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**Subjective Pain Intensity and Duration of
Hand Immersion in Water During a Cold-
Pressor Test in Sexually Aroused Women
Exposed to Erotic Film Clips**

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Abstract

Introduction. Aiming to inform interventions for genito-pelvic pain/penetration disorder (GPPPD), the present study investigates the effect of sexual arousal on pain intensity and duration of hand immersion in a Cold Pressor Task (CPT) in heterosexual women. An analgesic effect of sexual arousal has previously been found in animal and human studies. Sexual arousal itself could already have the potential to create such a pain-relief. It is hypothesized that both pain measures will be better in both pornographic film conditions and secondly, that the low-disgust condition will have the best effect on pain. *Method.* This study uses three conditions: a previously used original-, a new low-disgust pornographic film, and a neutral train film. A CPT set at 2°C is employed to induce pain. The disgust of participants is assessed for its effect on sexual arousal. One hundred seventy-four female first-year psychology students from the University of Groningen completed the experiment. Six one-way analyses of variance were conducted examining the sexual arousal and disgust manipulations as well as their influence on both pain measures. *Results.* Neither pain measure was influenced by sexual arousal ($p > .05$). Following an exploratory analysis, sexual arousal and disgust were found to have no individual influence on pain. *Discussion.* Overall, the study shows that pornographic films can be used to sexually arouse women, but this arousal did not affect pain measures. Future studies may utilize the findings of this study to inform their own study designs to investigate the analgesic effect of sexual arousal.

Keywords: analgesic effect, GPPPD, sexual arousal, disgust, heterosexual women, Cold Pressor Task (CPT).

Subjective Pain Intensity and Duration of Hand Immersion in Water During a Cold-Pressor Test in Sexually Aroused Women Exposed to Erotic Film Clips

Historically, “hysteria” has been used to disregard women’s pain, with doctors dismissing pain disorders in women as them being mentally unwell (Cleghorn, 2021). Over the years, this view of pain disorders in women started changing, with research being done on the topic, leading to more appropriate treatment. Specifically, the genito-pelvic pain/penetration disorder (GPPPD) has been investigated from a psychological perspective and is nowadays included in the DSM-V as a sexual dysfunction in women. GPPPD is marked by persistent pain during vaginal penetration, accompanied by fear of penetration, and tightening of vaginal muscles (American Psychology Association, 2013). Proposed factors contributing to this disorder are low sexual arousal and experiencing disgust (de Jong, 2010). Thereby, increasing sexual arousal and removing disgust could benefit treatment. Related to this idea, the analgesic effect (pain-reducing) of sexual arousal has been explored (Binik et al., 1999). So far, researchers have found that during sexual arousal, women can experience pain as less intense (Komisaruk & Whipple, 1986; Whipple & Komisaruk, 1985). In a study done on rats, sexual arousal was even presented as similarly potent in reducing pain as morphine (Komisaruk et al., 1976). However, further investigation of this analgesic effect is needed to inform the treatment of pain in women. This study is of interest as it broadens the knowledge of women’s experience of pain during sexual arousal.

The possibility of decreasing pain intensity in women during sexual arousal is fueled by research on animals as well as humans (Komisaruk and Whipple, 1986; Whipple & Komisaruk, 1985). According to Komisaruk and Whipple (1986), pain tolerance was significantly increased in women when reaching orgasm through vaginal stimulation. Without orgasm, the analgesic effect was mainly influenced by pleasurable stimulation of the anterior vaginal wall. Pain was administered by gradually increasing pressure on the fingers on the left

hand (Komisaruk & Whipple, 1986). Generally, the more pleasurable the vaginal self-stimulation is, the more effective the analgesic effect is (Whipple & Komisaruk, 1985). In a separate study, visual imagery was utilized to elicit orgasms in women (Whipple et al., 1992). All ten female participants reported reaching orgasm during the imagery period and a reduction in pain throughout. The potential biological mechanisms of this effect have been studied by using rats since sexual arousal seems to be similar in rats and humans (Komisaruk & Whipple, 2005). Also, an electroencephalogram (EEG) study investigated the mechanism of the analgesic effect of sexual arousal on rats (Komisaruk & Wallman, 1977). They inflicted pain on the rats' tail while vaginally stimulating the animal. The analgesic effect was neurologically evident in activation of the thalamic neurons only when pain and sexual arousal were coupled, but not when pain was inflicted without sexual arousal (Komisaruk & Wallman, 1977). Activation in the thalamus has previously been associated with the neural pathway of pain and for men its activation is also associated with sexual arousal (Kalat, 2016; Koyama et al., 2005; Karama et al., 2002). Another potential mechanism of the analgesic effect explains it as a bodily stress response. Whipple et al.'s (1992) study observed the physiological orgasmic responses of women as involving increased heart rate, respiratory rate, blood pressure, and muscle contractions. These responses resemble a stress reaction of the body; however, they create a pleasurable sensation (Komisaruk & Whipple, 2000). Komisaruk and Whipple (1986) had previously suggested sexual arousal to be a form of eustress (i.e., a positive stress), which relieves pain. In another study, beta-endorphins were noted as being involved in stress responses and in sexual behavior (Pilozzi et al., 2021). Beta-endorphins are an antagonist for opioid receptors (proteins that interact with opioids) and therefore act as a natural painkiller. The similarity in the neuronal pathway for pain and sexual arousal and the potential stress reaction of the body during sexual arousal could explain how the analgesic effect presents biologically. Taken together, the analgesic effect has

been successfully shown in studies allowing for vaginal stimulation and orgasm. Its potential mechanism through endorphins has already been seen in a state of sexual arousal without orgasm. Now, it is worth investigating a pain-relieving effect of sexual arousal in women without vaginal stimulation or orgasm to expand current research.

Despite these positive findings, there is also contradicting evidence about the relationship between sexual arousal and pain. In a study using men and women to investigate this analgesic effect, audio tapes have been implemented to sexually arouse the participants (King & Alexander, 2000). In this study pain was induced using a Cold Pressor Task (CPT). Contrary to their hypothesis, the findings revealed a decrease in pain tolerance among women in the sexual arousal condition. Their study remarks that audio tapes may not be sexually arousing enough to replicate the analgesic effect of previous studies (King & Alexander, 2000). Furthermore, King & Alexander (2000) propose that lower sexual arousal could increase pain sensitivity and decrease pain tolerance. Another study examined the analgesic effect in men and women using a CPT to elicit pain and presenting participants with slides of aversive and pleasant stimuli (Meagher et al., 2001). They found that pain intensity was lowered for men when presented with erotic slides. Both men and women exhibited reduced pain intensity when presented with slides designed to elicit fear and disgust (Meagher et al., 2001). The failure to find the analgesic effect in women in response to erotic pictorial presentation could be accounted for by a difference in sexual arousal potency in men and women (Karama et al., 2002). This difference may result from the complex sexual experience of women, and therefore pictorial erotic display might not be sufficient for high sexual arousal (Chivers et al., 2010). Therefore, investigation of female sexuality should consider stimuli that are sufficiently sexually arousing for women.

Female sexuality is complex, and research has found pornographic content as well as fantasy themes as capable to sexually arouse women and reach orgasm within laboratory

settings (Schauer, 2005; Daskalopoulou & Zanette, 2020; MacLeod, 2021; Whipple et al., 1992). Early feminist movements criticized pornography for its harmful portrayal of aggression toward women (Marques, 2019; Daskalopoulou & Zanette, 2020). In recent times, there has been an increase in pornographic consumption among women, with its content being viewed as sexual liberation, encouraging sexual exploration, and providing inspiration for one's own sex life (Daskalopoulou & Zanette, 2020; MacLeod, 2021). However, the main reasons to consume pornography are to help personal arousal for masturbation, to aid falling asleep, to cope with boredom, and to become aroused for subsequent sex with a partner (MacLeod, 2021; Schauer, 2005). An investigative study of 26 women highlighted their consumption of porn by actively engaging with the content (Marques, 2019). Research further investigated pornography that is supposedly tailored to women by being considered authentic and focused on female pleasure, however, a clear definition of pornography for women is still needed (MacLeod, 2021). Currently, porn films are classified as being consumed by heterosexual women when they entail elements of consensual sex, gay-male porn (two men having sex), and hetero-couple porn (man and woman having sex) (MacLeod, 2021, Schauer, 2005). Evidence has further shown that women's sexual arousal is amplified through consensual, emotional, and erotic sexual displays (Chivers et al., 2010). Overall, pornography has been illustrated as being sexually pleasurable for women (Daskalopoulou & Zanette, 2020, Chivers et al., 2010). Additionally, women can use imagined or real sexual experiences to become aroused through their own fantasies (Tokalidis & Over, 1995). The fantasy themes revealed in research have varied across studies. Often, they include genital and sensual contents, and power dynamics (Meuwissen & Over, 1991; Tokalidis & Over, 1995). Through engaging attentively in sexual fantasies, some women report reaching orgasm without tactile stimulation (Whipple et al., 1992). The study did allow physical stimulation in between the imagery sequences, but orgasm was reached during non-stimulation. Given the findings about

sexual arousal in heterosexual women, the pornographic films used in the current study had to be tested priorly to assess their effectiveness in the laboratory.

Consequently, Lakhsassi (2021) conducted a pilot study comparing two porn films (an original and a new porn) and found both to elicit sexual arousal, but some participants also reported feelings of disgust. The disgust was mainly associated with visible saliva, tongue kisses, male facial expression, fellatio, and finger licking in the low-disgust porn film (Lakhsassi, 2021). Nevertheless, both film clips elicited sexual arousal in participants, with the new porn (later referred to as low-disgust porn) eliciting a higher sexual arousal rating (56.25%) compared to the original porn film (43.75%). The current study adds to research on the analgesic effect of sexual arousal in women by employing a novel approach. Unlike previous studies, it is not using vaginal stimulation and orgasm, but it uses and compares two different pornographic film clips.

