These results may provide an explanation for the greater frequency of fertilization via rape compared to coercive sex (Coleman, 2015; Gottschall & Gottschall, 2003; Holmes et al., 1996); however, the interaction between fertility status and cue-nonspecific genital arousal should be investigated further using a more precise measure of vaginal lubrication before firm conclusions are drawn.

Limitations and Future Directions

The present study, in its endeavor to investigate a novel hypothesis, was plagued by several considerable limitations related to methodology and measurement. Additional research must address these methodological limitations before making definitive conclusions regarding the spermicidal hypothesis of vaginal acidity. Specific recommendations for methodological improvements and future research are outlined below.

Given that the present study was primarily concerned with changes in vaginal pH in response to audio stimuli, the instrument used to measure vaginal acidity is, arguably, the most significant limitation. The present study used pH test strips marketed as a feminine hygiene product. These test strips, although designed specifically for measuring vaginal pH, are manufactured and sold as products for women to assess the health of their vaginal environment, and to indicate potential issues such as yeast infections and bacterial vaginosis. Thus, these test strips may not offer the most accurate measure of vaginal pH. Further, these test strips measured vaginal pH in increments of 0.5 pH units; however, Wagner and Levin (1984) observed changes ranging from 0.13-0.8 pH when measuring the effect of clitoral self-stimulation on women's vaginal acidity. That sexual arousal via masturbation only resulted in these small changes in vaginal pH suggests that the stimuli used in the present study may not have been sufficient to elicit changes in vaginal acidity large enough to be detected by test strips measuring pH in increments of 0.5 units. Future research may wish to use a more precise and sensitive instrument for measuring vaginal pH, such as the glass pH electrode used by Wagner and Levin. However, it should be noted that this method of measuring vaginal pH is much more

intrusive than asking participants to swab their own vagina with a test strip in a private location, and a research assistant may need to manually insert the pH electrode into participants' vaginas. Further, Wagner and Levin collected data from 10 participants, and observed significant changes in pH for only four of these women. Thus, future research investigating changes in vaginal acidity may have to consider trade-offs between measurement accuracy and sample size.

Previous investigations of women's physiological arousal in response to audio stimuli have focused on vasocongestion. However, some researchers have raised concerns with using vasocongestion as a measure of women's physiological arousal (e.g., Clephane et al., 2020), and more recent work has attempted to assess vaginal lubrication directly (Handy & Meston, 2020). Thus, the present study attempted to measure vaginal lubrication directly by recording the mass of tampons after women were exposed to different audio stimuli. The most prominent methodological concern with this approach is that individual tampons varied in mass. That is, when removed from their individual plastic wrappers and applicators, the individual tampons varied in mass. The obvious solution to this problem would be to record the mass of each tampon before and after women inserted the tampon and listened to the audio story; however, this approach would have introduced a number of additional complications. Recording the mass of each tampon while it was still inside the applicator and plastic wrapper would not have provided an accurate measure of the tampon's weight before being inserted by the participant. The plastic wrapper and applicator could have been removed and discarded before the tampon was given to participants; however, in addition to sanitation concerns, it did not seem reasonable to ask participants to forgo the use of a plastic applicator for

tampon insertion. This issue might have been addressed by massing the tampon with its applicator and wrapper, then asking participants to return the applicator and wrapper so these items could be measured and the resulting mass subtracted from the total mass. Although this would have allowed us to assess the tampon's mass *before* participants experienced the audio stimulus, we were concerned that participants might fail to follow instructions and throw these items away. Thus, future research may wish to follow Handy and Meston's (2020) approach of using Schirmer Tear Test strips, which are designed specifically to measure moisture. However, it should be noted that although Handy and Meston observed significant difference in vaginal lubrication before and after exposing participants to a sexual film, the test strips did not reliably distinguish between women with sexual arousal concerns (i.e., women who scored below the clinical cutoff on a measure of sexual function) and those without such concerns.

Arguably, the most important covariate in the present study was fertility status. If cues to sexual coercion or non-sexual violence have an effect on vaginal acidity and/or lubrication, this effect is likely dependent on ovulatory cycle phase (and on the level of certain fluctuating hormones across the cycle). We entered women's responses to the menstrual cycle questionnaire into a calculator that estimated their next high fertility and low fertility phases. However, we did not require women to schedule at least one session during a high fertility phase, and one session during a low fertility phase. Rather, the high and low fertility phases for each woman were determined after data collection had ended, and session fertility status was coded based on the high or low fertility phases for each participant. A related complication is that, due to scheduling conflicts, women sometimes scheduled or rescheduled sessions that fell outside of what could be predicted by the

fertility calculator. In other words, the calculation performed in the current study could only determine high and low fertility windows during the woman's next cycle, but women would sometimes complete their 3rd or 4th sessions during their following cycle. Thus, sessions that occurred outside of the estimated ovulatory cycle were coded as neither high nor low fertility phase. As a result of these complications, there was a low frequency of women who completed any of the four experimental conditions during the high or low fertility phases of their ovulatory cycle. Further, and as noted above, about half of the participants in the present study likely completed the menstrual cycle questionnaire incorrectly, and provided inaccurate estimates of their typical ovulatory cycle in days. Although these values were manually altered to reflect the typical cycle length of 28 days, it is likely that estimates of high and low fertility were inaccurate for about half of the participants in the present study.

