

**The Impact of Anticipating Aversive Stimuli on the Sexual Response in Heterosexual  
Women: A Differential Conditioning Paradigm**

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### **Abstract**

This study explores the relationship between pain or disgust and associative learning in the development and persistence of female sexual dysfunction. Motivational priming theory (MPT) is used to explain the cyclical nature of sexual dysfunctions, denoting sexual approach and avoidance behaviours being facilitated by opposing appetitive and defensive motivational systems, respectively. Presumably, the defensive system reduces sexual arousal and response, leading to discomfort or pain (e.g., friction caused by lack of lubrication). This study aims to investigate the impact of anticipating aversive stimulation, specifically pain or disgust, on the sexual response in heterosexual women. Since no data processing has occurred, this thesis will focus on the rationale underlying the methodology. This research employs priming and differential conditioning, utilising a single unconditioned stimulus associated with pain or disgust and two fragments of similar pornographic films as conditioned stimuli. Participants will be deceived to anticipate the aversive stimulus following one pornographic fragment but not the other. However, the unconditioned stimulus will only occur once during the initial priming stage preceding the erotic film presentation. To test our hypotheses, participants' ratings of stimulus-expectancy and sexual arousal following the experimental manipulation, and their ratings of sexual arousal and disgust towards the erotic films preceding the manipulation will be considered. It is hypothesised that an increase in US expectancy will lead to a decrease in sexual arousal and expect this effect to strengthen across trials. This research precedes a comprehensive conditioning project, which incorporates psychophysiological measurements. Methodological choices, limitations, and future directions are discussed.

*Keywords:* female sexual dysfunction, differential conditioning, psychosexology, sexual health, pain, disgust

## Introduction

Sexual satisfaction is a human right. The World Health Organisation (WHO) includes sexual arousal, response, and interest in their definition of sexual satisfaction, denoting the importance of sexual functioning on a physical and psychological level (Sánchez-Fuentes et al., 2014). In their declaration on sexual pleasure, the World Association for Sexual Health (2021, p. 1) underlines the importance of access to enjoyable sexual experiences for all, calling it “part of [the] human experience and subjective well-being”. The impact of our sexual experiences stretches across various life domains, underscoring its’ link to quality of life (Nappi et al., 2016). Female sexual dysfunction (FSD) can have negative personal, sexual, and interpersonal consequences. For instance, provoked vestibulodynia, a disorder involving vulvar pain upon touch (Henzell et al., 2017) has been linked to challenges to one’s sexual experience and identity, doubts about one’s role as a partner, and the relationship’s stability (Bois et al., 2013; Bois et al., 2016). It is thus of paramount importance to study the development, maintenance, and treatment of sexual dysfunctions from an interdisciplinary perspective (Nappi et al., 2016). Despite the cultural variations in the epidemiology surrounding FSD, it is generally highly prevalent with estimates of around 40% of women reporting symptoms related to sexual dysfunction (Basson et al., 2000; Jaafarpour et al., 2013; Nappi et al., 2016). Recent estimates from Germany mention 45.7% of women experiencing sexual problems (Briken et al., 2020). Paradoxically, research has yet to live up to the incidence rates surrounding FSD, leading to a superficial level of knowledge. The notion of pursuing a comprehensive understanding of the mechanisms underlying sexual experience and behaviour is thus not only supported but crucial to improve female sexual health.

According to a narrative review conducted by Brom and colleagues (2014) the appraisal of sexual cues underlying sexual behaviour being a product of associative learning

processes has met broad consensus. Research translating this knowledge into experimental conditioning paradigms (; Both et al., 2008; Both et al., 2017; Pawlowska et al., 2020) has further established a link between associative learning to sexual dysfunctions. The cognitive behavioural model of dyspareunia, for example, points towards the acquired fear of experiencing pain as a driving force in a vicious cycle of experience and expectancy (Both et al., 2017). Experiencing an aversive stimulation, such as pain, during a sexual encounter due to various reasons (e.g., low sexual arousal, overstimulation) can decrease sexual arousal during the present situation, as well as subsequent ones. Anticipating an aversive stimulation can decrease sexual arousal, hindering an adequate sexual response (e.g., vaginal lubrication) which in turn facilitates further discomfort (e.g., friction). Thus, the link between discomfort and sexual experience is reinforced and potentially manifests into an aversive association over time. Pain and disgust have been identified and accepted as contributors to the development and perpetuation of these negative cycles (Borg & de Jong, 2012; Pawlowska et al., 2020; Both et al., 2017; Both et al., 2008). A study by Borg and de Jong (2012) found that women suffering from sexual dysfunctions show increased disgust towards erotic stimuli (e.g., saliva), mitigating their sexual approach behaviour.