The aversive nature of disgust has been proposed as thwarting sexual arousal and thereby interfering with female sexual arousal (Oaten et al., 2009; de Jong et al., 2007). This reduction in sexual arousal increases risk of painful experiences during sexual interaction, such as penetration, due to lack of vaginal lubrication. Therefore, disgust has been proposed as a psychological factor influencing sexual disorders in women (de Jong et al., 2007; DePesa & Cassis, 2017). The feeling of disgust is a strong, aversive, variable, and emotional response that often leads to an avoidance reaction. It is presented to function as a survival mechanism to avoid diseases, pathogens, and immoral behavior (Oaten et al., 2009). In line with the disease-avoidance perspective, it follows to avoid sexual behaviors which include an exchange of bodily fluids (Borg et al., 2018). Since this fluid exchange is generally related to disease transmission, it is highly adaptive to avoid disgust-provoking stimuli (Oaten et al., 2009). Human fluids, such as saliva, can be regarded as disgusting in a non-aroused state. Yet, sexual arousal can overwrite this typical disgust reaction, so that during sexual activities with

one's partner, their saliva is usually not considered disgusting. Sex-related disgusting stimuli, not generally disgusting stimuli, were found to elicit less disgust in men when they are sexually aroused (Stevenson et al., 2009). This was found after showing men erotic pictures of women and couples. In women, sexual arousal can also be powerful enough to overrule the natural disgust and avoidance reaction (Borg & de Jong, 2012). Following the presentation of an erotic film from 1982, women reported less disgust in response to sex-related disgusting stimuli. They also behaviorally approached more of the disgust-eliciting tasks within the study. Borg and de Jong (2021) captured the differential reactions to a sexual stimulus within an approach-avoidance model. It explains that the propensity of a sexual stimulus either leads to a disgust reaction in the individual or to a sexual arousal reaction. Whether sexual approach follows the sexual stimulus depends on which pathway exerts greater power over the individual (Borg & de Jong, 2021). For example, if disgust is the main experience, sexual arousal will decrease (Borg & de Jong, 2021, de Jong et al., 2007). Reasonably, when investigating pain in women during sexual arousal, the stimulus should be sexually appetitive enough for women to overrule potential disgust. Subsequently inferences about subjective sexual arousal without any disgust are reliable despite the absence of a physiological measure.

Two previous studies by Lakhsassi et al. (2022; n.d.) investigated the relationship between subjective sexual arousal in women and pain intensity and pain tolerance. The first study consisted of four conditions: sexual arousal (original pornographic film), general arousal (parkour film), distraction (counting during train film), neutral (train film) (Lakhsassi et al., 2022). During the film presentation, pain was provoked in the participant by use of a CPT containing 4 – 4.3° Celsius cold water. The results did not show a difference in subjective pain level between the four conditions. As a possible explanation, the disgust was proposed to interfere with the sexual arousal of the female participants and therefore attenuating the analgesic effect. Consequently, a second study was conducted by Lakhsassi et

al. (n.d.) in which women were presented with three conditions: sexual arousal (original pornographic film), disgust (vomiting film), and neutral (train film). Pain was induced with a CPT containing 2° Celsius cold water. The results replicate in showing no effect of subjective sexual arousal on pain intensity or pain tolerance. The present study replicates and extends on the previous designs by using the same original erotic film stimulus and the CPT to induce pain. However, a second, low-disgust pornographic film (called “new” in the pilot study) is added, and the potential disgust reactions of the participants will be assessed to control for its effect on sexual arousal.

This study aims to replicate and expand the two previous studies about the effect of subjective sexual arousal on duration of hand immersion in CPT and subjective pain intensity. The potential analgesic effect of sexual arousal on pain is argued to advance interventions for GPPPD in women. It is hypothesized that subjective pain intensity will be lower and duration of hand immersion in CPT will be longer when participants are sexually aroused. Specifically, both sexual arousal conditions will elicit this effect on pain. It is also expected that the low-disgust condition (new pornographic film) will have a stronger effect on reduced pain intensity and length of duration of hand immersion in CPT than the original porn condition. This will inform future research on sexual arousal in women and how it affects their subjective experience of pain.

Method

Participants

The sample was recruited through the online platform SONA for students at the University of Groningen (Appendix A). Participants received one research credit for an introductory course to research methods as compensation for their participation. For eligibility to the experiment, participants had to speak English, be right-handed, and heterosexual. Exclusion criteria included aversion to porn, pain-related conditions, ice-water training,

and/or a sexual dysfunction. After conducting a power analysis, a sample of 159 women were determined for sufficient statistical power. For contingency purposes, the study aimed at collecting data of 180 participants to ensure sufficient power after ruling out potential outliers. The total sample consisted of 174 first-year female psychology students.

Materials and Apparatus

Film Stimuli. To manipulate sexual arousal (SA) of the participants, three different film conditions (original porn, low-disgust porn, neutral) were compared. The participants were instructed to watch their assigned film attentively. The three film conditions are a) a sexually explicit original film clip of a heterosexual couple used in the two previous studies to induce SA (6.01 min), b) a sexually explicit new film clip of a heterosexual couple used in the pilot study to induce SA (5.59 min.), and c) a film clip of a train traveling outdoors through tunnels to induce a neutral state (6.00 min; Lakhsassi et al., 2022; n.d.; Lakhsassi, 2021). The films were presented on a TV measuring 100 inch (90x52 cm).

Cold Pressor Test. Before the experiment began, the skin temperature of the participants' left hand was standardized. Following previous use of a CPT, participants hand temperature was standardized by asking them to place their hand in a container (measuring 39 x 29 cm with a depth of 13 cm) filled with room temperature water (between 29° and 30° Celsius) for one minute (Wang et al., 2019; Clark et al., 2017). The CPT measured 34 x 35.5 cm with a depth of 20 cm approximating to 24 cubic centimeters of water. To induce pain in the participants, this CPT was employed. The apparatus contains water which was cooled down with ice cubes to a temperature of 2° Celsius (Wang et al., 2019). The ice cubes were removed before the participant submerged their hand into the water. An aquarium pump circulates the cold water from the bottom to the top to maintain the temperature at the surface where the hand was placed (guidelines in Appendix B). This ensured that the participant's

hand was in water of 2° Celsius for the experimental duration. All temperatures were checked with thermostats.

Programmed Button. A programmed button on the computer keyboard was used to mark the beginning and end of the CPT. Once the participant's hand touched the water in the CPT, the programmed button was pressed by a research assistant to mark the beginning. The button was pressed again once the participant removes their hand fully which marks the end of the CPT.

Measures

Assessment of SA. To ensure successful manipulation of SA, the participants were asked during the experiment to indicate their subjective level of SA. This was executed with a visual analogue scale (VAS) asking, "How sexually aroused do you feel?" after 1 min 41 seconds of the beginning of their film condition. The scale ranges from *not at all* (0) on the left to *very much* (10) on the right. The participants had eight seconds to answer the question, once they did, the question disappeared and moved on to the next question. This ensured quick reaction by the participant and avoided distraction from the film clip. This question was repeated once the experiment was over.

Assessment of Disgust. The previous studies by Lakhsassi et al. (n.d.) and Lakhsassi (2021) had indicated that the porn films they used elicited disgust in participants. To assess its impact in this study, the participants were asked to respond to the question "How disgusted do you feel?" on a VAS ranging from *not at all* (0) to *very much* (10). Again, they had eight seconds to respond before the question disappears. After answering the question, it disappeared and the instruction to submerge the hand into the CPT appeared. The subjective level of disgust was inquired again after the experiment.

Pain. The intensity of subjectively experienced pain was measured after the CPT. After the CPT, the experiment stops, and the level of pain intensity was inquired. The

question “How intense was the pain you felt?” is rated on a VAS ranging from *not at all* (0) to *very much* (10). Duration of hand immersion in CPT refers to the time participants left their hand in the 2° Celsius cold water of the CPT. The time started at initial submersion of a participant’s hand into the CPT and ended with its full removal.

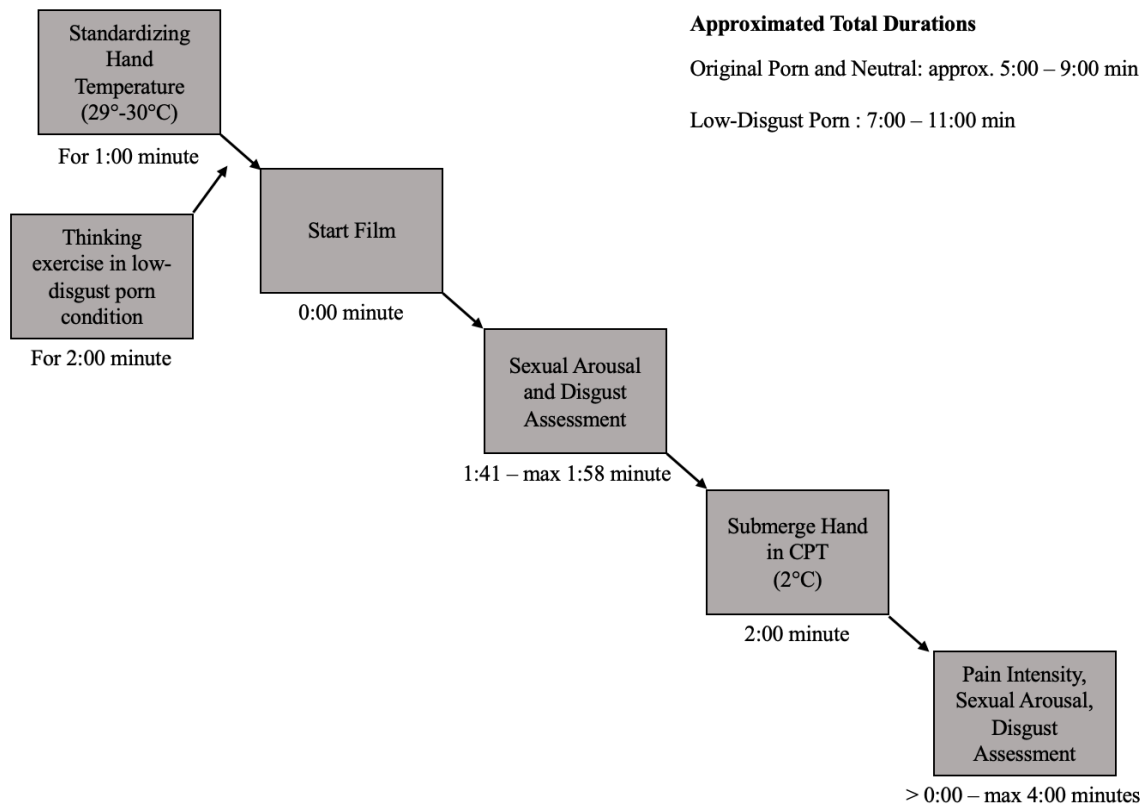
Procedure

Following approval from the Ethical Committee of Psychology (ECP approval code: PSY-2122-S-0422), the study was available for online sign-up. The participants were randomly allocated, based on a maximum occurrence per condition, to one of three film conditions prior to data collection. In the laboratory, two research assistants were always present during testing. All research assistants were women and used a script (Appendix C) to standardize contact with participants. Upon arrival of a participant (one at a time), one researcher greeted and welcomed them into the experiment room while the other researcher remained in the researcher room. The participants confirmed their age, gave their numerical identification, and disinfected their hands. They had time to read the information form (Appendix D) which explained the study to them, but the true hypotheses of the study were concealed. Subsequently they signed the informed consent (Appendix E) if they agreed with the terms. To prepare for the CPT, the participants removed any jewelry and to reduce distraction, left their phone on a desk prepared by the experimenter, in silent mode. Next, they were given a tour of the research set-up. The tour ensured the participant of having privacy during the experiment. For the remainder of the experiment, the participants stayed in the experiment room where they were initially instructed to place their hand in tepid water (29°-30°C) for one minute to standardize the temperature of their left hand. After seating the participant in the chair in front of the TV, and in-between the CPT and the computer mouse, they were informed about their assigned film condition (porn or train). The possibility of a thinking exercise prior to the film was mentioned but not further explained, since the