The results of the present study, and the clearly identifiable issues with measurement (pH, tampon mass/lubrication, fertility status) provide a clear path forward for future researchers. Specifically, future research should investigate the potential effect of consensual, violent, and sexually coercive stimuli while implementing more precise and sensitive measures of both vaginal acidity and lubrication. If future research implements a design similar to the present study (i.e., repeated measures across multiple study sessions), researchers should determine fertility status at each session, and ensure that participants are providing accurate assessments for the length of their ovulatory cycle. Researchers may also wish to implement the use of hormonal assays (e.g., saliva samples) in order to assess directly the amount of fluctuating hormones like estrogen, which likely drive differences in vaginal pH and lubrication across the ovulatory cycle.

Finally, given that women in the present study showed the greatest decrease in pH in response to the non-sexual violence stimulus, future research should incorporate a stimulus depicting sexual violence. The stimuli used in the present study were taken from Harris and colleagues (2008), and originally included a sexual violence stimulus (i.e., an audio story depicting violent rape). The sexual violence stimulus was not added to the present study due to concerns that participant attrition would increase with more return sessions. Further, it seemed reasonable to exclude the sexual violence condition in favor of the other stimulus conditions given that these would afford assessment of the effect of sexual coercion and violence, separately, on vaginal pH and lubrication. However, the results of the present study suggest that a stimulus depicting sexual violence may elicit a stronger effect than the stimuli used in the present study.

Conclusion

The present study aimed to test several predictions derived from the novel spermicidal hypothesis of vaginal acidity; however, the results largely failed to support the predictions derived from this hypothesis. Those results that did emerge should be interpreted with caution given the issues involved with measuring several key variables. Nevertheless, the present study is the first to assess directly changes in vaginal pH in response to audio stimuli, and further investigation is required to determine whether audio stimuli, or other types of stimuli, might have an effect on vaginal pH.

The predictions tested in the present study are conceptually similar to those addressed by an emerging area of research focused on female reproductive fluid and its role in facilitating fertilization. Gasparini and colleagues (2020) provided an extensive review of the potential role of female reproductive fluid in influencing sperm motility and

fertilization, and the potential environmental factors that may impact certain qualities of female reproductive fluid. As Gasparini and colleagues suggested, female reproductive fluid may play an important role in post-mating sexual selection, noting the possibility that certain qualities of female reproductive fluid may change in response to preferred or non-preferred sexual partners. Gasparini and colleagues proposed several possible mechanisms by which female reproductive fluid might have a biasing effect on the motility of sperm inseminated by preferred males. For example, some evidence has shown progesterone to be a chemoattractant for human sperm (Teves et al., 2006). Although Gasparini and colleagues briefly note the potential role of acidity in female reproductive fluid's ability to influence sperm motility, they do not discuss the relative alkalinity of ejaculates or the potential environmental factors that might influence the acidity of female reproductive fluid. Further, Gasparini and colleagues left open the question of whether female reproductive fluid may be subject to individual variation, or whether female reproductive fluid quality is consistent between individuals, thus producing a consistent preferential effect on the sperm of males with certain desirable traits. In the present study, observations of average baseline pH (i.e., before participants were exposed to a stimulus) across the four sessions revealed a leptokurtic distribution, such that vaginal acidity clustered around pH 4.53. However, average baseline pH also ranged from 4.25-5, suggesting at least some degree of individual variation. Many questions remain regarding individual variation in and environmental effects on vaginal acidity, and the potential effect of vaginal acidity on sperm motility in humans, and future research should investigate specifically vaginal acidity as a potential mechanism that facilitates or inhibits sperm motility.

Taken together, the emerging research on female reproductive fluid (Gasparini et al., 2020), improved instruments for measuring vaginal lubrication (Handy & Meston, 2020), and the preliminary insights offered by the present study, provide a strong rationale for further investigation into the possible evolved function of women's physiological arousal. Additional research is warranted, not only to determine whether women possess an evolved, physiological defense against fertilization via rape, but also to gain insight into the relatively high frequency of fertilization via rape. As Gasparini and colleagues noted in their review, investigation of women's reproductive fluid has lagged far behind that of male ejaculates, despite the potential role of female reproductive fluid in post-mating sexual selection and sperm competition. Additional research along these lines will afford a better understanding of women's physiological adaptations to sexual selection.