The paradoxical relationship between sexual arousal and disgust can be viewed as an evolutionary advantage. Sexual arousal reduces disgust (Borg & de Jong, 2012) and similarly, disgust reduces sexual arousal (Borg et al., 2019). Avoiding bodily fluids commonly associated with sex (e.g., saliva) is on the one hand necessary to maintain health and circumvent disease. Likewise, however, to promote reproductive behaviour, sexual arousal needs to override disgust-related avoidance. Such types of safety behaviours are similarly apparent in the context of pain and sex. For instance, Brauer and colleagues (2007) found sexual arousal being impacted by the degree of pain-related fear. The findings were interpreted as such, that the emotional evaluation of a sexual encounter dictates both the

genital as well as the subjective sexual response. The consideration of personal distress in the context of pain-related sexual dysfunctions supports this notion (Basson et al., 2000; Bois et al., 2013; Bois et al., 2016). While the interaction between sexual arousal and disgust can moderate the maintenance of health, avoidance of disease, and reproduction, the interaction between sexual arousal, pain expectancy, and emotional appraisal may serve as a protective mechanism to avoid harm and injury.

These interpretations are in line with motivational priming theory (MPT), which denotes emotional appraisal of a situation resulting from two competing motivational systems, the defensive and the appetitive system (Williams & Rhudy, 2012). In the context of sexual behaviour, aversive stimuli signalling a threat, such as pain or disgust, would lead to avoidance behaviours and negative affect. Appetitive stimuli on the other hand constitute for example sexually arousing cues (e.g., pleasant physical sensations). The appetitive system then promotes approach behaviours as well as positive affective responses, such as desire or becoming sexually aroused. Relating this theory to the aforementioned suggested mechanisms underlying sexual dysfunctions, the associative pairing of sexual cues and aversive experiences facilitates negative appraisal of sexual stimuli and leads to the activation of the defensive system. Thus, rather than exhibiting signs of sexual arousal (e.g., vaginal lubrication), the individual may for example experience increased pelvic floor muscle activity (Both et al., 2008), hampering sexual activity.

Taking these interactions into account, research aimed at furthering our understanding of sexual dysfunctions such as dyspareunia or vulvodynia has focused on the role of pain or disgust in sexual dysfunctions (Pawlowska et al., 2020; Both et al., 2017; Both et al., 2008). In order to mimic the over-time acquisition of such associations, principles of classical and differential conditioning, as well as MPT, were often integrated into the respective experimental design. Pioneered by physiologist Ivan Pavlov, classical conditioning refers to

the unconscious pairing of an automatic response with a stimulus (Rehman et al., 2022). The individual learns to associate a conditioned stimulus (CS), such as sexual touch, with an unconditioned stimulus (US), such as the experience of pain or disgust. Over time, the individual will begin reacting defensively to cues that are now associated with negative, rather than positive experiences. The respective protective behaviours are then thought to further fuel a cycle of reinforcement through avoidance and negative appraisal (Pawlowska et al., 2020; Both et al., 2017; Both et al., 2008).

The present study precedes an extensive project continuing the investigations of research led by Stephanie Both and colleagues (2008; 2017) and Aleksandra Pawlowska (2020) on the role of pain and disgust in sexual dysfunctions. Although pain and disgust have been investigated separately, combining these constructs within the same paradigm remains to be investigated. This direct comparison of their effect on the subjective sexual response enhances generalisability of research findings and provides clinical and therapeutic implications. In increasing our understanding of different aversive expectations in the sexual context we will ultimately contribute to the identification of therapeutic targets in sexual dysfunctions.

As the upcoming project will build upon the conditioning paradigms applied in these preceding studies, it is crucial to establish comprehensive knowledge of each conditioning phase and consider factors that could moderate the acquired association between sexual cues and an aversive experience. According to Klingelhöfer-Jens and colleagues (2022) and motivational priming theory (Williams & Rhudy, 2012), US expectancy plays an essential role in the acquisition of fear and safety associations. The current design enables us to draw inferences about the effectiveness of US expectancy following priming rather than acquired association by comparing the ratings of sexual arousal following the CS+ and the CS-. Hence, this research will have potential implications for clinical practice and highlight new areas of

research, but it will also support methodological choices in subsequent research using experimental paradigms build on principles of classical conditioning.