instructions will appear on the screen in the low-disgust porn film condition. Following, the content of the questions they will be asked during the film, were mentioned. To ensure adequate responding to the VAS, an example: “How much do you like this scale?” was presented. The research assistant demonstrated the use of the scale and asked the participant to rate it from *not at all* to *very much*. Subsequently the participant was instructed to submerge their hand up until the wrist into the CPT as soon as they see the instruction for it on the screen, thereby standardizing everyone’s initial contact with the ice water. They were further instructed to put the hand in the back part of the CPT. Possible questions were clarified, the CPT temperature checked, and the research assistant turned the ceiling light off when leaving the room to signal the participant to start the experiment. The only remaining light was an incandescent table lamp (max. 75W) behind the participant to create a cozy atmosphere during the experiment (photos in Appendix F). Before leaving the room, the participant was instructed to put on headphones for the duration of the experiment.

After the participant pressed “continue” with the mouse on the screen, the experiment started. For the low-disgust porn condition, a two-minute long thinking exercise appeared before the film clip started (experimental instructions in Appendix G). It instructed them to think about a past sexual experience they had enjoyed or to imagine one that they would enjoy. For the other porn and the neutral film conditions, the film started immediately without a thinking exercise. After one minute and 41 seconds, the questions about sexual arousal and disgust appeared at the bottom of the screen in a randomized order. After two minutes, they were instructed to submerge their hand in the CPT, containing 2° Celsius cold water, for as long as they could tolerate or up to maximally four minutes when the film clip and experiment were over. For a visual representation of the time process see Figure 1 below. The participants knew they could remove their hand freely once they could no longer tolerate the discomfort. The water was cooled down by the researchers with ice cubes and checked to ensure the

appropriate temperature for each condition. For the original porn and train film conditions, the temperature upon leaving was at 2° Celsius to ensure the target temperature during the CPT. In the low-disgust porn condition the temperature upon leaving was at 1.94° Celsius because the thinking exercise prior to the film would delay their hand submersion and it would warm up to 2° Celsius when the CPT started. The water pump was turned on during the experiment to ensure a stable temperature at the top of the CPT, where the participant places their hand (Clark et al., 2017; Mitchell et al., 2004). The experiment ended once their hand was removed from the water, or the film finished (approximately 4 minutes). A paper towel was placed next to them to dry their hand, and hand moisturizer was also available for use. Finally, the participants answered an additional question about their experienced pain intensity. They also repeated the sexual arousal and disgust question to see if it changed over the course of the film clip.

Figure 1*Visualization of time process for the conditions*

Note. This figure represents the process of the three conditions. The thinking exercise only applies in the low-disgust porn condition.

Data Analysis

Initially, the data will be explored for missing data. Before assessing the hypotheses, the assumptions of ANOVA will be evaluated using Q-Q plots and histograms to investigate the heterogeneity of the data. Homoscedasticity will be validated using Levene's test.

Manipulation Check. One-way between group analyses of variance (ANOVA) will be conducted to assess the sexual arousal and disgust level of the participants during and after the movie, across conditions, to identify differences in emotional states in response to the three different movies. This will ensure successful manipulation of their emotional states.

Between-group one-way ANOVAs will be performed on subjective pain ratings and duration

of hand immersion in CPT in all conditions to determine if both changed during sexual arousal. In total, six ANOVAs will be analyzed.

Planned Comparison. If significant results are found, planned comparisons of sexual arousal between low-disgust porn vs. original porn, and low-disgust porn vs. neutral film will be conducted. This will test the hypothesis that sexual arousal is stronger in the low-disgust porn condition compared to the original porn and neutral film conditions. Additionally, planned comparisons of the disgust response between the low-disgust porn vs. the original porn, and low-disgust porn vs. neutral film will be completed. This can inform the potential sexual arousal differences in the first comparisons.

Regression Analysis. In case of obtaining non-significant findings, the data will be further explored for specific correlation and regression relationships. Correlations between the measures can indicate potential associations between two measures. Only the low-disgust and original porn conditions will be included in the analysis, not the neutral condition. The first regression analysis will investigate pain intensity as predicted by pre-CPT sexual arousal and disgust jointly and individually. The second regression analysis inspects the effect of pre-CPT sexual arousal and disgust, jointly and individually, on duration of hand immersion in CPT. Two additional regression analyses will be repeated on pain intensity and duration of hand immersion in CPT with the post-CPT measures of sexual arousal and disgust.

Results

Assumptions

Inspection of the histograms for duration of hand immersion in CPT showed a left skew, and for pain intensity the distribution was skewed to the right. Q-Q plots for both duration of hand immersion in CPT and pain intensity showed deviations from normality. Homoscedasticity, assessed by Levene's test, for pain intensity was not violated (Levene's

statistic (2, 171) = .66, $p = .518$). For measuring duration of hand immersion in CPT the Levene's test was violated (Levene's statistic (2, 171) = 6.48, $p = .002$). The emotional measures' homoscedasticity was also violated according to Levene's test and for pre-CPT sexual arousal (Levene's statistic (2, 171) = 31.52, $p < .001$) and disgust (Levene's statistic (2, 171) = 30.80, $p < .001$) and for post-CPT sexual arousal (Levene's statistic (2, 171) = 67.10, $p < .001$) and disgust (Levene's statistic (2, 171) = 46.73, $p < .001$). Univariate ANOVAs will be conducted with the data since this analysis is robust against normality violations (Ghasemi & Zahediasl, 2012, Schmider et al., 2010). Graphs and analyses used for the assumption check can be found in Appendix H.

Missing Data

With a missing values analysis, nine participants with missing data were identified. The missing values occurred for the pre-CPT measures of sexual arousal VAS ($n = 4$) and disgust VAS ($n = 6$). All missed answers happened at random ($X^2(14) = 14.45$, $p = .416$) (Tabachnick & Fidell, 2022). Notably, mainly participants in the original porn (66.67 %) and low-disgust porn conditions (22.22 %) failed to answer the questions during the movie. This might relate to these film clips captivating the participants' attention more than the neutral film clip. Proceeding, the missing values were replaced by imputing the overall means of the conditions (Sterne et al., 2009).

Manipulation Checks

Emotional state induction prior to the CPT

Two one-way ANOVAs were conducted to examine whether the manipulation of emotional states during the experiment and before pain induction were successful. The manipulation of sexual arousal prior to the CPT was significantly different across conditions ($F(2, 167) = 90.63$, $p < .001$). A Tukey post hoc test confirmed specific significant differences between the neutral condition ($M = 4.59$, $SD = 2.34$) compared to the low-disgust

porn ($p < .001$) and original porn condition ($p < .001$). However, the difference was non-significant between the original porn condition ($M = 39.64$, $SD = 2.34$) and the low-disgust porn condition ($M = 45.862$, $SD = 2.34$, $p = .147$). A similar pattern also presents for the disgust during the experiment. There was a significant difference between the conditions ($F(2, 171) = 42.40$, $p < .001$) and according to a post hoc Tukey the neutral condition ($M = 3.72$, $SD = 2.42$) was rated lower on disgust than the low-disgust porn ($M = 22.84$, $SD = 2.42$, $p < .001$) and the original porn condition ($M = 35.03$, $SD = 2.42$, $p < .001$). The low-disgust porn still elicited disgust but significantly less than the original porn condition ($p < .001$).

Emotional state induction after the CPT

Two additional one-way ANOVAs evaluated if emotional state induction was successful throughout the experiment by assessing the subjective ratings of sexual arousal and disgust right after the CPT. The sexual arousal rating was significantly different between all conditions ($F(2, 171) = 82.94$, $p < .001$). Following, a Tukey post hoc test confirmed a difference in sexual arousal between conditions with the low-disgust porn condition scoring significantly higher on sexual arousal ($M = 45.79$, $SD = 2.52$) than the original porn condition ($M = 36.19$, $SD = 2.52$, $p = .021$) and the neutral condition ($M = 2.07$, $SD = 2.52$, $p < .001$), which also had significantly lower scores on sexual arousal compared to the original porn condition ($p < .001$). The second one-way ANOVA showed a significant difference in disgust between the conditions ($F(2, 171) = 31.67$, $p < .001$). The low-disgust porn condition ($M = 24.47$, $SD = 2.88$) had a lower disgust rating than the original porn condition which was non-significant according to Tukey post hoc ($M = 34.02$, $SD = 2.88$, $p = .052$). Further, a Tukey post hoc showed that the neutral condition had the lowest disgust rating ($M = 2.43$, $SD = 2.88$) compared to the original porn condition ($p < .001$) and the low-disgust porn condition ($p < .001$) which were significantly different.