APPENDIX A

IRB APPROVAL LETTER

OAKLAND UNIVERSITY

Institutional Review Board

October 12, 2020

Protocol #: IRB-FY2020-31

Research Team:
Gavin Vance
Virgil Zeigler-Hill

Based on applicable federal regulations, the following study, "Introital Lubrication pH" has been determined to be Approved, with the following categories 3. Prospective collection of biological specimens for research purposes by noninvasive means.
7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This letter along with the IRB date stamped consent document can be found in Cayuse in the Submission Details page under Letters and Attachments, respectively.

Please note that Oakland University has mandated a temporary stoppage of all in-person human subjects research procedures. An exception to the stoppage may be obtained for research with special circumstances from the Vice President for Research, Dr. David Stone.

Permission from Research Site(s):
Please note the following:

- This IRB approval letter means that the research has met the federal criteria for approval per 45 CFR 46.111 Criteria for IRB Approval of Research.
- Before the research is initiated, permission to conduct research at a given site must be obtained from all research locations listed in the IRB submission. You must keep copies of all such permission letters for your records.
- It is the responsibility of each researcher to follow all applicable policies and procedures of any outside institution where the research will be conducted.

Consent Document(s):
IRB date stamped consent document(s) must be used in consenting participants. Federal regulations require that

each participant receive a copy of the consent document unless a waiver is granted by the IRB. Signed consent form(s) must be retained for a minimum of three years after the completion of the project. Please remember that informed consent is a process that continues throughout the project, starting with recruitment and assurance of participant understanding of the project, and followed by a signed consent form when applicable.

Modifications:
Any changes to the approved project must be approved by the IRB prior to initiation by submitting a MODIFICATION request. Do not collect data while the changes are being reviewed. Data collected during this time cannot be used in research.

Incidents:
All unanticipated problems involving risks to participants or others, serious and unexpected adverse events, non-compliance issues and/or serious complaints regarding this project must be reported promptly to the IRB by submitting an INCIDENT report.

You are approved to start the research. Please retain a copy of this notification for your records.

If you have any questions, please contact the IRB office.

Thank you.

The Oakland University IRB

APPENDIX B

IBC APPROVAL LETTER

OAKLAND UNIVERSITY

Institutional Biosafety Committee

October 5, 2020

Professor Virgil Zeigler-Hill
Department of Psychology

Reference: IBC Application # 4561, "Introital Lubrication and pH"

Dear Professor Zeigler-Hill:

The Institutional Biosafety Committee (IBC), responsible for the review of research involving materials of human origin, recombinant DNA, and biohazardous, infectious or toxic materials, has reviewed the original proposal, noted the revisions provided by you upon committee's request, and approved the revised project referenced above.

The proposed activities were approved at BSL-2 for a period of three years starting, October 5, 2020 and ending October 4, 2023, and assigned the approval # 4561-20.

Any unanticipated problems, changes in, or halting of the activities proposed in the project, as described, must be promptly reported to the IBC or the biosafety officer.

In addition, all faculty, staff and students involved in the project must be trained and qualified to conduct the project in a responsible manner. Please note, in this regard, that you, the principal investigator, are fully responsible at all times for limiting or restricting access to laboratories and for assessing, in each circumstances, who may enter or work in a laboratory when biohazardous materials are in use.

Please let me know if you have any questions. Thank you.

Sincerely,

Domenic Luongo, CHMM
Director - Laboratory Safety and Compliance

Office of Research Administration

APPENDIX C

SURVEYS

Demographic Items

1. What is your age in years?
2. Please indicate your race
3. What is your gender?
4. What is your sexual orientation?
5. Are you currently using any of the following forms of birth control?
6. Are you currently in a committed, romantic relationship?
7. If you answered yes to the previous question, please indicate the length of your current romantic relationship in months
8. What is your height? (please answer in the format ft, in)
9. What is your weight? (please answer in pounds)

Assessment of Auditory Stimuli/Manipulation Check

You will now read a series of statements regarding the story you just listened to. Please indicate the extent to which you agree with each of the following statements.

1 = Strongly disagree
2 = Moderately disagree
3 = Slightly disagree
4 = Slightly agree
5 = Moderately agree
6 = Strongly agree

1. In general, the story was sexually arousing
2. The story was emotionally upsetting
3. The story was disgusting
4. The story was difficult to finish
5. The story made me uncomfortable
6. I can imagine myself experiencing what the narrator was experiencing
7. To what extent do you think you felt the same emotions as the narrator while listening to the story?