Overall, our research aims to investigate the relationship between psychological and physiological processes involved in sexual arousal through expectancy manipulations. In doing so, we hope to be able to attribute changes in sexual arousal in the context of aversive emotional or physical experiences to either priming or association. The present research will enhance the conclusions we will draw from experiments involving conditioning paradigms and studying approaches to extinction. Additionally, our research uniquely studies pain and disgust parallel to each other within the same experimental framework. Our study thus aims to shed light on the mechanisms of FSD and answer the question about the impact of the expectation of negative experiences on subjective sexual arousal in relation to pain and disgust.

Hypothesis I: A higher rating of expectation will coincide with a lower rating of subjective sexual arousal.

Hypothesis II: This negative correlation will increase with each trial within the experimental paradigm, as the expectancy will grow in the subsequent trial upon not experiencing the aversive stimulus in the previous one.

As this is an ongoing and young research project, we do not have enough data to warrant a sufficient analysis. Thus, this thesis will primarily focus on the theoretical background underlying our methodological choices as well as the decisions in which our statistical analysis plan is grounded. The aim is to provide an extensive and detailed explanation of our project to foster subsequent research in this area.

## **Method**

### **Participants**

#### ***Recruitment and Inclusion***

Our participants will be recruited through the Paid Participant Pool of the University of Groningen (general public) and through a first-year psychology student research portal (SONA). They will receive monetary compensation and course credits through participation, respectively. The study will be advertised through these portals and social media, as well as within university facilities. The study is solicited as a project aimed at “measuring the responses to erotic films and experiences of pain and disgust” to avoid any priming effects prior to data collection.

As the erotic material used in this experimental paradigm is of heterosexual nature and depicted penile penetration, a predominantly heterosexual orientation was one of the inclusion criteria (Both et al., 2017). Our definition of a predominantly heterosexual orientation was to primarily have a sexual preference for men. Additionally, the sample will consist of women who were previously sexually active with a partner in line with previous research (Both et al., 2008a; Both et al., 2008b; Jaafarpour et al., 2013), and ambitions to maintain a homogeneous sample. The age range was restricted to 18-45 to include approximately premenopausal women. Common symptoms of menopause-induced hormonal changes include inter alia vulvovaginal atrophy, posing a symptomatic overlap with diagnostic criteria of sexual dysfunctions (Nappi et al., 2016).

In order to maintain a high level of experimental control in eliciting similar levels of sexual arousal we are excluding participants who are pregnant or lactating, experienced sexual problems in the months leading to participation, have an affective or psychotic disorder diagnosis, have a history of drug abuse or a medical illness, or are taking medication that could interfere with their sexual response. The exclusion criteria were selected on grounds of previous research aimed at female sexual dysfunction (Both et al., 2008; Both et al., 2017; Jaafarpour et al., 2013; Pawlowska et al., 2020). Similarly, we noticed large differences in the perception of the electrical stimulation within our research team. Hence, we decided to



exclude those who do not report experiencing the stimulation as painful or aversive if it is set to its highest level. This decision was largely due to the electrical stimulation constituting our experimental conceptualisation of pain, but can also be attributed to a proposed link between peripheral pain sensitivity and sexual arousal (Payne et al., 2013). As research indicates an association between reduced finger sensitivity and reduced sexual desire even in healthy women, including those insensitive to such stimulation might impact the results of our present study.

### ***Sample Size Determination: G\*Power Analysis***

The sample size was determined via an a priori G\*Power analysis (Faul et al., 2007) to reach a power of .80 and an effect size of .25 at  $\alpha = .05$  (Kang et al., 2021). These parameters are based on medium to large effect sizes found in previous research (Pawlowska et al., 2020; Both et al., 2017; Both et al., 2008a). The G\*Power analysis established that the sample size needed to obtain a meaningful result in a repeated-measures 2 (group) x 2 (stimulus) x 10 (trial) mixed ANOVA was 34 per experimental group. The between-group distinction referred to the experimental group “pain” and the experimental group “disgust”. Our intended sample will therefore consist of 68 women.