Hypothesis Testing

Influence of Sexual Arousal & Disgust on Pain

Pain intensity and duration of hand immersion in CPT was investigated across conditions with two one-way ANOVAs. Pain intensity did not differ significantly between the conditions ($F(2, 171) = 1.27, p = .761, \text{partial } \eta^2 = .003$) and neither did duration of hand immersion in CPT ($F(2, 171) = 1.62, p = .202, \text{partial } \eta^2 = .019$). This outcome was contrary to the first hypothesis of the study.

Despite the insignificant difference between conditions on pain intensity, there was a minimally higher experience of pain for the participants in the original porn condition (see Figure 1 below). For duration of hand immersion in CPT the indication of lower duration is slightly seen in the original porn condition (see Figure 2 below). Based on the non-significance of the study's results, the predicted hypotheses were not supported statistically.

Figure 1

Means of Pain Intensity for the Three Conditions

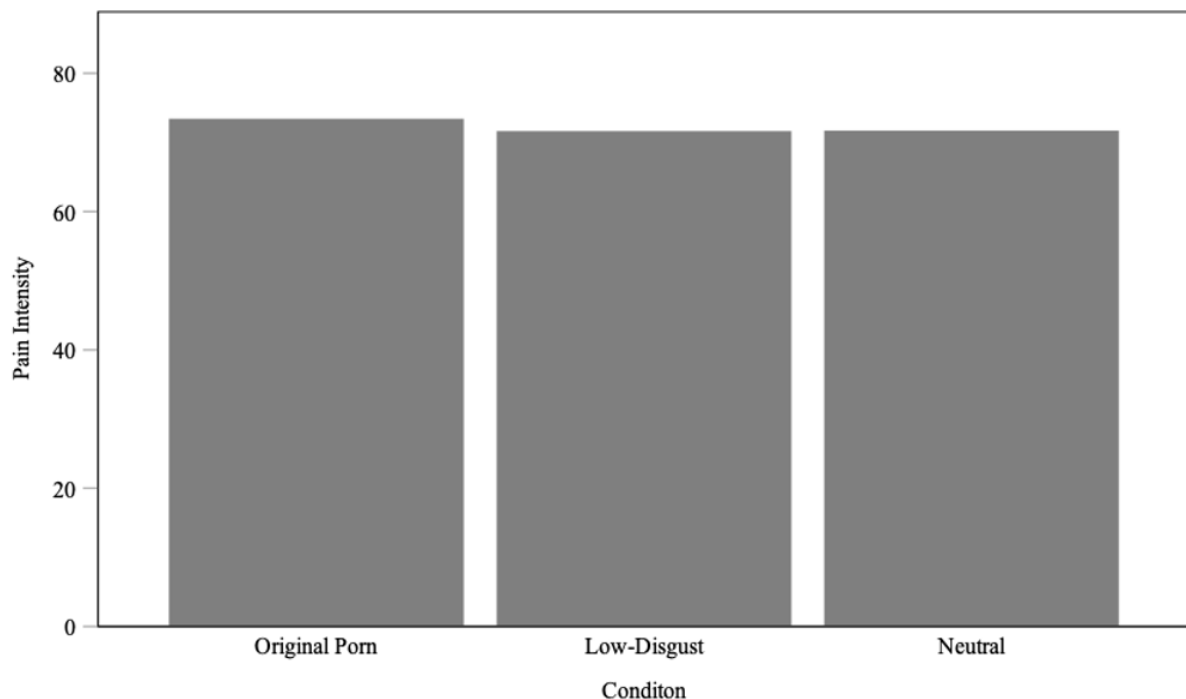
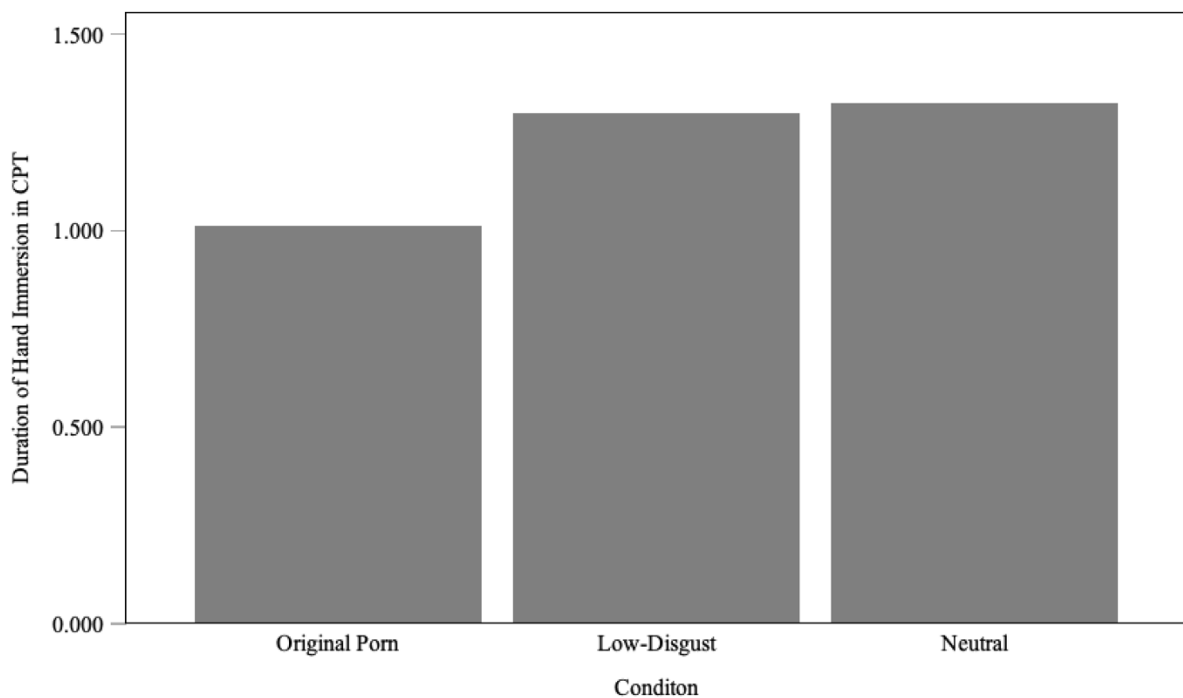


Figure 2***Means of Duration of Hand Immersion in CPT for the Three Conditions*****Exploratory Analysis*****Assumptions of Multiple Regression***

The lack of meaningful results from the main analysis prompted an explorative analysis to test how much the sexual arousal and disgust measures could explain both pain intensity and duration of hand immersion in CPT respectively. Multiple regressions were carried out to see if there is a significant relationship of either sexual arousal or disgust pre- and post- CPT on pain intensity and duration of hand immersion in CPT in only the two porn conditions. Initially, the assumptions for regression analysis were inspected. Normality is slightly violated for measures of pain intensity and strongly violated for duration of hand immersion in CPT. Homogeneity was violated for all measures. The analysis was carried out nevertheless since multicollinearity, assessed with variance inflation factor (VIF) was met across all measures ($VIF < 10$) and this assumption is crucial to perform a regression analysis.

Violations of normality and homogeneity can be tolerated by this analysis (Tabachnick & Fidell, 2022; Ernst & Albers, 2016).

Subjective Pain Intensity

Table 1 below includes the correlational relationship of sexual arousal, disgust, and subjective pain intensity. Significant relationships were found between duration of hand immersion in CPT and subjective pain intensity (Pearson's $r = -.28, p = .002$), between the pre-CPT and post-CPT sexual arousal measures (Pearson's $r = .78, p < .001$), and disgust measures (Pearson's $r = -.86, p < .001$). There was a significant negative correlation between pre-CPT disgust and sexual arousal (Pearson's $r = -.20, p = .033$) and post-CPT disgust and sexual arousal (Pearson's $r = -.24, p = .010$). Additionally, the correlational relationship between pre-CPT disgust and post-CPT sexual arousal was significant (Pearson's $r = -.27, p = .003$).

A multiple regression analysis found that neither sexual arousal nor disgust could explain the variance in pain intensity for the pre-CPT measures ($F(2, 113) = .51, p = .604, R^2_{\text{Adjusted}} = -.009$). Furthermore, sexual arousal without disgust did not have an independent relationship with subjective pain ($Beta = 0.067, t(116) = .70, p = .483$), and neither did disgust individually ($Beta = 0.08, t(116) = .85, p = .400$). A second multiple regression analysis included the post-CPT measures on subjective pain intensity. Again, sexual arousal and disgust together did not significantly explain the variance in pain ($F(2, 113) = .52, p = .596, R^2_{\text{Adjusted}} = -.008$). There was also no discrete relationship with pain intensity for sexual arousal ($Beta = 0.011, t(116) = .12, p = .909$) nor disgust ($Beta = 0.10, t(116) = 1.01, p = .314$). The two regression analyses were repeated without the outliers that were previously determined based on their values exceeding 1.5 times the interquartile range. Their removal did not change the outcome of the analysis much and it was still non-significant.

Duration of Hand Immersion in CPT

The correlational relationships for sexual arousal, disgust, and duration of hand immersion in CPT can be found below in Table 1. The only significant relationships that were found were between pain intensity and duration of hand immersion in CPT (Pearson's $r = -.28, p = .002$), and the pre- and post-CPT measures of sexual arousal (Pearson's $r = .78, p < .001$) and disgust (Pearson's $r = -.86, p < .001$), respectively.

For duration of hand immersion in CPT, regression analyses were conducted, again, including sexual arousal and disgust pre- and post-CPT. The regression for pre-CPT was not significant ($F(2, 113) = .13, p = .877, R^2_{\text{Adjusted}} = -.015$), meaning that the variance in duration of hand immersion in CPT was not explained by sexual arousal and disgust measures prior to the CPT. The individual relationships between duration of hand immersion in CPT and sexual arousal ($Beta = 0.001, t(116) = .01, p = .995$) as well as disgust ($Beta = -0.05, t(116) = -.50, p = .618$) was also not significant. In the second regression analysis with the VAS scores on emotional states post-CPT, there was also no significant result. The explanation in the measure of duration of hand immersion in CPT variance through the assessed emotional states of sexual arousal and disgust was not significant ($F(2, 113) = .09, p = .911, R^2_{\text{Adjusted}} = -.016$). There were again no significant explanations found in the individual associations of duration of hand immersion in CPT with sexual arousal ($Beta = -.04, t(116) = -.40, p = .698$) nor with disgust ($Beta = -.03, t(116) = -.27, p = .785$). Repeating the analysis without the outliers still resulted in non-significant results.