1 = Not at all 2 3 4 5 6 = Very much

Please indicate the extent to which you experienced each of the following emotions while listening to the story using a scale of 1 to 9.

1 = Emotion not present
9 = Emotion definitely present

Sexual arousal
Genital arousal
Fear
Anger
Disgust
Anxious
Calm
Pleasant
Unpleasant
Sadness
Indifference

Importance of Rape Avoidance Behaviors

Please indicate the extent to which you agree with each sentence as it pertains to you, personally.

1 = Strongly disagree
2 = Moderately disagree
3 = Slightly disagree
4 = Slightly agree
5 = Moderately agree
6 = Strongly agree

It is important that I avoid men with a reputation for forcing themselves on women
It is important to avoid letting men I don't know into my home
It is important that I lock my house doors
It is important to avoid men I don't know that make me feel uneasy
It is important that I avoid giving too much personal information to men I don't know well
It is important that I avoid taking rides with men I don't know
It is important to lock my car doors
It is important that I avoid meeting with men from the internet
It is important to avoid accepting drinks from men that I did not watch being made
It is important to avoid men who make me feel uncomfortable
It is important to avoid meeting with men I don't know in places I'm not familiar with
It is important to be aware of my surroundings when in public
It is important that I avoid drunk men
It is important that I avoid being around violent men
When at a club or party, it is important that I refuse drinks from men I don't know
It is important that I avoid ''blind" dates
It is important that I park in well-lit areas
It is important that I avoid leading men on sexually
It is important that I avoid jogging at night
It is important to avoid leaving my drink unattended when at a bar or party
It is important that I avoid wearing revealing clothes
It is important that I avoid drinking alcohol in unfamiliar places
It is important that I dress conservatively
It is important that I avoid staying out too late
It is important that I avoid drinking alcohol
It is important to avoid drinking alcohol if I am around men I don't know
It is important that I avoid wearing sexy clothing
It is important to avoid going out alone with a man I don't know
It is important to avoid ''making out" with a man I have just met

It is important to avoid attracting attention to myself It is important that I avoid large groups of men
It is important to avoid talking to men I don't know
It is important that I avoid taking drugs
It is important that I be cautious of male friends
It is important to avoid places where I am the only woman
It is important that I avoid teasing men by making sexual comments
It's important that I wear a lot of clothes
It is important to leave the television or music on when I'm at home alone
When I go out, it is important to stay with at least one other person that I know
It is important to let friends or family know where I am going when I go out
It is important to stay around other people when I go out
It is important to respond negatively to men when they flirt with me
It is important that I avoid going to public restrooms alone
It is important to avoid unfamiliar places where I could get lost
It is important to keep lights on in my house when alone
It is important that I avoid going to gas stations at night
It is important that I avoid sitting in a parked car for too long
When I go out, it is important to do so with at least one male friend
It is important to walk with someone to my car
It is important that I avoid walking alone at night
It is important to avoid parking far from my destination at night
It is important to look around before I get out of my car
It is important to check my house when I come home to make sure nothing has been tampered with
It is important to look in my car before I get in
It is important to keep a sharp object in my purse
It is important that I carry a knife
It is important to set my house alarm
It is important to report suspicious men in my neighborhood
It is important to pay special attention to my surroundings
It is important to check behind me when walking
It is important that I carry pepper spray
It is important to keep a weapon in my car
It is important to pay attention to my feelings in potentially dangerous situations
It is important to keep a weapon in my house
It is important to walk with my keys in hand, with a key in between my fingers
It is important to alert others if a man I don't know seems to be following me
It is important to present myself in a confident manner when around men I don't know
It is important to hold my keys in my hand when walking to my car
It is important to keep one hand free when walking alone

Fear of Rape Scale – Short-Form

Please indicate the extent to which you agree with the following statements

1 = Always

2 = Usually

3 = Sometimes

4 = Rarely

5 = Never

1. In general, I am suspicious of men
2. I am afraid of men
3. I am afraid of being sexually assaulted
4. I am wary of men
5. The possibility of rape affects my freedom of movement

Fear of Crime

4 = Very afraid
3 = Afraid
2 = Unafraid
1 = Very Unafraid

Using the above scale, how much are you afraid of the following:
1. Being cheated, conned, or swindled out of your money
2. Having someone break into your home while you are away
3. Having someone break into your home while you are there
4. Being raped or sexually assaulted
5. Being murdered
6. Being attacked by someone with a weapon
7. Having your car stolen
8. Being robbed or mugged on the street
9. Having your property damaged by vandals
10. Being kidnapped