## **Materials and Laboratory Setup**

### ***Laboratory Setup***

In order to maintain a high level of comfort, the experimental room was furnished with a comfortable chair, carpet, plants, and warm light (see Figure 2, Appendix A). The films are presented full-screen on a flatscreen TV.

### ***Stimuli***

The study employs two conditioned stimuli and one unconditioned stimulus, either associated with pain or disgust. The conditioned stimuli consist of two 8-second pornographic fragments, which have been established as eliciting similarly high levels of sexual arousal and

similarly low levels of sexual disgust in a pilot study conducted within the broader research team. The fragments were selected by members of the research team who share the same demographics as the population of interest. Both fragments show a heterosexual couple engaging in vaginal coitus with the women in a dominant position and are classified as female-friendly (Janssen et al., 2002).

The allocation of the films, which differ in camera angle and actors, to the CSs is counterbalanced among participants and the presentation occurs randomised in four predetermined patterns with a maximum of two successive presentations of the same CS. As the present experiment presents the individual with two conditioned stimuli (CS+, CS-), it employs differential conditioning (American Psychological Association, n.d.). The participant will be informed to expect the aversive stimulus upon presentation of the CS+ (marked with a red frame), while the CS- (marked with a green frame) will never be followed by the aversive stimulus. As there is deception involved, none of the CSs will be followed by the US. Employing differential conditioning poses as a manipulation check to investigate whether the US expectancy in relation to the red frame is rated as expected.

In the pain condition, we employ a 600 ms electro-cutaneous stimulus as the US. By placing electrodes on the skin's surface, here, the participant's middle finger of their non-dominant arm, an electric current elicits a physical, stinging sensation (IGI Global, n.d.). This kind of stimulus is completely safe and has been used in previous research (Both et al., 2017; Both et al., 2008). The intensity of the stimulus is set in accordance with the participant's subjective experience during the priming stage of the experiment. The intensity starts at its minimal level, which is undetectable, and increases until the participant describes a "painful and aversive" sensation. In the disgust condition, the US consists of a 5-second video of a woman throwing up. This fragment has been successfully applied in previous studies conducted by Pawlowska and colleagues (2020). The participant experiences the US only

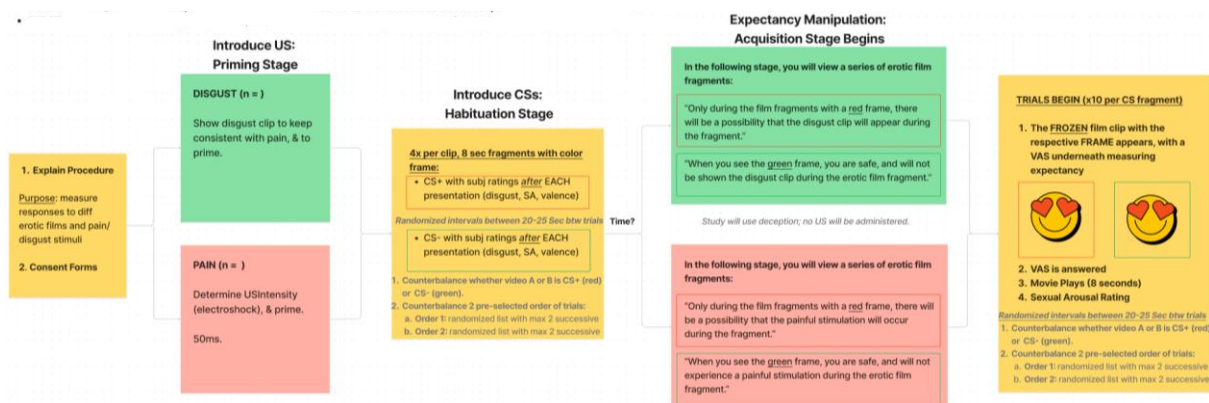
during the priming stage, with the purpose of priming the participant with a pain- or disgust-related expectancy.

## Deception

The study involves both the withholding of information (purpose of the study) as well as deception (expectancy manipulation). To not alter the results, it is necessary to not inform the participant of the true aim of the study. Further, deception will be employed to manipulate the participant's expectancies of the aversive stimulus. Although the participant is told that a red frame indicates the potential occurrence of the aversive stimulus (US), they will only experience these stimuli once during the priming stage. This serves the purpose of priming the participant with a pain- or disgust-related expectancy. Thus, we maintain expectancy as the dependent variable, as we do not install a genuine association. Following the completion of the experiment, the researcher fully debriefs the participant.