Table 1***Correlations of Emotion and Pain Measures***

		Pre-CPT			Post-CPT		
		Pain Intensity	Duration in CPT	Sexual Arousal	Disgust	Sexual Arousal	Disgust
Pain Intensity		1					
Duration in CPT		-.283**	1				
		[.002]					
Pre-CPT	Sexual Arousal	.051	.010	1			
		[.585]	[.914]				
	Disgust	.067	-.048	-.198**	1		
		[.472]	[.608]	[.033]			
Post-CPT	Sexual Arousal	-.012	-.031	.782**	-	1	
		[.897]	[.739]	[.001]	.272**		
					[.003]		
	Disgust	.095	-.017	-.116	.864**	-.239	1
		[.311]	[.852]	[.214]	[.001]	[.010]	

Note. The table depicts the correlations with the significance values below. Correlations that are significant at the 0.01 level (2-tailed) are denoted by ** and those significant at the 0.05 level (2-tailed) are denoted by *.

Discussion

The purpose of this study was to investigate if sexual arousal can decrease pain intensity and prolong duration of hand immersion in CPT (analgesic effect) and to replicate and advance previous studies conducted by Lakhsassi et al. (2022; n.d.). The analgesic effect of sexual arousal in women was previously found in studies using self-stimulating methods (Komisaruk & Whipple, 1986; Whipple et al., 1992). Here, sexual arousal modulated their experience to be less painful. This effect can inform psychological interventions for women with GPPPD since higher sexual arousal might alleviate the pain experience of women with this disorder (de Jong et al., 2010). In this study, the first hypothesis assumed that pain intensity and duration of hand immersion in CPT would be better in both porn conditions compared to the neutral condition. In line with the previous studies by Lakhsassi (2022; n.d.), the disgust of participants during and after the movie conditions was assessed because disgust can interfere with the sexual arousal of women (Borg et al, 2018; de Jong et al., 2010). If the film clip stimuli elicit disgust in participants, this might hamper sexual arousal which can interfere with the analgesic effect of sexual arousal. For the second hypothesis, the low-disgust porn condition was expected to have the highest sexual arousal ratings and the lowest disgust ratings of all three conditions and thereby the overall strongest effect on both pain measures. Neither of the hypotheses of this study were statistically supported.

Concluding, the results found (i) no difference in pain intensity or duration of hand immersion in CPT across the three conditions. (ii) Sexual arousal was present in both porn conditions and non-significantly higher in the low-disgust porn condition. Additionally, (iii) disgust was recorded in both porn conditions with the highest disgust ratings in the original porn condition.

Effect on Pain Measures

Concluding, this study supports research showing subjective assessment of sexual arousal as insufficient in finding an analgesic effect in women (Meagher et al., 2001). The first hypothesis, that pain intensity and duration of hand immersion in CPT would be better in the porn conditions, was not supported. Pain intensity, as well as duration of hand immersion in CPT, did not differ among participants and across conditions. There was no lower subjective pain intensity in either of the two porn conditions compared to the neutral condition, and neither was there a longer duration of hand immersion in CPT in the porn conditions. The second hypothesis, that the low-disgust porn film condition would elicit the best effect on the pain measures, was not supported either. Overall, there was no effect of sexual arousal on any pain measure in any condition.

This failure to find the analgesic effect could be explained by the pornographic films not being sufficiently arousing for women and genital stimulation may be necessary (Meagher et al., 2001; Karama et al., 2002; Chivers et al., 2010). Even though increased sexual arousal was found in the porn conditions, it might have been insufficient to produce a sexually induced analgesic effect. Previous research investigating this analgesic effect allowed direct vaginal stimulation, orgasm, and personal imagination exercises to induce sexual arousal during pain (Komisaruk & Whipple, 1986; Whipple et al., 1992). The studies did not report the level of sexual arousal they achieved. Nonetheless, their induction method of sexual arousal could be more effective than the use of pornographic films in this study to find a pain-relieving effect. Sexual arousal often co-occurs with the physical touch of erogenous zones, which intensifies the experience (MacLeod, 2021). Using such methods of arousal induction could be necessary to achieve sufficient excitement within women to lessen the experience of pain.

Prior to the low-disgust porn condition, a thinking exercise of two minutes was included to increase sexual arousal. The exercise instructed participants to think of an enjoyable past sexual experience to prime them for subsequent sexual arousal. Priming has been utilized in many studies and has been shown to work by activating associated behavior (Dai et al., 2023). Previous research on female sexuality used imagination and self-stimulation to induce orgasms in women while others highlighted the influence of imagination itself in women's sexual experience (Whipple et al., 1992; Tokatlidis & Over, 1995). Therefore, the thinking exercise in this study might have attenuated the effect of sexual arousal in the low-disgust pornographic content, which was rated most arousing ($M > 45$). A thinking exercise was not added prior to the original porn clip since it had already been shown to be less potent in sexually arousing participants (Lakhsassi et al., n.d.). However, none of the participants reported engaging in the exercise. This failure could be explained by the exercise being rather short (2 min). A study investigating a causal model of sexual arousal and fantasy used a guided imagination exercise which lasted five minutes (Green & Mosher, 1985). They reported successful induction of sexual arousal in their participants. Additionally, the current study did not use guided imagery, unlike Green and Mosher (1985), but instructed the exercise through text. This could also have been suboptimal for its successful implementation.

Using pornographic content in scientific studies is associated with both positive and negative aspects. For one, being in a laboratory can reassure the participants that the situation is safe if they feel uncomfortable during exposure to the material (e.g., film clips) (Lewandowski & Siemer, 2021). Unfortunately, it hinders private interaction with the content since a laboratory is more public. Natural behaviors such as stopping, rewinding, or forwarding the film, changing the film, or masturbating is not possible in a laboratory setting used in the present study which hinders full engagement (Lewandowski & Siemer, 2021). Moreover, Marques (2019) notes that women have an ambivalent relationship with

pornography. They engage with it on a sexual level but may still deem the content as problematic in its objectifying portrayal of women and lack of focus on female pleasure (MacLeod, 2021; Neville, 2015). This could distract them cognitively and emotionally from engaging with pornographic content sexually. If this occurred in the present study, it may have hampered sexual arousal. Moreover, low sexual arousal can magnify painful experiences (King & Alexander, 2000)

Further, Komisaruk and Whipple (1986) and Whipple et al.'s (1992) studies inflicted pain in participants by putting pressure on their fingers. This method of pain induction may be more suitable for investigating the arousal-induced analgesic effect than the CPT used in this study because pain tolerance scores were much higher in these studies.

Emotional Manipulation

Two pornographic film clips were presented to sexually arouse participants. Subsequent analysis of sexual arousal confirmed successful induction for both porn films compared to the neutral condition. Specifically, before the CPT the low-disgust porn film ($M > 45$) had the highest overall rating on subjective sexual arousal, followed by the original porn film ($M > 39$) and the neutral film ($M > 4$) elicited almost no sexual arousal. This pattern repeated for the assessment after the CPT: low-disgust porn ($M > 45$), original porn ($M > 35$), neutral ($M > 2$). The minor recording of sexual arousal during the train film may have occurred because the participants were primed by the description of the study (Parker & Sjöden, 2010). This insight supports the choice of using pornographic film clips to sexually arouse women in a laboratory setting.

Since disgust is a strong emotional response of the body which can hinder sexual arousal, it was assessed for each participant in this study (Borg et al., 2018; Oaten et al., 2009). Considering disgust in this study can inform whether sexual arousal might have been influenced by this emotion. In line with the pilot study on the porn films, the disgust ratings in

the current study prior to the CPT were highest for the original porn condition ($M > 35$) compared to the low-disgust porn ($M > 22$) and neutral condition ($M > 3$; Lakhsassi, 2021). This gradation repeats for the disgust measure after the CPT: original porn ($M > 34$), low-disgust porn ($M > 24$), neutral ($M > 2$). This validates the usefulness of the low-disgust porn film shown in this study since it induces less disgust in heterosexual women in a laboratory setting. Unexpectedly, the lowered disgust was only associated with a minor elevation in sexual arousal for the low-disgust porn. This could be in line with the approach-avoidance model where either disgust or sexual approach behavior can follow a sexual stimulus, based on their respective intensity (Borg & de Jong, 2021). In this study, it might indicate that the disgust experienced during the film presentation had an impeding effect on sexual arousal. Thereby, the pathway of avoidance of the sexual stimulus and a decrease in sexual arousal would follow. To increase sexual arousal, pornographic films which elicit less, or no disgust would be helpful.

Strengths and Limitations

This study had several limitations. Firstly, the sample was recruited from one cohort out of convenience, which means that only female psychology students in their first year at the University of Groningen were used. This sample is unrepresentative of clinical populations who may suffer from a pain disorder. Nevertheless, this study aimed at replicating two previous studies, thereby the current sample helped optimizing the design by not changing critical points. Secondly, the programmed buttons used to track duration of hand immersion in CPT were manually pressed by the research assistants which leaves opportunity for human error. The assistants did not always press accurately, potentially leading to inaccurate measures of duration times in the CPT measure. This can lead to inaccurate recordings of the duration of hand immersion in CPT measure. Having said this, the research

assistants worked as conscientiously as possible, and no alternative for this recording could be provided.

Future research might also benefit from previously piloting the CPT measure for their specific population since Mitchell et al. (2004) note that studies using CPTs have previously differed substantially in their methodology. This includes whether they used circulation during the CPT as well as temperature, age, and gender. Within this study a pump for circulation, cooling it down to 2°C, and standardizing hand temperatures prior CPT have been incorporated already (Mitchell et al., 2004; Clark et al., 2017; Lakhsassi et al., 2022). Nevertheless, the used population has not been piloted to establish the optimal temperature for female undergraduate students in the Netherlands. Additionally, participants' initial duration of hand immersion in CPT and pain experience might differ based on other unaccounted factors, such as individual differences in pain perception. A study by Crawford et al. (2023) advises researchers who investigate pain modulatory paradigms, such as a CPT, to consider individual differences in pain perception prior to the experiment. Unfortunately, such a thorough assessment would have been beyond the scope of the current study, and it remained as much of the original design of Lakhsassi et al (2020; n.d.) as possible for appropriate replication.

