



Sexual arousal and pain: The influence of sexual
arousal on subjective pain intensity and pain
tolerance during a cold pressor test in women

Veronika Bunte

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Department of Psychology
University of Groningen
Examiner/Daily supervisor:
Charmaine Borg/ Lara Lakhsassi

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Abstract

Introduction. Research has shown that orgasm and vaginal self-stimulation can reduce pain. However, research regarding the question if sexual arousal on its own has a similar effect is contradicting. Therefore, the current aims to clear up these contradicting results by investigating if whether sexual arousal without self-stimulation moderates pain tolerance and pain intensity while controlling for disgust. *Method.* One-hundred and seventy-four heterosexual female first year students were randomly assigned to either the neutral, the female-friendly or the original porn condition. While watching either the neutral film or one of the two pornographic films, the participants performed a cold pressor task which was used to induce pain. Furthermore, subjective sexual arousal, disgust and pain intensity were measured via visual analogue scales. *Results.* Sexual arousal was sufficiently induced in the original and female-friendly condition compared to the neutral condition. However, the results indicate that sexual arousal did not significantly reduce pain intensity and did not significantly increase pain tolerance. *Conclusion.* The study results do not support the hypothesis that sexual arousal on its own without self-stimulation is sufficient in moderating pain intensity and pain tolerance

Keywords. sexual arousal, pain intensity, pain tolerance, cold pressor task, women

Sexual arousal and pain: The influence of sexual arousal on subjective pain intensity and pain tolerance during a cold pressor test in women

“Nothing treats period pain quite like an orgasm-it’s science” Coates (2021)

In line with this headline, scientific evidence has shown that orgasm can reduce pain and several studies have found a reduced response to pain in response to vaginal stimulation (VS) in (Komisaruk & Whipple, 1986; Melles et al., 2018; Szechtman et al., 1981; Whipple & Komisaruk, 1988).

A possible explanation for this reduction in response to pain was proposed by Whipple et al. (1992). The authors proposed that the female body responds to sexual arousal and orgasm with a stress response through increased sympathetic nervous system activation. The activation leads to an increased heart rate, systolic blood pressure and an increase in pupil diameter. This stress response leads to an increase in beta-endorphins which are the body’s natural opiates that can reduce pain and lead to a state of analgesia (Khajehei & Behroozpour, 2018; Komisaruk & Whipple, 2000; Pillozzi et al., 2020).

More recent research has focused on the role of sexual arousal without self-stimulation and its influence on pain perception. On the one hand, there is evidence that low sexual arousal might lead to increased pain. For example, research has shown that women with superficial dyspareunia, a disorder where intercourse is experienced as painful (American Psychological Association, 2023), experience lower sexual arousal while watching erotic films compared to healthy females (Brauer et al., 2007; Brauer et al., 2009). This research provides some evidence that low sexual arousal might be a possible explanation for pain during intercourse. On the other hand, there is research in support of the idea that high sexual arousal might lead to a decrease in pain. King and Alexander (2000) showed in their study that in men, higher sexual arousal was associated with an increase in pain tolerance and pain threshold. In women, however, higher pain sensitivity was associated with

weaker sexual motivation and lower enjoyment while listening to sexual audio. However, there is evidence that contradicts the findings that sexual arousal decreases pain. Lakhsassi et al. (2022) investigated the role of sexual arousal and pain. Their study had healthy female participants assigned to either the sexual arousal, the general arousal, the distraction, or the neutral condition. The general arousal condition and distraction condition were included to see if sexual arousal has a more significant impact on pain perception due to evidence showing that distraction and emotions can reduce pain (Hodes et al., 1990; Meagher et al., 2001). Participants watched a film corresponding to their assigned condition while performing a cold pressor task (CPT), which involved participants submerging a hand in cold water. They found out that sexual arousal did not reduce pain and that neither generalized arousal nor distraction resulted in a more substantial analgesic effect than the neutral condition. In the feedback they received from the participant, it became apparent that the sexual arousal film might have induced disgust and not sexual arousal which might have influenced sexual arousal.

Disgust has been shown to reduce sexual arousal (Borg et al., 2022; Grauvogl et al., 2015) and, in some cases, even increase pain sensitivity (Meagher et al., 2001; Oaten et al., 2015; Rhudy et al., 2008). The reduction in sexual arousal found in these studies can possibly be explained by the information-processing model of sexual arousal (de Witte et al., 2011; Grauvogl et al., 2015). This model suggests that when a sexual stimulus captures a person's attention, the sexual system becomes activated and appraises the stimulus as either positive or negative. If the stimulus is positively evaluated, sexual arousal and sexual motivation to approach are increased. If the stimulus is negatively appraised because it might be seen as disgusting or painful, attention is diminished, and inhibition and avoidance behaviour is increased. When sexual arousal increases, it can act as an inhibitory factor for disgust and increases approach behaviour. However, when disgust is perceived as too prominent, it can

inhibit sexual arousal (Borg & de Jong, 2017). Taken together, it might be the case that the pornographic film used by Lakhsassi et al. (2022) induced disgust, which led to avoidance behaviour and increased pain sensitivity and decreased sexual arousal. This decrease in sexual arousal and increase in disgust counteracted the pain-decreasing effect of sexual arousal.

A not-yet-published follow-up study by Lakhsassi (2023) was conducted to investigate if disgust influences pain and if the used pornographic film elicits disgust and sexual arousal. Results indicated no significant difference in pain perception between the disgust, sexual arousal, and the neutral condition. Furthermore, results showed that the pornographic film used induced disgust alongside sexual arousal. Additionally, in the sexual arousal condition, participants reported lower sexual arousal than in the first study that was conducted by Lakhsassi (2022). There are several possible explanations for these findings. First, the lower sexual arousal found in this study might be due to the fact that participants were informed that they might be assigned to watch a disgusting film. Due to this, they might have been primed with disgust which might have reduced sexual arousal (Fleischman et al., 2015), thus counteracting the pain-decreasing effect of sexual arousal. An explanation for the disgust that was induced alongside sexual arousal might be that the pornographic film used was not a female-friendly version. Man-made pornographic films have been shown to produce more negative feelings like shame, guilt, and aversion than the female-friendly version (Laan et al., 1994) since they focus less on female pleasure, agency, and consent than the female-friendly versions (Sun et al., 2008). Therefore, a pornographic film focusing more on female pleasure, agency and consent might induce less aversion and increase sexual arousal.