**Figure 1**

### Study design



## Study Design

### Procedure

The participants are randomly allocated to the two experimental groups, a pain condition, and a disgust condition, which differ in the unconditioned stimulus (US) used. Upon arrival in the laboratory, a trained researcher explains the procedure of the study to the

participant in detail and shows them the experiment and researcher room as well as the measures taken to ensure their privacy throughout the experiment. The participant is informed that the study aims to measure responses to different erotic films and pain/disgust stimuli. The explanation of the experiment is concluded by signing the informed consent form.

During the priming stage, the participant is introduced to the respective unconditioned stimulus. In the pain condition, this stage features the abovementioned determination of the US intensity. To maintain a similar level of priming, participants in the disgust condition are presented with the disgust film. The subsequent habituation stage introduces the CSs. The participant is presented with four trials. Each trial consists of the respective 8-second fragment which is either framed red (CS+) or green (CS-). Each trial is followed by a subjective rating of disgust and sexual arousal. The intertrial intervals vary between 20-25 seconds and differ across participants in a randomised and counterbalanced manner.

The expectancy manipulation in the trial stage of the experiment informs the participant as follows: “In the following stage, you will view a series of erotic film fragments: Only during the film fragments with a red frame, there will be a possibility that the disgust clip/painful stimulation will appear/occur during the fragment. When you see the green frame, you are safe, and will not experience a painful stimulation during the erotic film fragment.” Following, the participant is presented with 20 trials, each CS fragment being shown ten times. Each trial will begin with a frozen image of the film clip with the respective frame (red/green) and a Visual Analogue Scale (VAS) underneath measuring the expectancy of the US. After the VAS is answered, the respective film plays and the trial ends with a subjective sexual arousal rating. The same randomisation and counterbalancing measures as during the habituation stage is applied to the CS order and the intertrial intervals. The allocation of the films to the CSs stays the same.

### ***Programme***

The survey flow is administered through OpenSesame, a programme developed at the University of Groningen. The programme allows for high experimental control regarding the presentation of the video material. The intertrial intervals vary from 20 to 25 seconds and are randomised and counterbalanced across participants. The videos are displayed in four predetermined combinations, allowing equal display of both film X and Y as the CS+ or CS- and a randomised order of presentation. Modelled after previous research (Both et al., 2008a; Pawlowska et al., 2020), each predetermined sequence includes a maximum of two successive presentations of the same stimulus (e.g., CS-, CS+, CS-, CS-, CS+, ...). Each phase presents the participant with a different order, though the allocation of film X and Y to either CS+ or CS- stays the same in both experimental stages. Such an approach ensures an equally distributed start of each sequence. Employing this level of experimental control over stimulus presentation, allows us to account for personal preferences as well as unintended priming effects.

### ***Measures***

This study features exclusively subjective measures on VAS scales, specifically on Likert scales of 1 (not at all) to 10 (very much). During the habituation stage of the experiment, the participant is asked to rate their disgust and sexual arousal level following each presentation of the erotic film fragments. Taking such variables into account will provide us with information regarding the sexually arousing, as well as disgusting properties of each erotic film. Further, it will allow for comparison with ensuing data points and manipulation checks. In the successive stage, each trial includes a measurement of US expectancy upon being presented with a frozen picture of each film clip in addition to a red or green frame. After indicating their US expectancy, the participant watches the movie and once again, reports on their subjective sexual arousal. We thus measure sexual arousal and disgust during

the first stage (SA1, D) and sexual arousal (SA2) and US expectancy (E) during the second stage.

## **Data Analysis**

### ***Preliminary Analysis and Manipulation Checks***

As part of our data analysis, we will first consider the descriptive statistics of the sexual arousal and disgust ratings collected during the habituation stage of the experiment. The results will inform us whether the erotic films elicit the expected high and low subjective ratings of sexual arousal and disgust, respectively. Comparing the sexual arousal ratings of CS+ and CS- from the final stage of the experiment using a paired sample *t*-test, will allow us to check for the experimental manipulation of framing the erotic fragments either red or green and differentiating between the CSs. In order to check whether the conditioning paradigm functions as intended, we will conduct another paired sample *t*-test to compare the sexual arousal ratings between the habituation and trial stages. These manipulation checks allow us to test whether the US expectancy manipulation is received and the CSs successfully distinguished. All tests will be run two-tailed and at alpha level .05. The conservative approach is most sensible, as we did not hypothesise any specific directions regarding the considered comparisons.