Likelihood of Victimization

4 = Very likely
3 = Likely
2 = Unlikely
1 = Very Unlikely

Using the above scale, how likely do you think you would be a victim of the following:
1. Being cheated, conned, or swindled out of your money
2. Having someone break into your home while you are away
3. Having someone break into your home while you are there
4. Being raped or sexually assaulted
5. Being murdered
6. Being attacked by someone with a weapon
7. Having your car stolen
8. Being robbed or mugged on the street
9. Having your property damaged by vandals
10. Being kidnapped

Sexual Experiences Survey- Short-form Victimization

1. Someone fondled, kissed or rubbed up against the private areas of my body (lips, breast/chest, crotch or butt) or removed some of my clothes without my consent (*but did not attempt sexual penetration)* by:
    a. Telling lies, threatening to end the relationship, threatening to spread rumors about me, making promises I knew were untrue, or continually verbally pressuring me after I said I didn't want to
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    b. Showing displeasure, criticizing my sexuality or attractiveness, getting angry but not using physical force, after I said I didn't want to
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    c. Taking advantage of me when I was too drunk or out of it to stop what was happening
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    d. Threatening to physically harm me or someone close to me
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    e. Using force, for example holding me down with their body weight, pinning my arms, or having a weapon
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
2. Someone had oral sex with me or made me have oral sex with them without my consent by:
    a. Telling lies, threatening to end the relationship, threatening to spread rumors about me, making promises I knew were untrue, or continually verbally pressuring me after I said I didn't want to
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    b. Showing displeasure, criticizing my sexuality or attractiveness, getting angry but not using physical force, after I said I didn't want to
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    c. Taking advantage of me when I was too drunk or out of it to stop what was happening
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    d. Threatening to physically harm me or someone close to me
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+

e. Using force, for example holding me down with their body weight, pinning my arms, or having a weapon
    i. How many times in the past 12 months?: 0 1 2 3+
    ii. How many times since age 14?: 0 1 2 3+

3. A man put his penis into my vagina, or someone inserted fingers or objects without my consent by:
    a. Telling lies, threatening to end the relationship, threatening to spread rumors about me, making promises I knew were untrue, or continually verbally pressuring me after I said I didn't want to
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    b. Showing displeasure, criticizing my sexuality or attractiveness, getting angry but not using physical force, after I said I didn't want to
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    c. Taking advantage of me when I was too drunk or out of it to stop what was happening
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    d. Threatening to physically harm me or someone close to me
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    e. Using force, for example holding me down with their body weight, pinning my arms, or having a weapon
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+

4. A man put his penis into my butt, or someone inserted fingers or objects without my consent by:
    a. Telling lies, threatening to end the relationship, threatening to spread rumors about me, making promises I knew were untrue, or continually verbally pressuring me after I said I didn't want to
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    b. Showing displeasure, criticizing my sexuality or attractiveness, getting angry but not using physical force, after I said I didn't want to
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    c. Taking advantage of me when I was too drunk or out of it to stop what was happening
        i. How many times in the past 12 months?: 0 1 2 3+
        ii. How many times since age 14?: 0 1 2 3+
    d. Threatening to physically harm me or someone close to me

i. How many times in the past 12 months?: 0 1 2 3+
ii. How many times since age 14?: 0 1 2 3+

e. Using force, for example holding me down with their body weight, pinning my arms, or having a weapon
i. How many times in the past 12 months?: 0 1 2 3+
ii. How many times since age 14?: 0 1 2 3+

5. Even though it did not happen, someone TRIED to have oral sex with me or make me have oral sex without my consent by:
a. Telling lies, threatening to end the relationship, threatening to spread rumors about me, making promises I knew were untrue, or continually verbally pressuring me after I said I didn't want to
i. How many times in the past 12 months?: 0 1 2 3+
ii. How many times since age 14?: 0 1 2 3+

b. Showing displeasure, criticizing my sexuality or attractiveness, getting angry but not using physical force, after I said I didn't want to
i. How many times in the past 12 months?: 0 1 2 3+
ii. How many times since age 14?: 0 1 2 3+

c. Taking advantage of me when I was too drunk or out of it to stop what was happening
i. How many times in the past 12 months?: 0 1 2 3+
ii. How many times since age 14?: 0 1 2 3+

d. Threatening to physically harm me or someone close to me
i. How many times in the past 12 months?: 0 1 2 3+
ii. How many times since age 14?: 0 1 2 3+

e. Using force, for example holding me down with their body weight, pinning my arms, or having a weapon
i. How many times in the past 12 months?: 0 1 2 3+
ii. How many times since age 14?: 0 1 2 3+