To test if a more female friendly pornographic film reduces pain, the present study aims to investigate whether sexual arousal without self-stimulation moderates pain tolerance

and pain intensity while controlling for disgust. This is done by using the original pornographic film used in the study by Lakhsassi et al. (2022) and a female-friendly version used in a study by Coslar (2022). Another aim of the present study is to replicate the study conducted by Lakhsassi (2023) to investigate if priming with disgust took place in the second study, which might have influenced the sexual arousal of the participants. Based on the model of information processing of sexual arousal, the role of beta-endorphins in sexual arousal, and the literature that has shown the connection between sexual arousal and pain, the following hypotheses are formulated. First, it is hypothesized that sexual arousal will reduce pain intensity and increase pain tolerance. Precisely, it is predicted that both sexual arousal stimuli will reduce pain intensity and increase pain tolerance in women compared to the control group (I). Moreover, it is predicted that the low disgust sexual stimulus will show a stronger increase in pain tolerance and a stronger decrease in pain intensity than the original sexual stimuli used (II). The two hypotheses will be tested with a CPT. While watching a neutral, female-friendly pornographic film or the original pornographic film, participants are asked to perform a CPT. The original porn was the one used in the previous study by Lakhsassi. Participants' pain tolerance was measured by the duration they did the CPT, and pain intensity was measured via a visual analogue scale.

Method

Participants

Participants were recruited through the first year SONA participant pool. A prior power analysis with G*Power was conducted with an effect size of 0.25 and power of 0.80 and predictors. This indicated a sufficient sample size of 159 participants. To ensure that the study is not underpowered due to potential dropouts the sample size was increased to 175. Inclusion criteria for this experiment were that participants were at least 18 years old, English-speaking females who are predominantly heterosexual. Exclusion criteria were

sexual dysfunction, prior cold training, and medical problems involving pain. A total of 175 participants took part in the study. One participant was excluded due to a malfunction of that pump which led to the temperature being too high during the CPT. One-hundred and seventy-four participants were included in the analysis. For their time investment, participants received one SONA credit.

Materials

Video Stimuli

To elicit the different emotional states, three 6-minute-long videos were shown to the participants on a TV screen (Length: 90cm; Width: 52cm, Dimension: 100cm). In the original porn condition, a sexually explicit video was shown of a heterosexual couple involved in foreplay and intercourse. The couple engaged for 2 minutes and 30 seconds in foreplay and for 3 minutes and 30 seconds in intercourse. This was the pornographic film used in the previous studies by Lakhsassi et al. (2022) which was selected by a research team and viewed as being sufficient in eliciting sexual arousal. In the female friendly condition, a female friendly explicit video of a heterosexual couple involved in foreplay (4min15sec) and intercourse (1min45sec) was shown. In a study by Coslar (2022) this pornographic movie was shown to induce significant sexual arousal and was therefore chosen for this study. The difference between the two sexual arousal stimulus was that the female friendly version focused more on the female pleasure and the female protagonist took a more leading role and that the foreplay was longer. The neutral condition stimulus consisted of a video of a train traveling outdoors. To have the stimuli appear similar to the other two films used the neutral stimulus was also in colour which deviates from the neutral film used in the study by Lakhsassi et al. (2022).

Cold Pressor Task

To simulate pain a cold pressor task (CPT) was used (Mitchell et al. 2004). The set up included a plastic cooler (Length: 39cm, Width: 36cm, Height: 22cm), that was filled three quarters with water. An aquarium pump was put at the bottom of the cooler with the exit tube facing the participant's hand. This was done to ensure that the cold water was circulated through the cooler. To cool down the water to a standardized temperature of two degrees Celsius ice cubes were placed in the water. These were removed before the participant started the task. Furthermore, two thermometers were placed and secured at the side close to where the participants placed their hands. To ensure that there were enough ice cubes, a refrigerator, and ice machine and ice cube trays were available in the laboratory.

Tepid Tub

As a means to standardize the hand temperature of the participants a tub (Length: 39cm, Width: 28cm, Height: 13cm) was filled halfway with water and kept at a temperature between 29-30 degrees Celsius (Mitchell et al. 2004).

Programmed Button

To time the durations participants left their hand in the CPT, one of the researchers pressed a programmed key on the keyboard to start a timer as soon as the participant began the CPT and pressed a second programmed key as soon as the participant ended the task to stop the time. To be able to assess the moment the participant started and ended the CPT a camera was aimed at the CPT which was a live feed only.

Measures

Manipulation Check

To assess if the target emotion was elicited participants were asked to indicate how sexually aroused, they felt on a visual analogue scale (VAS) ranging from 0 to 100, where 0 indicated *not at all* and 100 indicated *very much*. In addition to that participants were asked to

indicate how disgusted they felt and to rate this on the same VAS. The two VAS were presented after the movie was playing for 1 minute and 45 seconds.

Priming

In the female friendly condition, a 2-minute priming task was used to ensure that participants were primed with sexual arousal (Pawłowska et al., 2021). Participants were asked to close their eye and think about a past sexual experience they had found enjoyable and perusable, and they should let themselves fantasize about this experience. If they did not have such a memory, they were asked to think about a sexual fantasy that they would enjoy if it would occur. They also were instructed that once they hear the bell sound they may stop and open your eyes. Lastly, they saw in instruction on the screen to press continue. A picture was then shown that informed the participant to start fantasizing (Appendix A.). After the bell sound occurred participants were asked if they successfully manage to think about a sexual memory or fantasy. This was done as a manipulation check to see if the fantasy or memory sufficiently primed the participant.

Pain

Pain intensity was assessed after they finished the CPT on a VAS that appeared on the screen asking the participant “How intense was the pain you felt” and rating pair pain from 0 (no pain at all) to 100 (very intense pain).

Pain tolerance was assessed through duration participants were able to leave their hand in the CPT. The time range was set from 0 seconds to 4 minutes because after the participants received the instruction to place their hand in the CPT only 4 minutes of the film was left. The variable for the analysis was created by calculating the difference between the difference between the CPT end time in milliseconds and the CPT begin time in milliseconds. The result was then divided by 60000 to convert the time from milliseconds to minutes.

Procedure

Participants were randomly assigned in a between group experimental design to three conditions, namely: original porn (OP), female friendly porn (FF) and the neutral condition (N). Before the experiment, participants were asked to confirm again that they were 18 or above the age of 18 and to read the information form and sign the consent form upon agreement (Appendix B.). During that time the researcher went behind a screen where the CPT was set up and insured that the water in the CPT was around 1.88 degrees Celsius for the neutral and the OP condition, and around 1.81 degrees Celsius for the FF condition. This was done to ensure that when the participant started the experiment the water was at a target temperature of 2 degrees Celsius for the neutral and OP condition and 1.94 for the FF condition. In addition to that the researcher checked that the temperature in the tepid tub was at 30 degrees Celsius. To be able to cool down the water ice cubes, and cool packs were provided. In addition to that a kettle was provided to heat up the water. Before going back to the participants, remaining ice cubes were removed from the CPT with gloves and the aquarium pump was switched on.