### ***Main Analysis***

Prior to testing our hypotheses, a preliminary correlation analysis between the US expectancy ratings and sexual arousal ratings during the final stage of the experiment will allow us to identify potential linear effects. The results yielded from this information will be easiest to interpret and distribute, and potentially offer clear directions for further statistical analyses. To expand on the correlational evidence, we will conduct a 2 x 2 generalised mixed-model ANOVA and a mixed 2 x 2 x 10 repeated measures ANOVA with the data derived from both experimental groups.

The former is included to test our first hypothesis, while the latter is directed at the second one. To assess for general effects, an omnibus  $F$ -test will be conducted and Cohen's  $d$  will be considered. Doing so in both groups and in both the generalised mixed-model ANOVAs and repeated measures ANOVAs enables provisional comparisons between groups. Consequently, we will test both hypotheses within the experimental groups using the  $F$ -tests and use a comparison of Cohen's  $d$  values to make tentative inferences regarding the differences in the strengths of effects between pain and disgust. This will enable us to determine whether the negative impact of US expectancy on sexual arousal is true in both groups (hypothesis 1) and whether it increases in strength with each trial (hypothesis 2) and does so more intensively within one group or the other.

#### ***Generalised Mixed-model ANOVA***

The collected data can be split into multiple factors, enabling us to conduct a 2 (group) x 2 (CSs) generalised mixed model ANOVA. We will be able to examine the mean differences between the experimental conditions of pain and disgust, constituting the between factors within our ANOVA. The independent variables within this study, namely the allocation of the videos to the respective conditioned stimuli, CS+ or CS-, make up the second factor. As the mixed-model ANOVA is an omnibus test statistic, we will not be able to obtain results indicating each individual effect of the independent variables. Thus, its aim is to provide statistical evidence for a main effect of US expectancy. In doing so, possible interaction effects of US expectancy and pain, and US expectancy and disgust in the respective experimental condition can be identified as well. We will then be able to draw inferences about any observed change in sexual arousal being attributable to an interaction of US expectancy and either pain or disgust. Such a test will enable us to test the first hypothesis of an increase in US expectancy leading to a decrease in sexual arousal.

#### ***Repeated Measures ANOVA***

A more detailed approach would include the number of trials in the second stage of the experiment as a third independent variable with 10 levels. Therefore, a 2 (group) x 2 (conditioned stimulus) x 10 (trial) repeated measures ANOVA will be conducted. This independent variable has a level of 10, as we conduct 10 measurements per conditioned stimulus. In doing so, we can expand on the evidence of the existence of any interaction and main effects, and gain a more comprehensive picture regarding their development. Such a test will enable us to investigate the second hypothesis regarding the increase of the effect of US expectancy on sexual arousal over trials.

The present research design uniquely combines pain and disgust within the same conditional paradigm. The sub-samples are independent of each other, thus an interaction effect between pain and disgust cannot be tested. Nonetheless, it is possible to conduct a preliminary comparison between the effect size values of the mixed-model, as well as the repeated measures ANOVA conducted within the two experimental groups. By comparing the significance values we can tentatively draw conclusions about differences in the strength of the proposed effects in the pain and disgust experimental groups.

### ***Assumptions***

In accordance with general ANOVA assumptions, the dependent variable in our design, sexual arousal, is a continuous ratio variable, and the within-subject independent variables, CS+ or CS- allocation, are categorical. The experimental groups (between-subject variables) are independent of each other. Although we cannot predict any potential outlier yet, we are already making preventative methodological choices such as the exclusion of those who report no pain sensation following the electrical stimulation. Once we have completed data collection we will evaluate the assumptions of Normality, homogeneity, and sphericity through Q-Q plots, Levene's test, and Mauchly's test, respectively.

### **Discussion**



This project's main objective is to deepen our understanding of the impact of anticipating aversive stimuli, specifically painful or disgusting stimuli, on the subjective sexual response. Considering the current status of this project, any data processing was not possible as of yet. Nonetheless, taking the considered theoretical background and previous findings into account, our expectations are as follows. The sexual arousal ratings following the erotic stimuli in the final stage of the experiment are expected to be negatively correlated with the US expectancy ratings. Such findings would confirm the assumptions grounded in motivational priming theory, namely the activation of the defensive, rather than the appetitive system.