Contrary to the initial plan of this study, there was no objective measure of sexual arousal. Measuring sexual arousal objectively by using a vaginal photoplethysmography (VPP) could bring more accurate assessment of genital sexual arousal additionally to the subjective sexual arousal (Sawatsky et al., 2021). Unfortunately, the VPP could not be delivered and installed in time for the experiment. But assessing both sexual arousal and disgust subjectively can be a good alternative to accurately evaluate sexual arousal. Furthermore, sexual arousal in this study was measured using the VAS, which was only presented for a short time. This could interfere with accurate responses because of time

pressure and distractions due to the film clip. Some participants reported that they could not respond in time. Contrarily, the fast pace might capture the participants state emotion more accurately. Lastly, using pornographic films in research can be challenging. The initial motivation for seeking out pornographic films is often associated with behaviors of masturbation or subsequent sexual interaction with a partner (MacLeod, 2021). However, these motivational incentives are not given in this experimental setting which could affect motivation to consume pornographic films actively. Future research might therefore consider including the opportunity for masturbation in their study design to motivate sexual interaction with pornographic content.

Conclusion

This study shows the usefulness of two pornographic film clips in eliciting sexual arousal in women. However, hypotheses could not be confirmed. Pain intensity did not decrease, and duration of hand immersion in CPT did not increase under sexually aroused conditions. No significant difference was found between the two film clip conditions. This may be due to persistent disgust induced by both films and/or insufficient sexual arousal without direct stimulation for the analgesic effect. Future research can add to the findings by using an objective measure of sexual arousal, find pornography that is highly arousing for women to watch, and then investigate the analgesic effect with a CPT.

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Appendix A

Recruitment Text on SONA

Study Name

PSY-2122-S-0422 Porn & Pain

Study Type

Standard (lab) study

This is a standard lab study. To participate, sign up, and go to the specified location at the chosen time.

Study Status

Visible to participants : Approved

Active study : Appears on list of available studies

Duration

20 minutes

SONA Credits¹ SONA Credits

AbstractThe 'Porn and Pain' research team would like to invite FEMALE participants (18+) who are predominantly HETEROSEXUAL and right-handed to participate in our study examining the relationship between sexual arousal and pain

Description

You will be asked to:

- (1) watch a film clip (either a Porn film or a Neutral Train film); the assigned film clip will be randomized.
- (2) respond to questions about your emotions on a visual analogue scale on two separate occasions.
- (3) place your hand in a cold pressor (i.e., ice-cold water at 2 degrees Celsius) and leave it in for as long as you can tolerate.

The study will take place in the basement area of the Heymans building, room -149.

Eligibility Requirements

English-speaking

Must NOT have:

- aversion to porn,
- ice-water bath training
- pain-related conditions (chronic pain)
- a sexual dysfunction (vaginismus, dyspareunia, troubles achieving sexual arousal/orgasm)

Preparation: Please make sure to take a corona self-test (also available at the Heymans building reception) before arriving to your appointment. Please email us to reschedule if you have any flu-like symptoms.

Appendix B

Guidelines for the Research Assistants in the Laboratory

WHEN YOU ARE FIRST IN THE MORNING SHIFT:

- Room 149: TV screen on first
- Room 151: turn on electricity + drop your stuff.
- Room 171: ice maker on + prep CPT; start early so u can let the ice melt fully.
 - Make sure it's filled to the top for participant.
- Room 149: turn on computers and set the tasks.
- T.1 = right. T.2 = left (use for tepid tub too).

[10MIN PREP-TIME] CHECKLIST BEFORE PARTICIPANT ENTERS :

- Script person: I took a picture of the registrations for the day + have my cell phone.
 - Conditions are there too as a reminder of which temp I'm aiming for.
- Location of CPT & mouse is appropriate & reachable in target area.
- We have enough paper towels & they are in place.
- Trash bin is emptied.
- Headphones & mouse sanitized.
- There are enough information forms + consent forms, and they are in the right position
- A pen is available
- Turn off Aquarium pump when not necessary to have it on.
- Ensure living room doors closed-ish so participant can't see inside
- FIX THE TEMPERATURES (see below!)

WHEN PARTICIPANT IS READING INFO FORM:

- TEPID TUB: @ 30 degrees
- CPT (N + OP): 1.88 degrees □ LEAVE COOLER IN.
- CPT (FF): 1.82 degrees [whatever thermometer jumps to before 1.88] □ LEAVE COOLER IN.

WHEN PARTICIPANT HAND IN TUB:

- TEPID TUB: @ 29 degrees

BEFORE YOU LEAVE:

- CPT (N + OP): 2 degrees □ REMOVE COOLER
- CPT (FF): 1.94 degrees □ REMOVE COOLER

~~~~~

**Your Partner goes to the info form area only after being introduced.**

Act as an assistant.

#### **End of Day:**

- Clean up
  - empty trash bin
  - clean the CPT & tepid water baths with soap & sponge.
  - turn everything off. Electricity button off.
- Check if we need more of something
  - More info forms?
  - More lotion?

- More paper towels?
- More ice? (at LEAST 9 bags of ice ready before the next day.)
- Turn off ice-maker.
- Upload ALL participant DATA onto the Drive.



## Appendix C

### Script for Researchers Assistants

#### *Participant Enters...*

Welcome, thanks for coming to our study. ☺ [be friendly!]

My name is \_\_\_\_\_. You can place your jacket/bag on this chair if you like, and you can have a seat right over here.

- I'd like to first confirm that you are **18 or above the age of 18?**
- Great, and may I have your SONA/PPP number to confirm the booking?
- Lastly, I'd like to ask you to please **sanitize** your hands before we begin.

#### **Perfect, thank you.**

Alright, so here you have the information form which will tell you a about what you can expect from this experiment.

- Please read through it very carefully, and let me know if you have any questions.
- You can then read the consent form over here and sign it if you agree with the terms and would still like to participate in the study.
- OK? Let me know when you're ready! 😊

[Use this time to check on both water baths]

Use T.2 for Tepid Tub, and leave T.1 in the CPT closest to participant.

#### Collect information & consent forms...

All set? Thank you!

- OK, so before we begin, are you wearing a watch or any jewellery on your hands? []
  - Please **remove your watch** and your **jewellery**; and you can place them over here. This is to make sure nothing gets wet during the experiment.
  - I'd also like to ask that you leave your cell phone out here; can you please make sure it is on silent mode? Thank you.

#### Give them a tour...

- Before we begin, I'd like to give you a tour of our research set-up.
  - My colleague and I will be sitting in this room over here (follow me).
    - This is \_\_\_\_\_.
    - As you've read in the information form, we have a camera facing the cold pressor (as you can see on the screen). This camera is a live-feed only, so it does not record anything, it will only show your hand and nothing else.
    - This is all we see on our side, everything else remains private on your side.
- You can follow me back to the experiment room [*enter 'living room'*].
- So this is where you will be during the experiment.
  - Before I explain the procedure, I'd like to have you start by placing your left hand in this water for 1 minute. **Just give me one moment before you begin...**
    1. **Use Spatula**
    2. **NOTE the Tub temperature before they start** ☐ tell partner.

3. **Start timer**
    - OK, go ahead! - This is just to standardize the hand temperature.
  1. *While you wait, start the aquarium pump to check you're @ target. Then turn back off.*
  2. *Place thermometer back into the CPT.*
    - Ok, you can dry your hands,
    - and you can have a seat on this chair.
- **Please make sure NOT to touch the water at any point** before you see the instruction ON THE SCREEN to place your hand in the water. All clear?
  - OK, so you have been assigned to view the [PORN or Train ride] film.
  - **I will now explain the experimental step by step.**
    - You will be sitting in this room on your own to ensure privacy.
    - Once I leave the room, please follow the instructions on the screen.
      - You may or may not be asked to follow a thinking exercise. If so, you will receive instructions for this on the screen.
    - Next, your assigned film will begin to play. Please focus all your attention on the movie.
    - After a few minutes, you will have two questions that pop up on the screen about your emotions. For example, you'll be asked to rate on a scale your level of sexual arousal and level of disgust, no matter which film you are watching.
    - **\*\*\*The questions will appear on a scale like this one, where you will be asked to rate your answer from not at all (on the left) to very much (on the right).**
      - You have a few seconds to hover the mouse over the scale like this, but once you click, the question will move on, and you can no longer change your answer. This is meant to be quick as to not distract you from the film too much. So, please make sure you click where you intend to, and try to answer before it disappears.
      - **OK, so you can try it out now and answer the question on the screen. [don't press continue yet].\*\*\***
    - Now the question doesn't disappear right now, but if the movie is playing, it will disappear after you click and move onto the next question or instruction.
    - All scales & instructions during the movie will show here, at the bottom of the screen.
    - Once you've answered both questions, you will see an instruction on the screen to place your hand in the water and leave it in for as long as you can tolerate.
      - **As soon as you see this instruction**, please submerge your hand fully in the water up until your wrist [*show visually; location*], all in one go; so not in and out with your fingers, just put your whole hand in in one go. Then rest your arm comfortably over the armrest and continue watching the film.
      - Also, please make sure that your hand goes in in *this area here* [*show location*]
      - Once you can no longer tolerate it, remove your hand, dry it with this paper towel, and answer the remaining questions on the screen.

- This is the camera that I mentioned earlier; it's for us to see when you put your hand in and when you remove it.
- That's it! Is everything clear? No questions? [answer Q's / summarize if need be]
- Perfect.
  - So you can roll up your sleeve and rest your arms comfortably on the arm rests so you can easily reach the mouse and the water.
  - Please wear the headphones over here.
  - I will turn off the lights, and once I leave the room, you can press 'continue' to begin the experiment.

### **Checklist before leaving:**

- Aquarium pump is turned on.
- CPT is at target temperature with 2 thermometers in place.
  - No ice cubes/coolers in the CPT
- Lamp is turned on.
- Turn off room light before you leave.

### **Post Experiment**

Thanks so much!

- Did everything go alright? [take notes if anything unusual]
- And just for our notes, have you ever participated in a similar version of this study?
- Great, well thank you, and have a nice day! 😊

~~~~~  
Check on ice maker every 2

Appendix D

INFORMATION ABOUT THE RESEARCH

Version for participants

“Pain & Porn”

PSY-2122-S-0422

Dear Participant: Welcome, and thank you for your interest in participating in our research! In this study, we are interested in finding out how sexual arousal might influence the experience of pain. We are inviting healthy female (18+) volunteers who identify as mostly heterosexual to participate in our experiment.