6. Even though it did not happen, a man TRIED to put his penis into my vagina, or someone tried to stick in fingers or objects without my consent by:
a. Telling lies, threatening to end the relationship, threatening to spread rumors about me, making promises I knew were untrue, or continually verbally pressuring me after I said I didn't want to
i. How many times in the past 12 months?: 0 1 2 3+
ii. How many times since age 14?: 0 1 2 3+

b. Showing displeasure, criticizing my sexuality or attractiveness, getting angry but not using physical force, after I said I didn't want to
i. How many times in the past 12 months?: 0 1 2 3+
ii. How many times since age 14?: 0 1 2 3+

c. Taking advantage of me when I was too drunk or out of it to stop what was happening
i. How many times in the past 12 months?: 0 1 2 3+

ii. How many times since age 14?: 0 1 2 3+

d. Threatening to physically harm me or someone close to me
   i. How many times in the past 12 months?: 0 1 2 3+
   ii. How many times since age 14?: 0 1 2 3+

e. Using force, for example holding me down with their body weight, pinning my arms, or having a weapon
   i. How many times in the past 12 months?: 0 1 2 3+
   ii. How many times since age 14?: 0 1 2 3+

7. Even though it did not happen, a man TRIED to put his penis into my butt, or someone tried to stick in fingers or objects without my consent by:

a. Telling lies, threatening to end the relationship, threatening to spread rumors about me, making promises I knew were untrue, or continually verbally pressuring me after I said I didn't want to
   i. How many times in the past 12 months?: 0 1 2 3+
   ii. How many times since age 14?: 0 1 2 3+

b. Showing displeasure, criticizing my sexuality or attractiveness, getting angry but not using physical force, after I said I didn't want to
   i. How many times in the past 12 months?: 0 1 2 3+
   ii. How many times since age 14?: 0 1 2 3+

c. Taking advantage of me when I was too drunk or out of it to stop what was happening
   i. How many times in the past 12 months?: 0 1 2 3+
   ii. How many times since age 14?: 0 1 2 3+

d. Threatening to physically harm me or someone close to me
   i. How many times in the past 12 months?: 0 1 2 3+
   ii. How many times since age 14?: 0 1 2 3+

e. Using force, for example holding me down with their body weight, pinning my arms, or having a weapon
   i. How many times in the past 12 months?: 0 1 2 3+
   ii. How many times since age 14?: 0 1 2 3+

8. Did any of the experiences described in this survey happen to you one or more times?

   Yes
   No

   What was the sex of the person who did them to you?

   I reported no experiences
   Female only
   Male only
   Bothe females and males

9. Have you ever been raped?

   Yes
   No

Trait Fear

Directions: This questionnaire contains statements that different people might use to describe themselves. Each statements is followed by four choices: T t f F. The meaning of these four different choices is as follows:

T = True t = somewhat true f = somewhat false F = False

For each statement, circle the choice that describes you best. There are no right or wrong answers; just choose the answer that best describes you.

Remember: Circle only one choice per statement.

Like this: T (t) f F

Answer all of the items. Please work rapidly and do not spend too much time on any one statement.

1. It bothers me to be in new situations where things are uncertain.
2. I stay cool, even in emergencies.
3. I tend to be unsure of myself in tough situations.
4. I like doing physically dangerous things.
5. I'm always willing to rush in where others fear to tread.
6. I am afraid of a lot of things.
7. I feel pretty confident when meeting new people.
8. I find it frightening to be in a strange new place on my own.
9. I'm afraid of far fewer things than most people.
10. I gladly do things I've never done before, even if they might be dangerous.
11. I always panic when I'm under pressure.

12. I'd like the rush of racing into a burning building to save someone.
13. I don't like walking into new situations, even when there's nothing to fear.
14. I never worry about making a fool of myself with others.
15. I am very easily frightened.
16. I function well in new situations, even when unprepared.
17. I have no strong desire to parachute out of an airplane.
18. I'm not an especially shy person.
19. I prefer the safety of familiar situations.
20. I stay calm, cool, and collected in scary situations.
21. I probably have the least amount of confidence of anyone I know.
22. I really enjoy doing new things that others are afraid of doing, even if I don't know what to expect.
23. I sometimes shy away from crowds of people.
24. I am fearless.
25. Major tasks or challenges can seem overwhelming to me.
26. I might like to try hang-gliding someday.
27. I'm very adventurous, and I love to do all kinds of new things.
28. I have more fears than some people.
29. I really enjoy (or would enjoy) cliff-diving.
30. Deep down, I'm terrified to do things I'm not familiar with.
31. I have a great deal of courage.
32. It's easy to embarrass me.
33. It does not disturb me when I have to do something novel and unfamiliar.
34. I stay away from physical danger as much as I can.
35. I am never as afraid as most other people.