Once the participants gave their consent, they were asked to remove any jewellery and watches from their hands. After that they received a tour of the research set up and were invited to go to the room next door where a second researcher was sitting. In this room participants were shown the live feed of the camera to assure their privacy. The participants were invited back to the experiment room and to go behind the screen where they were asked to put their left hand in the tepid tub for a minute to standardize their hand temperature. After that they were invited to take a seat in an armchair that was facing a TV screen. On the right-hand side of the chair were a computer mouse and headphones and on the left-hand side the CPT was placed. Pictures of the research set-up can be found in Appendix C. Participants were then informed if they were watching the train film or the porn film. Following this, the

participant was given a detailed explanation of what would be expected from them during the experiment.

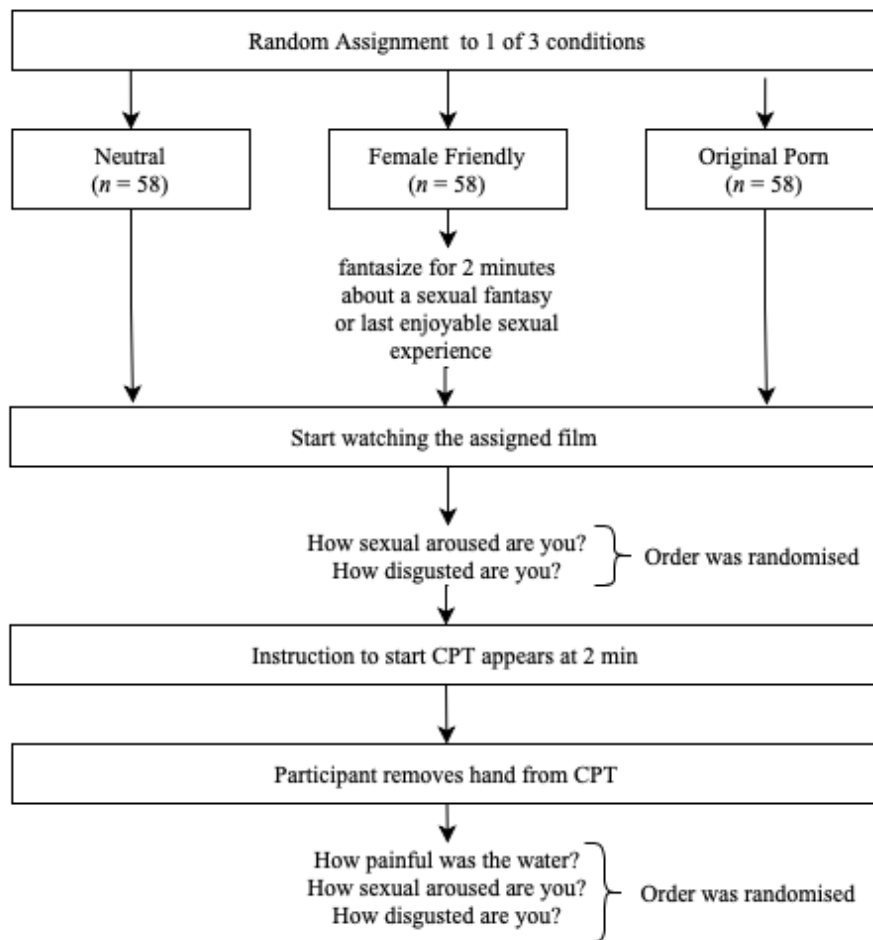
The participants were informed that they will be watching the film on their own to ensure privacy in a dark room. Then they were informed that they will be asked question about their emotions during the film and the VAS was explained with an example where participants rated how much they liked the scale. After this, the CPT was explained. The participant was told that an instruction will appear on the screen when they had to submerge their hand in the water up until their wrist and that they have to leave it in the water for as long as they could tolerate. In addition to that, the participant was shown that they had to place their hand during the CPT in the bottom right corner. After the experiment was explained step by step, participants were asked to put the provided headphones on, and press continue as soon as the researcher left the room and turned the light off. The water temperature was checked one more time by the researcher to ensure that it was at 2 degrees Celsius for the neutral and the OP condition and at 1.94 degrees Celsius for the FF condition before leaving the room. The temperature for the FF condition was lower to ensure that after the thinking exercise that CPT was at the same temperature as the other two condition when the instruction to start the CPT appeared.

After the researcher left the room and the participant clicked continue, the randomly assigned film began to play in the N and OP condition. In the FF condition participants were asked to fantasize about their last sexual experience they found pleasurable or think about a sexual fantasy for two minutes. When they pressed continue a picture (see Appendix A.) was shown with an instruction to now begin to fantasize and after 2 minutes a bell sound indicated the end of this exercise. As a manipulation check, they were then asked if they managed to think about a sexual fantasy or memory. After that they had to press continue again and the FF film began to play. One minute and forty-one seconds into the movie the

two VAS were presented as a manipulation check for sexual arousal and disgust and after answering these two questions the participant was asked to place their hand in the water and leave it for as long as they could tolerate. As soon as their fingers touched the water the researcher pressed the key on the keyboard to start a timer. When the participant removed their hand fully the stop button was pressed by the researcher, or the film stopped on its own after four minutes. Participants then received three more VAS on their screen, which they had to answer. On the first one, participants were asked to indicate the intensity of pain. They were then asked to indicate their level of sexual arousal and their level of disgust during the experiment. The order in which the question about sexual arousal and disgust were randomized to ensure that no order bias took place. After they finished the experiment, participants received an instruction to inform the researchers that they completed the experiment. See Appendix C. for the full script of the experiment and Appendix D. for the set-up checklist.

Design

The design of this study can be found in Figure 1.

Figure 1.*Study design***Analysis*****Transformation of the Raw Data***

A categorical variable was created to indicate if the participant watched the neutral film, the female friendly film, or the original porn film. For participants who received the neutral film, the variable was coded as 3, those who watched the original porn film were coded 1 and those who watched the female friendly film were coded 2.

Manipulation Check

To see if the desired emotion was elicited, pre-CPT VAS scores for sexual arousal and disgust were measured across the three conditions and assessed individually with one-

way between group analysis of variance (ANOVA). Additionally, to assess if the desired emotional state was induced throughout the experiment for each condition, the post-CPT VAS scores for sexual arousal and disgust were subjected to one-way ANOVAs. The assumption of variance was tested via the Levene's test, and the assumption of normality was tested via Q-Q plots and Histograms.