Our study will be conducted by 1 Ph.D. candidate (Lara Lakhsassi) and 5 Psychology Master students (Veronike Bunte, Betty-Charlotte Kay, Valeria Osorio Remy, Leonie van Jaarsveld, and Merith Baan) from the University of Groningen, supervised by dr. Charmaine Borg and Prof. Peter de Jong. The research is evaluated by the Ethical Committee of Psychology at the University of Groningen.

Do I have to participate in this research?

Participation in the research is voluntary. However, your consent is needed. Therefore, please read this information carefully. Ask all the questions you might have, for example because you do not understand something. Only afterwards you decide if you want to participate. If you decide not to participate, you do not need to explain why, and there will be no negative consequences for you. You have this right at all times, including after you have consented to participate in the research.

What do we ask of you during the research?

Before we begin the experiment, you will be asked for your written consent to voluntarily participate. Next, we will explain the experimental procedure to you step by step.

During the experiment, you will be left alone in the room and instructed by the screen to think about a specific memory. Following this, you will watch one of three film clips (Porn Clip A, Porn Clip B, or a film of a train riding along the tracks); the assigned film clip will be randomized. During the movie, you will be asked to rate different emotions you might feel using a visual analogue scale; please respond to these as quickly as possible. Afterwards, you will receive an instruction for when to place your hand in the cold pressor (i.e., ice cold water); once you begin, you are asked to leave your hand in for as long as you can tolerate. There will be a camera facing the cold pressor that will allow the researcher to see and time the duration between when the hand was first placed in

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THE INFLUENCE OF SEXUAL AROUSAL ON PAIN

the water and when it was removed. To guarantee privacy, the camera will show NOTHING else besides the hand in the cold pressor, and will NOT record any material. Once the movie clip has ended, you will be asked to rate your level of pain

on a scale, as well as rate different emotions you might have felt while watching the movie clip on a scale.

The experiment as a whole will last up to ~20 minutes (including set-up and instructions). Once you are finished, you can exit the room and let the researcher know.

During the experiment, you may experience slight physical or personal discomfort due to the cold water or due to the nature/content of the movie clip. We would like to remind you that you are free to withdraw your participation without ANY consequences at any stage during the trial.

Once the experiment has been completed you will receive your SONA credits as compensation (or money for the paid participant pool)!

How will we treat your data?

The data collected will be processed for academic and educational purposes only. It will be collected electronically during a psychology laboratory setting at the University of Groningen by the researchers involved in the study. All participants will be assigned a participation code to ensure confidentiality, and the assignment to the three trial groups will be random.

What else do you need to know?

You may always ask questions about the research: now, during the research, and after the end of the research. You can do so by speaking with one of the researchers present, or by emailing (c.borg@rug.nl)

Do you have questions/concerns about your rights as a research participant or about the conduct of the research? You may also contact the Ethics Committee of the Faculty of Behavioural and Social Sciences of the University of Groningen: ec-bss@rug.nl.

Do you have questions or concerns regarding the handling of your personal data? You may also contact the University of Groningen Data Protection Officer: privacy@rug.nl.

As a research participant, you have the right to a copy of this research information.

Appendix E

Informed Consent for Participants

INFORMED CONSENT

“PORN AND PAIN”

PSY-2122-S-0422

- I have read the information about the research. I have had enough opportunity to ask questions about it.
- I understand what the research is about, what is being asked of me, which consequences participation can have, how my data will be handled, and what my rights as a participant are.
- I understand that participation in the research is voluntary. I myself choose to participate. I can stop participating at any moment. If I stop, I do not need to explain why. Stopping will have no negative consequences for me.
- I confirm that I meet the eligibility requirements.

I confirm that (please leave blank if you do not agree):

- I am 18 years old or above
- I identify as mostly heterosexual (i.e., sexual preference for men)
- I do not have a sexual dysfunction (e.g., vaginismus, pain during sex, problems achieving sexual arousal or orgasm)
- I do not have medical problems involving pain (e.g., chronic pain)
- I do not have a strong aversion to pornography
- I do not participate in cold water training exercises (e.g., regular ice water bathing)
- I am right-handed

- Below I indicate what I am consenting to.

Consent to participate in the research:

- Yes, I consent to participate.
- No, I do not consent to participate

Consent to processing my personal data:

- Yes, I consent to the processing of my personal data as mentioned in the research information. I know that until 10-02-2023 I can ask to have my data withdrawn and erased. I can also ask for this if I decide to stop participating in the research.
- No, I do not consent to the processing of my personal data.

Participant's full name:	Participant's signature:	Date:
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Full name of researcher present:	Researcher's signature:	Date:
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The researcher declares that the participant has received extensive information about the research.

Appendix F

Experimenter Room Set-Up – Photos

Figure 1

Lab Setting while Playing Low-Disgust Porn



Note. Laboratory at Heymans Building at University of Groningen; picture by B. C. Kay.

Figure 2

Lab Setting with Cozy Light



Note. Laboratory at Heymans Building at University of Groningen; picture by B. C. Kay.

Figure 3

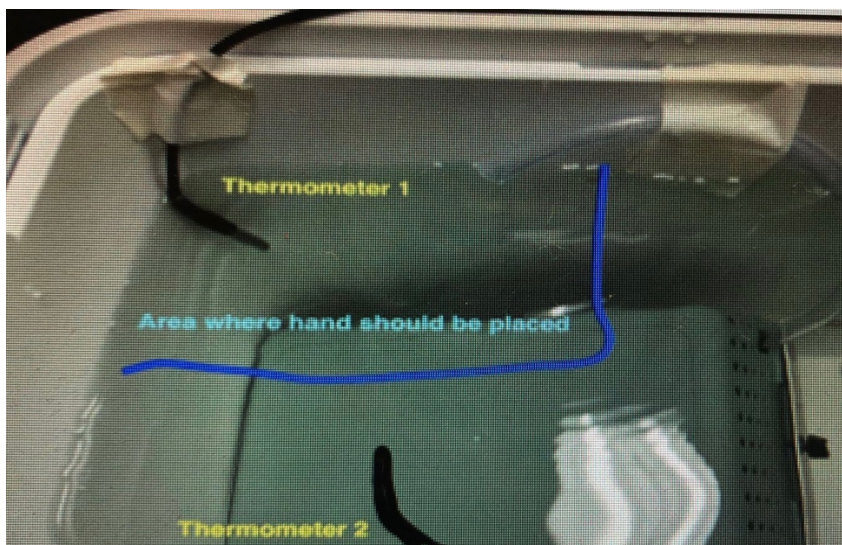
Laboratory Setting of the Tepid Water on the Table Behind the Chair



Note. Laboratory at Heymans Building at University of Groningen; picture by B. C. Kay.

Figure 4

Cold Pressor Task Instructions for Set-Up



Note. Laboratory at Heymans Building at University of Groningen; picture by L. Lakhsassi.

Appendix G

Experimental Task: Screen

Replication #3 Task: E-prime

There are 3 conditions/films:

- SEX 1 (same film as last year)
- SEX 2 (new film, attached below)
- NEUTRAL (same film as last year)

Random assignment to a condition (the participant cannot know/see which condition until they start the experiment)

The participant can practice the mouse & VAS on the screen. "Do you like this scale?".

Standard: 0 = (not at all) – 10 = (very strongly).

Begin the experiment.

In the SEX2 CONDITION ONLY, the screen begins with a dark background, white font.

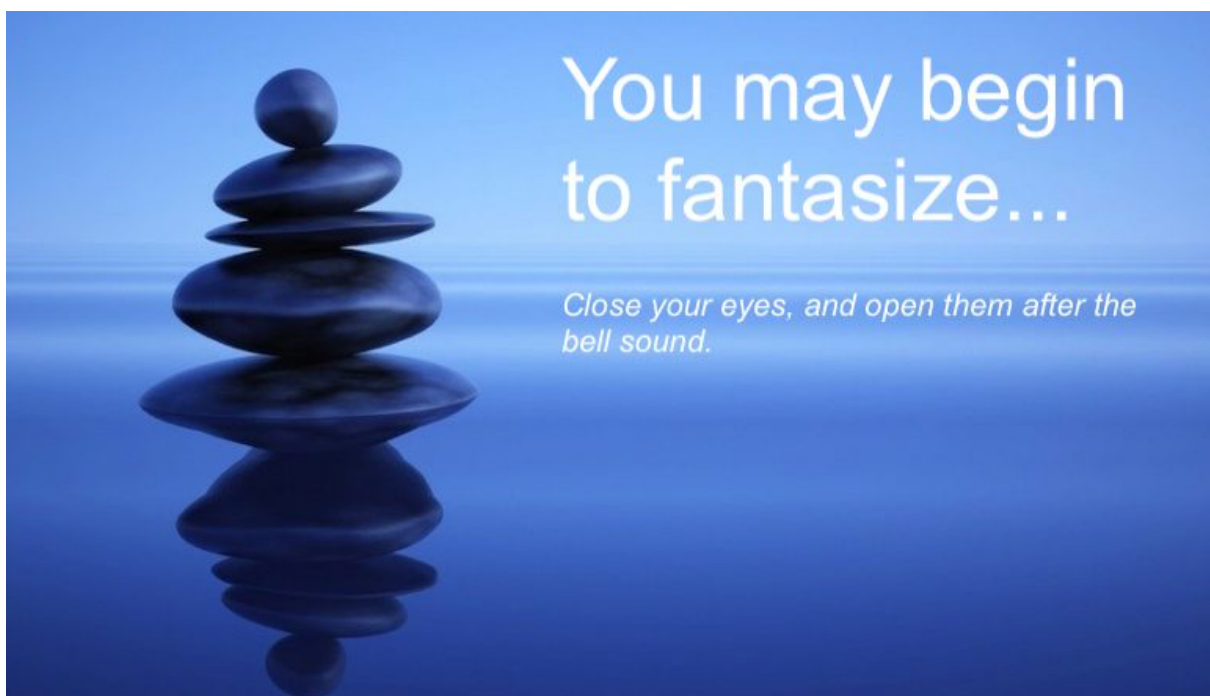
**You have been assigned the thinking exercise.
Please read the instructions below & press 'continue' to begin.**

For the following period, we ask that you close your eyes & think about a past sexual experience that you had found enjoyable and pleasurable, and let yourself fantasize about this experience.