36. In dealing with other people, I always dread making a social blunder.
37. It worries me to go into an unfamiliar situation without knowing all the details.
38. I can shut off my fears and worries whenever I want to.
39. I'm shy.
40. It never worries me to be in a strange new place on my own.
41. I enjoy (or would enjoy) sky-diving.
42. I get scared easily.
43. In challenging situations, I love to be in the "driver's seat."
44. I enjoy doing new things that other people are afraid to do.

Positive and Negative Affect Schedule

Indicate the extent you have felt this way over the past week.

1 = Very slightly or not at all

2 = A little

3 = Moderately

4 = Quite a bit

5 = Extremely

1. Interested

2. Distressed

3. Excited

4. Upset

5. Strong

6. Guilty

7. Scared

8. Hostile

9. Enthusiastic

10. Proud

11. Irritable

12. Alert

13. Ashamed

14. Inspired

15. Nervous

16. Determined

17. Attentive

18. Jittery

19. Active

20. Afraid

Frequency of Sexual Experiences

1. Over the past month, how frequently have you had sex, on average?

0 times per week
1-2 times per week
3-5 times per week
6-7 times per week
8+ times per week

2. Over the past month, how frequently have you masturbated, on average?

0 times per week
1-2 times per week
3-5 times per week
6-7 times per week
8+ times per week

Menstrual Cycle Questionnaire

Please refer to a calendar for assistance with exact dates

1a. What was the FIRST day of menstrual flow for your last period?

MONTH_____DAY_____YEAR_____

1b. How certain are you of this estimate? Please circle one:

1 2 3 4 5 6 7 8 9

Not at all Certain — Completely Certain

2a. What was the FIRST day of the menstrual flow for your period before last?

MONTH_____DAY_____YEAR_____

2b. How certain are you of this estimate? Please circle one:

1 2 3 4 5 6 7 8 9

Not at all Certain — Completely Certain

3a. When do you expect your next menstrual period to start?

MONTH_____DAY_____YEAR_____

3b. How certain are you of this estimate? Please circle one:

1 2 3 4 5 6 7 8 9

Not at all Certain — Completely Certain

4a. What is the usual length of your menstrual cycle? That is, **what is the typical number of DAYS between the <u>first day</u> of menstrual blood flow in one month to the <u>first day</u> of menstrual blood flow in the next month?** Please think carefully about this and provide the most accurate answer you can:

Usual length of menstrual cycle in DAYS: _____

MONTH_____DAY_____YEAR_____

4b. How certain are you of this estimate? Please circle one:

1 2 3 4 5 6 7 8 9

Not at all Certain — Completely Certain

5. Are you currently taking hormonal contraceptives? This includes the birth control pill, patch, ring, (such as the NuvaRing), injection, or hormonal IUD. (Circle one) YES NO

APPENDIX D

NEUTRAL STIMULUS TRANSCRIPT

Sleet lightly patters against the window of the travel agency on this gray January day. There's a cold gust of air as the door swings open. I recognize him immediately. He's a steady customer who likes to book some kind of big trip every year. I greet him cheerfully. I'm glad because this commission may be just what I need. I've accumulated a lot of bills lately. There have been a lot of unplanned expenses because my car is getting old. In addition, my house has required a lot of repair in preparation for the onslaught of cold weather. "Where can I send you this Winter?" I ask expectantly. He says he wants something different. We discuss all inclusive resorts in the Caribbean, but he says he's a little bored with that scene. I suggest two weeks in the Mediterranean, the French Riviera, Southern Italy, or Greece. He looks thoughtful and asks about typical temperatures in February. He's disappointed when I tell him the results of a quick check in the reference book. He says he's looking for something with sun and really warm temperatures. Then I suggest the Pacific. Hawaii or Tahiti, perhaps. That intrigues him and he asks about prices. It takes me several minutes on the computer to get the information about the available airfares and resorts. I'm glad because any trip to the South Pacific will be quite expensive. This may be an excellent commission. However, when I tell him my estimated total, he looks grim and simply says "too much". I don't wanna lose this sale, so I reassure him that we will be able to find something of interest within his budget. Next, I propose that he consider taking a tropical cruise. That does it. He looks over several brochures and picks a premium package. I happily clip a sizeable deposit check to his file, and he cheerfully heads out the door, into the blustery street.