Main Analysis

Two fixed one-way ANOVA were conducted to assess whether sexual arousal in comparison to a neutral state increases pain tolerance and decreases pain intensity. The dependent variable for the first analysis was the pain intensity VAS and for the second analysis was the duration of the CPT as a measure of pain tolerance. Prior to the ANOVA the assumptions of the analysis were assessed. The assumption of variance was tested via the Levene's test, and the assumption of normality was tested via Q-Q plots and Histograms. To see if the female friendly film reduced pain intensity and increased pain tolerance more significantly than the original porn and the neutral film, a follow up planned comparison will be conducted to compare the female friendly condition to the other two conditions. The data was statistically analysed with IBM SPSS statistics (version 26).

Results

Assumption

The assumption of normal distribution was violated for pain intensity, pain tolerance, sexual arousal pre-CPT, disgust pre-CPT, sexual arousal post-CPT, and disgust post-CPT across conditions based on Q-Q Plots and Histograms. The Q-Q Plots and Histograms showed that pain tolerance, sexual arousal pre-CPT, disgust pre-CPT, sexual arousal post-CPT, and disgust post-CPT were positively skewed, and pain intensity was negatively skewed. Levene's test based on the mean showed that the homogeneity of variance was violated for pain tolerance, sexual arousal pre-CPT, disgust pre-CPT, sexual arousal post-

CPT, and disgust post-CPT. The assumption of homogeneity of variance based on the mean was only met for pain intensity. Results can be found in Table 1. These results do not affect the analysis because ANOVA is relatively robust against these violations (Blanca et al., 2018; Schmider et al., 2010).

Table 1.

Levene's Test based on Mean

	Levene's Statistic	df1	df2	Sig.
Sexual Arousal pre-CPT	33.98	2	166	< .001
Disgust pre-CPT	33.15	2	164	< .001
Sexual Arousal post-CPT	67.38	2	170	< .001
Disgust post-CPT	46.92	2	170	< .001
Pain Tolerance	6.07	2	170	.003
Pain Intensity	0.71	2	170	.495

Missing Data

Missing data were only identified for the pre-CPT VAS scales (for sexual arousal $N = 4$ and disgust $N = 6$). After conducting a missing data analysis, it was confirmed that there was no pattern linking the missing data and that it was missing at random ($\chi^2(14) = 18.92, p = .168$). These results align with some participants reporting that they might have missed answering some scales at the beginning because they were distracted by the movie playing. However, additional analysis showed that a pattern could be detected even if the data were missing at random. More missing data was observed in the original porn condition, with 6.9% on the pre-CPT sexual arousal VAS and 5.2% on the pre-CPT disgust VAS. This was followed by the female friendly condition with 3.5% in the pre-CPT disgust VAS and 1.7% in the pre-CPT disgust VAS in the neutral condition. During the analysis, the missing data

was dealt with by listwise deletion because only a small number of data was missing; all procedures handling missing data will produce similar data (Peng et al., 2007).

Manipulation Checks

Induced state prior to CPT

To see if the desired emotional state was induced before the CPT was started, two one-way ANOVAs were conducted. The results show that sexual arousal was significantly higher before the CPT ($F(2,166) = 90.63, p < .001$). A post hoc Tukey HSD analysis showed that sexual arousal was significantly more induced in the female friendly condition ($M = 46.23, SD = 19.16, p < .001$) and the original porn condition ($M = 40.35, SD = 23.24, p < .001$) compared to the neutral condition ($M = 4.59, SD = 8.56, p < .001$). However, the induced sexual arousal was not significantly higher in female friendly condition compared to the original porn condition ($p = .199$). Likewise, disgust was also significantly higher prior to the CPT ($F(2,164) = 42.84, p < .001$). Again, a post hoc Tukey HSD analysis showed that disgust was significantly more induced throughout the experiment in the original porn condition ($M = 35.82, SD = 24.83$) compared to the female friendly condition ($M = 23.07, SD = 18.67, p = .001$) and the neutral condition ($M = 3.42, SD = 9.55, p < .001$).

Induced state post-CPT

The VAS scores for sexual arousal and disgust directly after the CPT were analysed with a one-way ANOVA to assess whether the desired emotional state was induced throughout the experiment. The results show that sexual arousal was significantly higher post-CPT ($F(2, 170) = 82.56, p < .001$). A post hoc Tukey HSD analysis showed that sexual arousal was significantly more induced in the female friendly condition ($M = 45.95, SD = 21.19, p < .001$) and the original porn condition ($M = 36.19, SD = 25.49, p < .001$) compared to the neutral condition ($M = 2.07, SD = 3.94, p < .001$). Furthermore, the induced sexual arousal throughout the experiment was significantly higher in the female friendly condition

than in the original porn condition ($p = .02$). Likewise, disgust after the CPT was also significantly higher ($F(2, 170) = 31.66, p < .001$). Again, a post hoc Tukey HSD analysis showed that disgust was significantly more induced throughout the experiment in female friendly condition ($M = 24.7, SD = 23.49, p < .001$) and original porn condition ($M = 34.02, SD = 28.70, p < .001$) compared to the neutral condition ($M = 2.43, SD = 8.51, p < .001$). However, disgust was not significantly more induced in the original porn condition compared to the female friendly condition ($p = .062$) throughout the experiment.

Hypothesis Testing

Influence of Sexual Arousal and Pain

The hypothesis that sexual arousal influences pain was tested by performing two one-way ANOVAs. One ANOVA was conducted with pain intensity as the dependent variable, and another ANOVA was conducted with pain tolerance as the dependent variable. The results show that participants in the female friendly and the neutral conditions reported lower pain intensity and a higher pain tolerance than participants in the original porn condition (see Figures 2. and Figure 3.). However, there was no significant difference in pain tolerance ($F(2, 170) = 1.49, p = .228, partial \eta^2 = 0.017$) nor in pain intensity ($F(2, 170) = 0.21, p = .812, partial \eta^2 = 0.002$) across conditions.

In addition to that, the outcomes did change slightly after outliers were excluded, but not significantly. The outliers were excluded when the data point exceeded 1.5 times the interquartile range (Vinutha et al., 2018). The results showed that now for all three conditions, the average pain tolerance decreased from $M = 1.2$ with outliers to $M = 0.86$ without outliers (see Figure 2. and Figure 4.). Furthermore, after excluding the outliers, pain intensity increased slightly from $M = 72.5$ with outliers to $M = 73.86$ without outliers across all three conditions (see Figure 3. and Figure 5.). However, this increase was not significant for pain intensity ($F(2, 165) = 0.05, p = .95, partial \eta^2 = 0.001$) and for pain tolerance ($F(2,$

149) = 0.14, $p = .868$, $partial \eta^2 = 0.002$) across conditions. For pain tolerance, the majority of the outliers were in the neutral condition ($N = 10$) and in the female friendly condition ($N = 8$) and only a few were in the original porn condition ($N = 3$). Similar results regarding outliers in pain tolerance were found for the outliers in pain intensity, with only $N = 3$ for the neutral, $N = 2$ for the female friendly condition, and no outlier in the original porn condition. Participants that were excluded as outliers were those that had lower pain intensity ratings and higher pain tolerance.