Furthermore, following the expectancy manipulation preceding the final experimental stage, we expect the negative effect of US expectancy on sexual arousal ratings to increase with each trial. The participant is assumed to rate the likelihood of a US occurrence higher with each trial, attributable to preceding trials not featuring a US occurrence. However, it is possible that the participant might become aware of the pattern and the experimental deception or grow fatigued throughout the substantial number of trials in this experimental stage. Thus, an alternative result could be that this effect assumes the form of a parabola, opening downward.

### ***Limitations and Strengths***

Ethical considerations present sexuality research with a reoccurring challenge of subjectivity in stimuli effectiveness, and overall generalisability from the artificial laboratory environment to real life. The present research involves the imitation of extreme emotional and physical sensations, namely pain, disgust, and sexual arousal. Beyond the laboratory setting presenting a hurdle, the effectiveness of the stimuli might vary greatly between subjects. Both chosen unconditioned stimuli, vomit video, and electrical stimulation, have been successfully applied in previous research (Pawlowska et al., 2020; Both et al., 2008a; Both et al., 2017).

Nonetheless, the strength of the painful US has been subject to doubt. During piloting and training within the research team, we noticed varied responses to the electrical stimulation, ranging from descriptions of pain to disgust or simply “odd”. Ethically, improvement in this aspect is complicated. Regardless, given the safe nature of the current method of electrical stimulation, subsequent research should consider placing the electrodes in more sensitive locations (e.g., inner arm or thigh).

Individual preferences toward erotic stimuli, whether content or medium, pose a similar challenge. Highly publicised authors Ellen Laan and Stephanie Both (2008) have argued the psychophysiological success of visual erotic stimuli on women. However, their reasoning dates back to the 1990s. Considering the ongoing debate on pornography’s effect on sexual functioning (Böthe et al., 2020), the arousing properties of conventional porn within a research setting should not be overestimated. As of now, the lack of methodological research on erotic stimuli in the experimental context renders the avoidance of such limitation challenging. Nonetheless, in employing women-centered erotic films, which have lesser disgust and more arousal properties for our population of interest (Janssen et al., 2002), and piloting the films within the larger research team, we addressed this foreseeable limitation to our best abilities. Secondly, research on the appraisal of sexual stimuli found identification with the actress being a relevant factor in preference for erotic stimuli (Goldey & van Anders, 2015). Thus, despite the films' similar pilot ratings, one of the featured couples being interracial and the other intraracial is another relevant aspect to consider.

The present research is part of a larger project employing a next-step approach to the exploration of the mechanisms underlying the development and maintenance of FSD. Thus, many of our current limitations can and will be addressed in subsequent research, building on the present methodological implications. For example, the repetitive presentation of the same two pornographic fragments rather than the same film broken into multiple, connected

fragments could potentially result in habituation or fatigue. Displaying non-penetrative sexual acts (e.g., cunnilingus) in a counterbalanced manner that would not interfere with the responses could foster higher levels of sexual arousal and attention to the survey flow. Depending on the statistical analysis in place, such a design could additionally offer information on the effect size of US expectancy on sexual arousal between penetrative and non-penetrative sexual acts.

Lastly, subsequent research will need to measure not only a subjective but also an objective level. The inclusion of psychophysiological measurements will allow insight into potential imbalances in sexual concordance (Bouchard et al., 2017). Subjective indications of sexual arousal could be distorted through discomfort in disclosing aspects of one's sexual experience. Additionally, the laboratory setting and potential of an aversive stimulus could foster feelings of nervousness and general arousal which may be misattributed to sexual arousal. The upcoming psychophysiological conditioning study will enable the differentiation between general and sexual arousal, yielding results of higher relevance.

Our project paves the way for subsequent research and allows for methodological progress surrounding an intimate and sensitive matter. Its strengths lie within the unique combination of pain and disgust in the same experimental paradigm, filling knowledge gaps highlighted in previous studies (Both et al., 2017). The parallel comparison could allow for a more specified and narrow approach to treatment in identifying relevant targets. Another strength is the repeated measurement of US expectancy in addition to sexual arousal as the experiment progresses. Considering the effect of US expectancy on sexual arousal at individual points in time offers valuable implications on the methodological level, e.g. the impact of "bracing oneself" or getting habituated to the sensation. This project specifically benefits from such a design due to its reliance on expectancy and priming rather than acquisition through repeated exposure.