APPENDIX E

CONSENSUAL STIMULUS TRANSCRIPT

It’s nearly dawn. The campground for our company retreat is quiet. We’re walking back to my trailer. I’ve asked him back to my place for a nightcap. He works in another department and I’ve gotten to know him a little. We shared a drink and he has been telling me stories. We walk in silence and he places his hand in mine. Once inside my trailer, he begins kissing me softly. We tumble back onto the couch in an embrace. I feel his gentle hands caress my hair. I savour the caress of his soft hands. Together we snuggle. He kisses me affectionately again. I enjoy the feel of his tongue as it hungrily searches my mouth. As my passion mounts, he grinds his hardening cock against me. Quickly we ease out of our clothes and he begins kissing and licking my entire body. “Yes, yes, yes, please,” I moan. I gasp with delight as he takes my nipples into his warm mouth. My body begins to tremble excitedly as he sucks my hardening nipples. He cups my heaving breasts in his soft hands as he gently tickles each nipple with his tongue. It feels so good. My entire body is tingling with delight. He continues licking and sucking my throbbing nipples while I stroke his thick hair. I moan as he sucks harder. With a groan of passion, he spreads my legs and eases his hard erection deep inside me. I arch my back and feel the delight of his throbbing cock slipping inside me. Together, we begin moving in unison. He fucks with more and more intensity as our embrace reaches a fevered pitch. I enjoy the feel of his strong body as he cradles me in his arms. It feels so good; I’m so excited. Wrapping my legs tightly around him, I gasp as he thrusts deeper inside me. “Yes, yes!” I moan. His tender fingers gently caress my aroused nipples. My breasts are flushed and swollen with desire. Gasping with delight, he thrusts powerfully as he reaches orgasm and we curl up together.

APPENDIX F

NON-SEXUAL VIOLENCE STIMULUS TRANSCRIPT

The dorm room was quiet this weekend. I'm carrying books back to my room. I can see someone at the dark end of the corridor. It's a guy who lives on the same floor as me. I go over to say hello, and he surprises me by sticking out his foot, and tripping me. I glare at him and tell him to get lost. With a quick right foot, he kicks me in the stomach and pounces on top of me. My face stings as he grinds it into the dirty carpet. What the hell is going on? I'm angry and frightened. "Leave me alone" I shout. He screams at me telling me that he's going to beat the shit out of me. Unable to free myself from his grasp, I start to scream. With a growl, he punches me hard in the face. I feel blood run from a gash on my lip. He continues punching me in the head. I beg him "please, stop, please". He ignores me. His violent punches are too much for me, so I curl up into a ball, and try to cover my head. With mounting fury, he stands up and begins kicking me in the side and back. Pain screams into my ribs. Again, I beg him to stop. In spite of my protests, he continues driving his boots into my agonized body. He drags me to my feet and throws me headfirst into a wall. I crumple to the floor, stunned from the pain. Warm, sticky blood drips down my face. He picks me up again and drops me on my head. Another kick thunders into my face. My mouth is full of blood. I'm gagging and retching violently. But he's unconcerned. I'm terrified and want this to end. He continues putting the boots to my tortured body. He grabs my arm and twists it sharply behind my back. I feel dizzy and sick. Sharp pain bites into my jaw as he slams me, face first into the hard floor. With a few last kicks, he walks off, leaving me terrified, weeping and broken on the floor.

APPENDIX G

RAPE STIMULUS TRANSCRIPT

We're walking home at sunrise. We met a few weeks ago and again at tonight's party. I danced with him several times. He entertained us with his jokes. As we reach my door, he presses his face close to me, hoping for a kiss. I'm not interested so I ignore him. He asks for a coffee, but I say I have to work early tomorrow. As I enter the house, he places his foot in the door and he holds me tightly in his arms. "I want to screw," he growls. He begins kissing my cheek and mouth. I gasp and try to push him away but he clamps his lips hard against mine. His tongue forces my lips apart and surges inside my mouth. My eyes are wide open and I'm powerless as he glares at me. I try to tell him to leave but my voice is just a gurgle. I try to resist him and get away. Undaunted, he begins rubbing my body. I struggle to get away, but he's too heavy and strong. "No, go away," I beg. His strong body overpowers me. I struggle desperately but can't get him away from me. Quickly, he hauls my dress up, pulls off my panties, and begins sucking and licking my naked tits. His rough hands massage my breasts. "No, no please stop," I beg him. Although I attempt to roll him off me, I'm helpless and he manages to pull out his hard erection and shove it into me. I can't believe this is happening to me. His cock drives into my cunt. His hungry mouth sucks my squirming body. Again, I beg him to stop. He pumps into me again and again, as I continue to struggle beneath him. His mouth is all over me. I'm disgusted but I'm helpless beneath him. His cock continues to thrust deep inside me. Holding my ass, he pumps into me in strong deep thrusts. His hands cover my mouth as he collapses in orgasm. Disgusted and ashamed, I continue trying to get him off me.

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