Because the main analysis was non-significant, no follow-up comparison was performed. Furthermore, based on the non-significant results found, the hypothesis that sexual arousal decreases pain intensity and increases pain tolerance was statistically not supported.

Figure 2.

Means for Pain Tolerance with Outliers

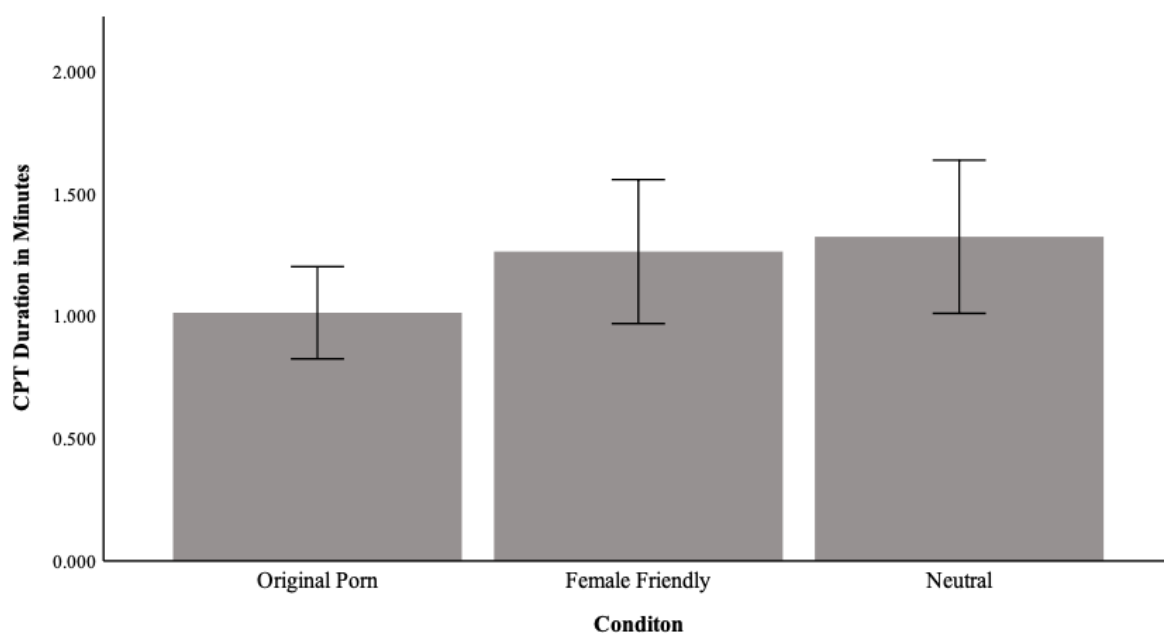


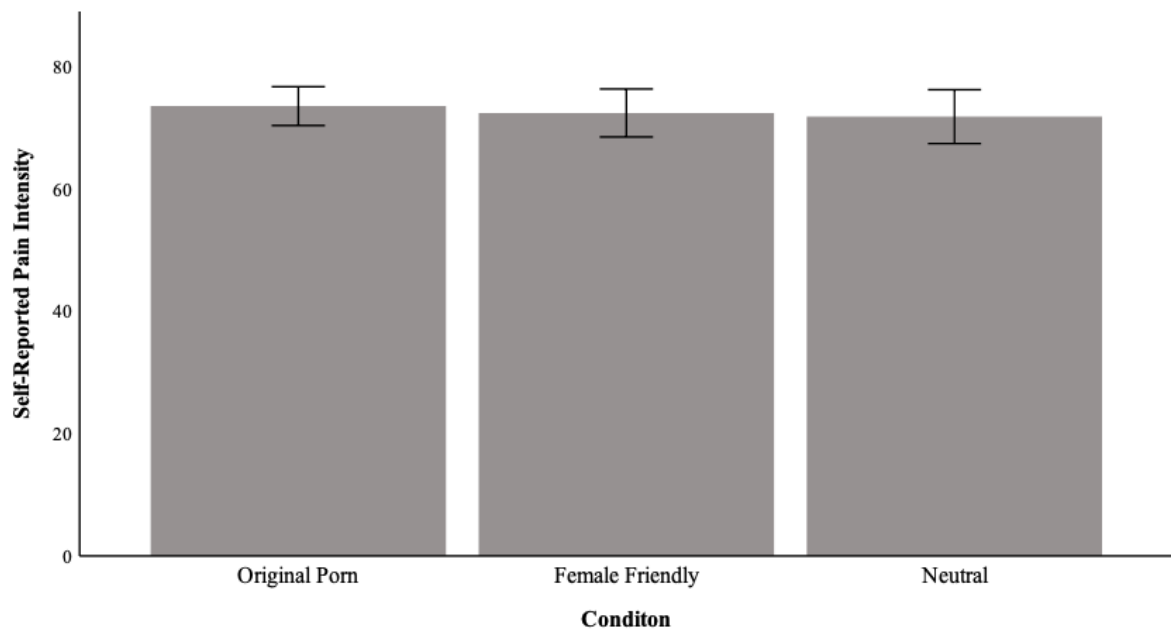
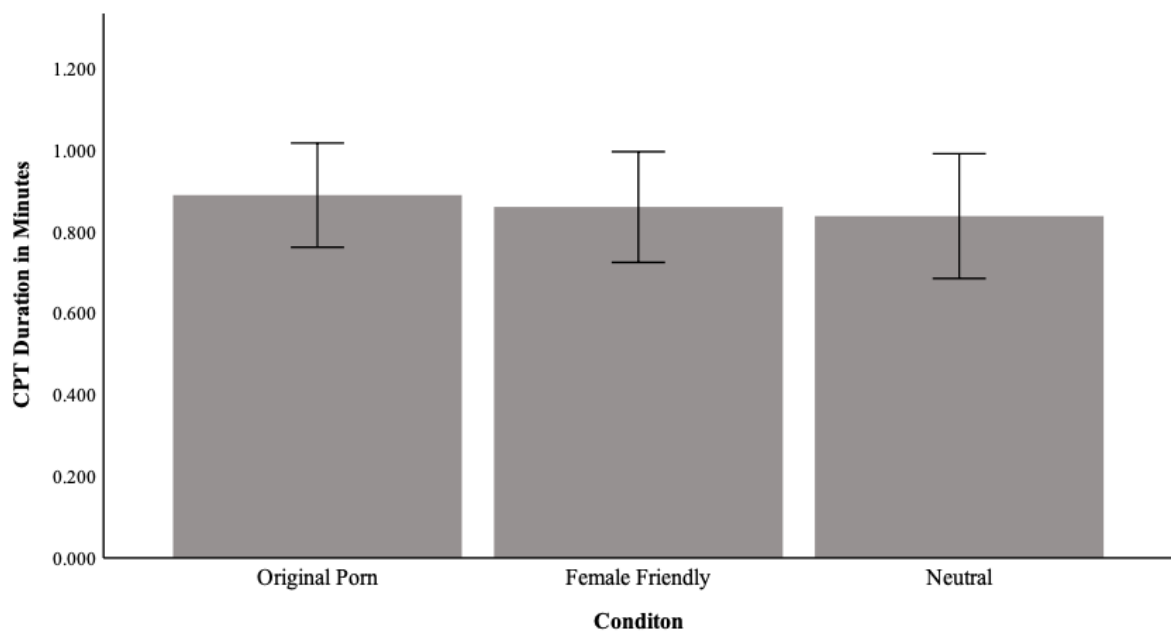
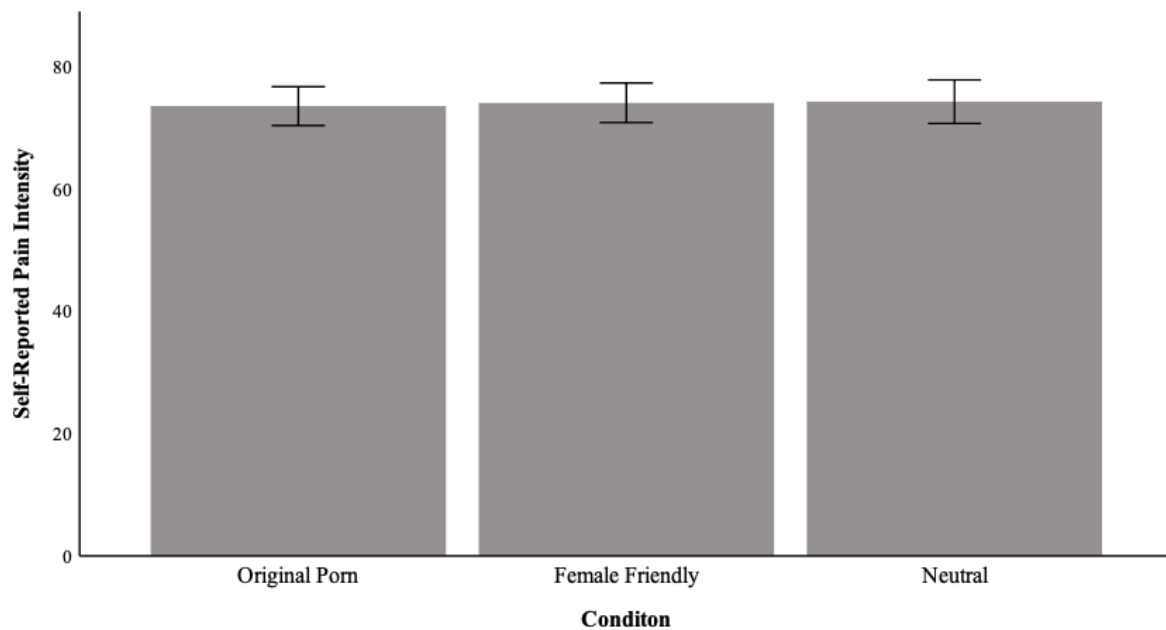
Figure 3.*Means for Pain Intensity with Outliers***Figure 4.***Means for Pain Tolerance without Outliers*