If you do not have such a memory, please think about a sexual fantasy that you would enjoy if it were to occur.

Once you hear the bell sound, you may stop and open your eyes.
Press 'Continue' to begin with your fantasy exercise.

Then, for 2-minutes, show the image attached below on the screen [picture below].



When the minute is over, a bell sound to notify them to open their eyes.

Manip Check Question #1:

Did you successfully manage to think about a sexual memory or fantasy?

- Mouse options:
 - Yes, I managed to have some erotic thoughts within this minute.
 - No, I did not manage to have any erotic thoughts whatsoever.

NEXT, the screen will say; dark screen, white font:

"You will now begin watching your assigned film. Please focus all your attention on the film, and follow the prompts on the screen when they show up."

Press 'Continue' to begin start watching the film.

The movies begin to play...

After a 1min41 → VAS #1: "how sexually aroused do you feel?" (8 seconds MAX answering time)

1 second pause, and immediately moves onto next question

After answering (latest @ 1min50) → VAS scale #2: "how disgusted do you feel?" (8 seconds MAX)

After 2min (always) → VAS #1: "Place your hand in the water and leave it in for as long as you can tolerate." (5 seconds lasting on screen)

Movies end after 4 minutes (or after stop button), followed by 4 more pages below:

"Lift your hand out of the water, and answer the question *before drying your hand.*"

Then, press 'Continue'.

1. How intense was the pain you felt? 0 = (no pain at all), 10 = (very intense pain)

You may now dry your hand & answer the remaining questions.

Press 'Continue' to move onto the next question.

2. How sexually aroused did you feel during the experiment? 0 = (not at all) – 10 = (very strongly)

3. How disgusted did you feel during the experiment? 0 = (not at all) – 10 = (very strongly)

Thank you, you have reached the end of the experiment.

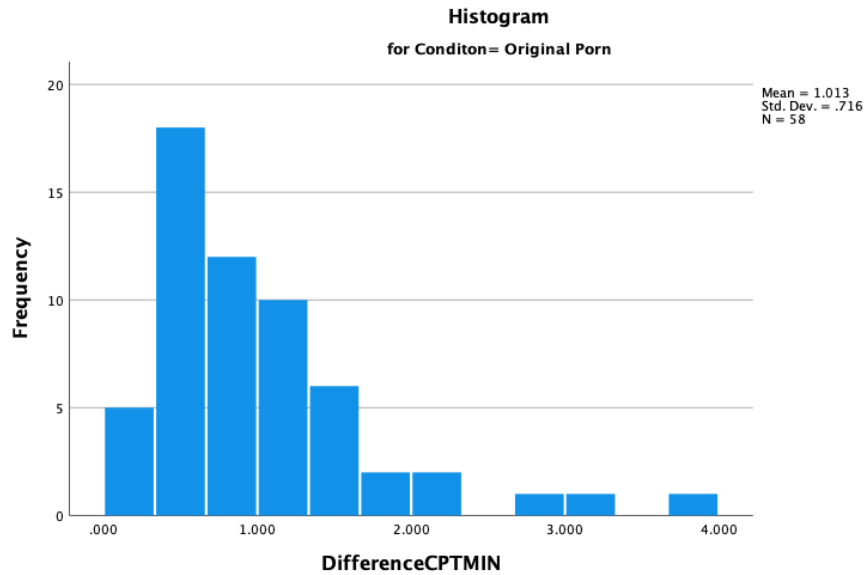
If you wish, please help yourself to some hand lotion on the table behind you, and when you are ready, please knock on the researcher's door (room -151) and let them know you are finished.

Appendix H

Assumption Check of Normality of Pain Measures

Graph 1

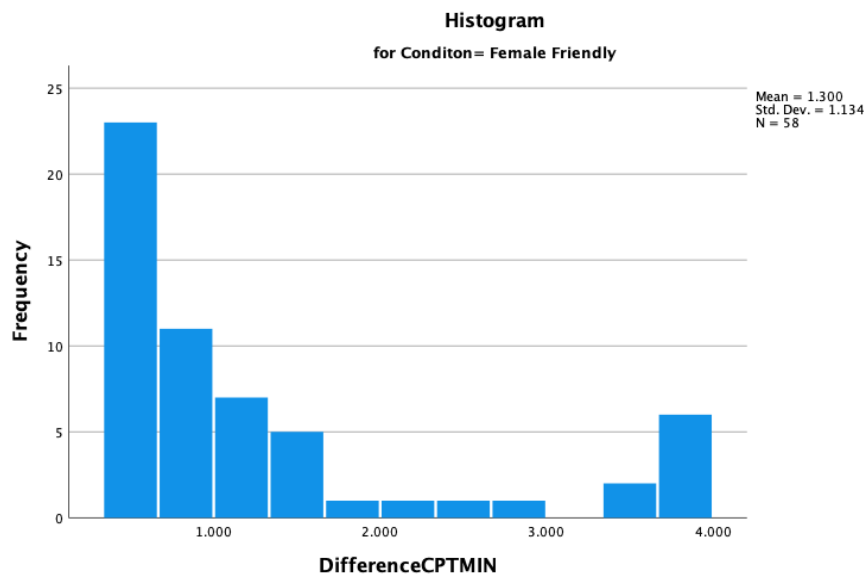
Histogram of Duration of Hand Immersion in CPT in Original Porn



Note. Left skewed distribution.

Graph 2

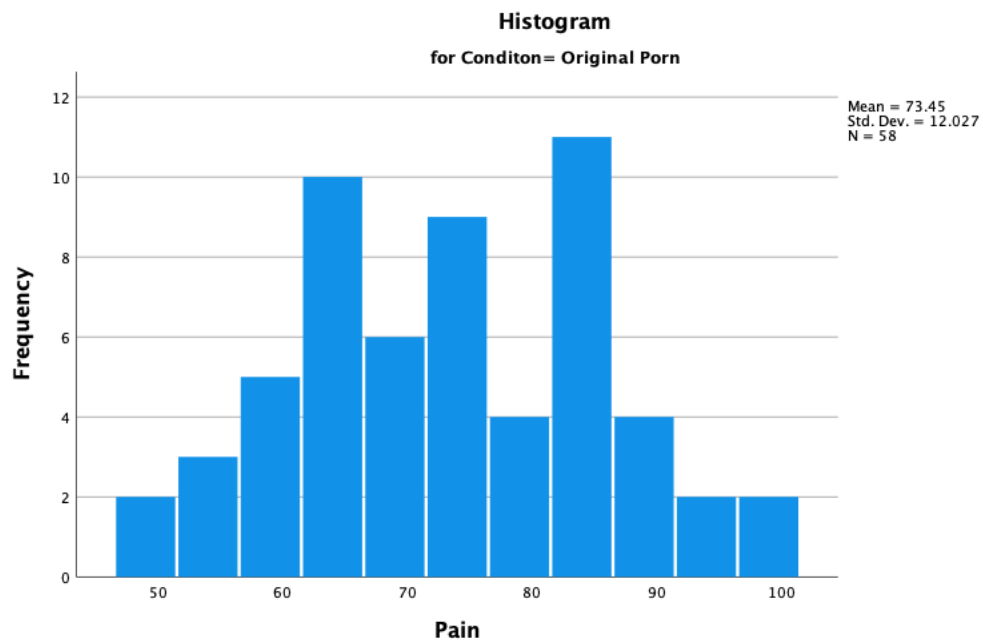
Histogram of Duration of Hand Immersion in CPT in Low-Disgust Porn



Note. Left skewed distribution. Female friendly porn aka low-disgust porn.

Graph 3

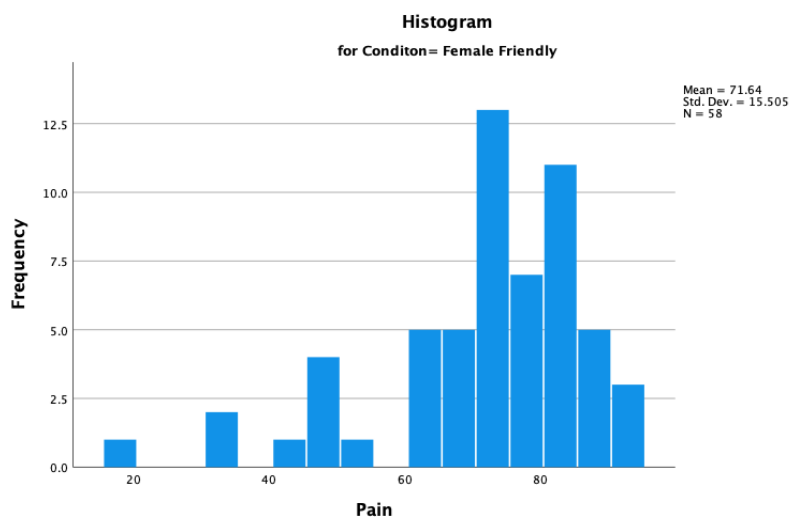
Histogram of Pain Intensity in Original Porn



Note. Approximately normal distribution.

Graph 4

Histogram of Pain Intensity in Female-Friendly Porn



Note. Right skewed distribution.

Table 1*Levene's Test for Duration of Hand Immersion in CPT**Levene's Test of Equality of Error Variances^{a,b}*

		Levene	df1	df2	Sig.
		Statistic			
DifferenceCPTM IN	Based on Mean	6.479	2	171	.002
	Based on Median	2.627	2	171	.075
	Based on Median and with adjusted df	2.627	2	148.058	.076
	Based on trimmed mean	5.380	2	171	.005

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: DifferenceCPTMIN

b. Design: Intercept + Conditon

Table 2*Levene's Test for Pain Intensity**Levene's Test of Equality of Error Variances^{a,b}*

		Levene	df1	df2	Sig.
		Statistic			
Pain	Based on Mean	.660	2	171	.518
	Based on Median	.438	2	171	.646
	Based on Median and with adjusted df	.438	2	146.532	.646
	Based on trimmed mean	.505	2	171	.605

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: Pain

b. Design: Intercept + Conditon