### ***Psychophysiological Conditioning Study***

The present research precedes an extensive study investigating the role of pain and disgust in relation to sexual arousal employing a full conditioning paradigm. While the current study focuses on the acquisition and aims at differentiating priming from association, the upcoming project will attempt to install an association between sexual cues and either pain or disgust through multiple acquisition trials, and subsequently evaluate the success of various methods of extinction. For this purpose, it will include not only ratings of disgust, sexual arousal, and US expectancy, but extensive questionnaires considering sexual functioning and cognition, such as catastrophising. Additionally, we will include psychophysiological measures, specifically skin conductance measures, vaginal photoplethysmography (VPG), and electromyography (EMG) to objectively measure general physical arousal, sexual arousal, and disgust, respectively. Including the concordance of mental and physical sexual arousal (Bouchard et al., 2017) in the interpretation of such data will render the results more reliable. Understanding the apparent interaction of mind and body in FSD (Both & Laan, 2008), will inform future research and clinical practice alike. Especially the inclusion of the extinction stage holds promise for developing treatment programmes.

### ***Implications for Future Research and Clinical Practice***

On the assumption of the successful execution of this research providing us with relevant insights, there are numerous future directions implied. Katy Bois and colleagues highlighted the moderating function of interpersonal factors in the maintenance and treatment of FSDs such as vulvodynia (2016) and provoked vestibulodynia (2013). The larger research project in the context of which the present, as well as upcoming study, takes place, considers the entire cycle of FSDs: development, perpetuation, and treatment. Relevant interpersonal factors would encompass communicative (Mallory, 2022) and affectionate aspects, as well as behavioural reactions to expressions of discomfort. Considering vulvovaginal pain occurring

primarily in relationships including affection, such considerations are crucial (Bois et al., 2013). Future research directed at specifically the development and treatment of FSDs should include factors such as intimacy levels between partners.

Additionally, future research should add functional psychophysiological measures of sexual arousal to the repeated subjective US expectancy ratings. In doing so, the fluctuations in mental and physical sexual arousal could be analysed in light of US expectancy. This inclusion would highlight physiological processes in accordance with cognition and vice versa. Considering the lack of concordance (Bouchard et al., 2017), as well as possible genital arousal automatism in response to sexual cues (Both & Laan, 2008), such research could once again aid in identifying treatment targets (e.g., mental relaxation or lubrication aids).

At this stage, a homogenous sample made up of those primarily impacted by FSD, namely heterosexual women, is crucial to gain a solid foundation of knowledge of the relationships at hand. Nonetheless, the difference between sexual orientations in the likelihood of development of FSD could offer valuable implications for treatment and resistance. Concrete treatment plans are subject to the findings of future research, but it can be assumed that broadening the sexual script could form a starting point that offers sexual intimacy beyond heterosexual sexual scripts. In sum, successive directions for research on FSD comprise the addition of interpersonal factors and psychophysiological measurements, and the broadening towards nonheterosexual populations and scripts.

### **Conclusion**

The present research, though ongoing, holds promise for a nuanced understanding of how expectancy contributes to the acquisition of aversive associations of pain or disgust with sexual arousal. It is hypothesised that an increase in expectancy will lead to a decrease in sexual arousal, in line with motivational priming theory. A second hypothesis states that the negative effect of US expectancy on sexual arousal will increase in strength with each trial,

provided the experimental manipulation and deception are effective. The juxtaposition of pain and disgust can aid the identification of treatment targets, eventually leading to the development of care for those suffering from female sexual dysfunction. The present research precedes an extensive conditioning study including subjective as well as physiological measurements. Gaining insights into the acquisition process, specifically the effectiveness of the methodological choices and manipulation involved in differential conditioning can enhance subsequent research in its methodology and interpretation. Sexual satisfaction and health significantly impact various domains associated with the overall quality of life. Although this research is a step in the right direction, the deficiency in comprehensive knowledge pertaining to female sexual health remains a significant obstacle that deserves and requires increased attention from the scientific community.

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## Appendix A

**Figure 2**

*Laboratory set-up in the Sexual Health Laboratory of the University of Groningen*