Figure 5.*Means for Pain Intensity without Outliers***Exploratory Analysis*****Relationship between Sexual Arousal and Disgust in the Two Porn Film Conditions***

An explorative analysis was conducted due to the lack of meaningful results in the main analysis. Post Hoc, it was assessed whether a relationship between sexual arousal and disgust exist across the two porn film condition and the neutral condition was excluded from the analysis. To test this, a Pearson correlation was conducted for the two porn film conditions for pre-CPT and post-CPT. There was a significant negative correlation between sexual arousal and disgust pre-CPT ($r = -.21, p = .03, n = 107$) and post-CPT ($r = -.24, p = .010, n = 115$), indicating that when disgust increases, sexual arousal decreases and the other way around.

Predictability of Pain Intensity and Pain Tolerance in the Two sexual Stimuli Conditions

Due to the fact, that the main analysis lacked meaningful results, an explorative analysis was conducted post hoc to assess whether sexual arousal predicts pain intensity and

pain tolerance when controlling for disgust and vice versa. A series of multiple regression analyses were conducted on a set with outliers and one without outliers. The multicollinearity assumption was assessed via variance inflation factor (VIF) and was met ($VIF \geq 1.05$).

Normality was assessed via P-P Plots and the assumption was met. In addition to that, the assumption of homoscedasticity assessed via scatterplots was violated. Due to the fact that multiple regressions are relatively robust against these violations, the analysis was carried out as planned (Ernst & Albers, 2017).

Pain Intensity

The multiple regression analysis showed that pre-CPT sexual arousal on its own ($F(1,105) = 0.71, p = .402, R^2_{Adjusted} = -0.003$) and sexual arousal and disgust could not significantly explain variance in pain intensity ($F(2,104) = 0.59, p = .556, R^2_{Adjusted} = -0.01$). Neither sexual arousal ($Beta = 0.10, t(106) = 0.97, p = .337$) nor disgust ($Beta = 0.07, t(106) = 0.69, p = .492$) showed an independent relationship with pain intensity. After removing outliers based on $1.5 \times IQR$, neither sexual arousal ($F(1,104) = 1.05, p = .308, R^2_{Adjusted} = 0.00$) nor sexual arousal and disgust could significantly explain the variance in pain intensity ($F(2,103) = 0.95, p = .388, R^2_{Adjusted} = -0.001$) and neither sexual arousal ($Beta = 0.12, t(105) = 1.20, p = .234$) or disgust ($Beta = 0.09, t(105) = 0.93, p = .356$) had an independent relationship with pain intensity.

Similar results from the pre-CPT multiple regression analysis were found for the post-CPT analysis with sexual arousal and disgust. Neither sexual arousal on its own ($F(1,113) = 0.03, p = .857, R^2_{Adjusted} = -0.01$) nor the model with sexual arousal and disgust could significantly explain the variance in pain intensity ($F(2,112) = 0.37, p = .693, R^2_{Adjusted} = -0.01$). An independent relationship for pain intensity was not found for sexual arousal ($Beta = 0.003, t(114) = 0.03, p = .979$) or disgust ($Beta = 0.8, t(114) = 0.84, p = .404$). After outliers were removed based on $1.5 \times IQR$ the results remain non-significant for sexual arousal (F

(1,111) = 0.34, $p = .559$, $R^2_{Adjusted} = -0.01$) and sexual arousal and disgust ($F(2,110) = 0.98$, $p = .378$, $R^2_{Adjusted} = 0.00$). Furthermore, neither sexual arousal ($Beta = -0.02$, $t(112) = -0.24$, $p = .808$) nor disgust ($Beta = 0.12$, $t(112) = 1.27$, $p = .206$) showed an independent relationship with pain intensity.

Pain Tolerance

The same multiple regression analyses were performed with pain tolerance as the dependent variable. Similar results as the results for pain intensity were found for pain tolerance. Pre-CPT, neither sexual arousal on its own ($F(1,105) = 0.00$, $p = .970$, $R^2_{Adjusted} = -0.01$) nor the model with sexual arousal and disgust could significantly explain the variance for pain tolerance ($F(2,104) = 0.08$, $p = .919$, $R^2_{Adjusted} = -0.02$). Both Sexual arousal ($Beta = -0.12$, $t(106) = -0.12$, $p = .902$) and disgust ($Beta = -0.04$, $t(106) = -0.41$, $p = .684$) did not show a significant independent relationship with pain tolerance. After removing 1.5xIQR outliers, the model with sexual arousal ($F(1,95) = 0.23$, $p = .635$, $R^2_{Adjusted} = -0.01$) as well as the model with sexual arousal and disgust remained non-significant and could not explain the variance in pain tolerance ($F(2,94) = 0.77$, $p = .464$, $R^2_{Adjusted} = -0.01$). Furthermore, neither sexual arousal ($Beta = 0.08$, $t(96) = 0.72$, $p = .471$) nor disgust ($Beta = 0.12$, $t(96) = 1.15$, $p = .254$) showed an independent relationship with pain tolerance.

Similar results were found for post-CPT sexual arousal and disgust. Neither sexual arousal on its own ($F(1,113) = 0.09$, $p = .762$, $R^2_{Adjusted} = -0.01$) nor the model with sexual arousal and disgust could significantly explain the variance in pain intensity ($F(2,112) = 0.05$, $p = .949$, $R^2_{Adjusted} = -0.02$). Again, neither sexual arousal ($Beta = -0.03$, $t(114) = -0.32$, $p = .749$) nor disgust ($Beta = -0.01$, $t(114) = -0.11$, $p = .912$) showed an independent relationship with pain tolerance. After removing 1.5xIQR outliers, the model with sexual arousal ($F(1,102) = 0.09$, $p = .77$, $R^2_{Adjusted} = -0.01$), as well as the model with sexual arousal and disgust, remained non-significant ($F(2,101) = 0.97$, $p = .383$, $R^2_{Adjusted} = -0.00$).

Furthermore, neither sexual arousal ($Beta = 0.06$, $t(103) = 0.63$, $p = .532$) nor disgust ($Beta = 0.14$, $t(103) = 1.36$, $p = .176$) showed an independent relationship with pain tolerance.

Discussion

This thesis investigated whether sexual arousal without self-stimulation moderates pain tolerance and pain intensity while controlling for disgust. It was hypothesised that sexual arousal would reduce pain intensity and increase pain tolerance. Furthermore, it was hypothesised that the low disgust sexual stimulus would show a more substantial decrease in pain intensity and increase in pain tolerance than the original sexual stimulus. These hypotheses were tested by having participants perform a CPT while watching either a neutral film, a female-friendly pornographic film (low disgust sexual stimulus) or the original pornographic film. The results indicate that sexual arousal was successfully induced in original porn and female-friendly porn condition compared to the neutral condition. Furthermore, these results were relatively stable throughout the experiment. However, the hypothesis that sexual arousal moderates pain tolerance and pain intensity was not supported because the difference in ratings of pain intensity and pain tolerance was not significant between the three conditions and was of small effect size. Based on this, it can be concluded that sexual arousal did not influence pain perception. In addition, it was shown that sexual arousal was not correlated with pain intensity and pain tolerance, and this was also the case when controlled for disgust.

These results are in line with previous research that has shown that sexual arousal in women is not sufficient enough to evoke an analgesic state. For example, Lakhsassi et al. (2022) showed that induced sexual arousal was not enough to reduce subjective pain. In her study the original porn movie that was used was rated higher sexual arousing than the same movie in the present study. A possible explanation for the non-significant results could be that disgust might have influenced sexual arousal. This explanation would be in line with

previous research that has shown that a negative relationship between sexual arousal and disgust exists (Borg et al., 2022; Meagher et al., 2001; Oaten et al., 2015). Andrews et al. (2015), for example, investigated this relationship and showed that women primed with disgust showed lower sexual arousal than women primed with a neutral stimulus.

Furthermore, they showed that women in the disgust condition rated sexual pictures as less arousing than women in the neutral condition, and this trend decreased even further when they had to rate more pictures. In addition, in the present study, a negative relationship between sexual arousal and disgust was found, indicating that when disgust increases, sexual arousal increases. Based on these findings and the literature, it might be the case that disgust was induced alongside sexual arousal and that disgust decreased sexual arousal. Furthermore, research has shown that disgust increases pain sensitivity (Oaten et al., 2015). Therefore, it might be the case that the disgust induced while watching the sexual stimuli increased pain sensitivity and nullified the pain-reducing effect of sexual arousal. Taken together, it might be the case that the sexual stimuli used in this study induced disgust alongside sexual arousal; disgust might have then decreased sexual arousal and decreased pain tolerance and increased pain intensity, leading to the non-significant results.

In addition to that, the sexual arousal that was induced in the female-friendly condition in the present study did not reach the same level as in the study conducted by Lakhsassi et al. (2022) and Coslar (2022). In their study, Lakhsassi et al. (2022) used the original porn, which induced a mean sexual arousal of over 60 (out of 100 points) on the VAS, and Coslar (2022) used in her study the same female-friendly porn, and their female participants reached a mean sexual arousal of around 60 on the VAS. The difference between the mean sexual arousal in the present study and the study conducted by Coslar (2022) can be explained through the different set-up of the experiment. In the study by Coslar (2022), participants were allowed to masturbate while watching the film. Self-stimulation can

increase sexual arousal, which might explain why the mean sexual arousal was higher in a study conducted by Coslar (Levin & van Berlo, 2004). The difference between the mean sexual arousal in the study conducted by Lakhsassi et al. (2022) and the present study is, however, surprising because, in the study conducted by Lakhsassi et al., some of the participants stated that they found the original porn disgusting and the female-friendly porn used in this study was validated to be less disgusting and more sexually arousing (Coslar, 2022). Furthermore, in the present study, the original porn also induced lower sexual arousal than in the study conducted by Lakhsassi et al. (2022). A possible explanation could be that without self-stimulation, the female-friendly porn was not sexually arousing enough, and that the original porn evoked more disgust than sexual arousal. Future studies should therefore select their sexual stimulus more carefully to ensure that no disgust and high sexual arousal are induced, and that sexual arousal is on average similar across studies. Studies have shown that women prefer looking at stimuli where the female protagonist receives oral sex and prefer to look more at the female body than close-ups of the genital (Rupp & Wallen, 2009). Based on this, future research should consider even more women's preferences when selecting the sexual stimulus by for example letting participants bring their own pornographic film which they find sexually arousing, which would also ensure that they do not find the stimulus disgusting.

These results add to the existing literature by showing that sexual arousal without genital stimulation might not be sufficient to influence pain. However, the possibility that disgust might have influenced sexual arousal cannot be ruled out because the sexual stimulus used both evoked significant disgust, which, as mentioned above, can reduce sexual arousal and nullify the pain-reducing effect sexual arousal has, according to the research (King & Alexander, 2000). Therefore, future research should further look into possible ways that

induce sexual arousal without inducing disgust by, for example, choosing stimuli that do not induce disgust or choosing other forms to elicit sexual arousal.

Another explanation for the non-significant results could be that the sexual arousal that was induced was too low to activate the sympathetic nervous system (SNS), which in turn did not lead to a stress response that is associated with the release of beta-endorphins that act as the body's natural pain killer (Khajehi & Behroozpour, 2018; Komisaruk & Whipple, 2000; Pillozzi et al., 2020). Research conducted by Lorenz et al. (2012) has shown that the relationship between SNS activation and sexual arousal is curvilinear. They showed that low SNS activation is associated with low and too-high sexual arousal. It might therefore be the case that only during orgasm the sexual arousal is at a level associated with increased activation of the SNS. This increased activation of the SNS might, in turn, be high enough to induce an analgesic stage. Further support for this idea comes from Zuckerman (1971), who stated in his review that SNS activation is not typical for the initial phase of sexual arousal. Taken all this evidence together, it might be the case that the low sexual arousal did not activate the SNS, which in turn did not activate the body's stress response, which is associated with the release of beta-endorphin and, therefore, the pain-reducing effect that is found during orgasm (Whipple et al., 1992) could not be induced. Future research could investigate this by using objective measures to assess sexual arousal and measure the body's stress response to see if the body of the participants reacts with activation of SNS to low sexual arousal. If it does not, this will support the idea that only during orgasm is the activation of the SNS high enough to reduce pain.

An interesting finding was that participants in the female-friendly condition and the neutral condition reported a similar decrease in pain intensity and increase in pain tolerance which was not in line with the hypothesis and also not in line with the study conducted by Lakhsassi et al. (2022) in which they found that the neutral condition was the one with the

highest pain intensity ratings. A possible explanation for these contradictory findings regarding the neutral condition could be that the new neutral film used in this study was more engaging and distracting than the old train film used by Lakhsassi et al. (2022). It might be the case that because the new neutral film was in colour and the train was driving through the countryside, the participants paid more attention to the movie and away from the pain they experienced, which might have led to a reduction in pain intensity and an increase in pain tolerance (Villemure & Bushnell, 2002). In addition, the new film might have been more relaxing, and research has shown that positive emotions can also increase pain tolerance (de Wied & Verbaten, 2001). Therefore, future studies should investigate if the film used distracted the participant from the pain and induced positive emotions. If it is the case that the new film was too distracting and induced positive emotions, future studies should select a less distracting movie.

Strength

One of the strengths of this research was the large sample size. Due to this, the study did not encounter the risk of being underpowered and of the sample parameter being considerably different from the actual population values (Crutzen & Peters, 2017). Another strength was that the order in which the VAS appeared was randomized, and therefore the different questions could not influence each other, and carry-over effects were avoided (Brooks, 2012).

Limitations

There are some limitations of the study that should be considered. First, the researchers were not blinded to the condition the participants were assigned to, which might have led to performance bias (Renjith, 2017). In this case, the researchers might have unconsciously treated participants in the neutral condition different than the participants in the sexual stimulus condition, which can influence the results of the study (Karanicolas et al.,

2010). However, participants were randomly assigned which helped reduce possible confounding and a protocol was used for the interaction with the patient that might have helped reduce performance bias (de Bruin et al., 2015). In addition, the participants were also informed if they were in the neutral condition or if they would watch a pornographic film. By informing the participants about their condition, performance bias might be induced again (Karanicolas et al., 2010), especially when subjective criteria like pain are assessed (Day & Altmann, 2000). It might be the case that because participants knew that they were assigned to the neutral condition, they performed the CPT for a shorter time and did not follow the protocol, which stated that participants had to leave their hand in the water for as long as they could tolerate (Karanicolas et al., 2010).

Another limitation was that the researcher pressed the start and stop buttons for the duration of the CPT manually. Pressing the start and stop buttons manually could have led to disparities in the way the dependent variable was measured because it cannot be ruled out that the start and stop buttons were pressed too early or too late by the researchers, which is a threat to internal validity (Flannelly et al., 2018). Therefore, it cannot be ruled out that the non-significant difference found in this study for pain tolerance was due to disparities in how pain tolerance was measured. Future research could use a recording device or a sensor to measure duration more objectively.

A final limitation of the present study was that prior pain sensitivity and pain tolerance were not measured before the start of the experiment, which could have induced selection bias (Flannelly et al., 2018). Even after random allocation to the different conditions, it cannot be ruled out that the conditions differed from the start in pain tolerance and pain intensity, which threatens internal validity. These differences at the start might have influenced the possibility of the experiment to find results that show an influence of sexual

arousal on pain intensity and pain tolerance. Future research could control for this by measuring pain intensity and pain tolerance before the start of the experiment.

Conclusion

The present study results do not support the hypothesis that sexual arousal alone without self-stimulation is sufficient in moderating pain intensity and pain tolerance when controlling for disgust. The non-significant results might be because the two sexual stimuli used were not arousing enough and induced a significant amount of disgust that might have influenced the pain perception. Another explanation could be that sexual arousal alone is not enough to reduce pain, and only self-stimulation can produce an analgesic state. Further investigation is needed to investigate if sexual arousal on its own is enough to reduce pain.

Reference

- American Psychological Association (n.d.) *APA Dictionary of Psychology: dyspareunia*. Retrieved March 7, 2023, from <https://dictionary.apa.org/dyspareunia>
- Andrews, A. R., Crone, T., Cholka, C. B., Cooper, T. V., & Bridges, A. J. (2015). Correlational and experimental analyses of the relation between disgust and sexual arousal. *Motivation and Emotion, 39*(5), 766–779. <https://doi.org/10.1007/s11031-015-9485-y>
- Blanca M. J, Alarcón R., Arnau, J., Bono, R., & Bendayan, R. (2018). Effect of variance ratio on anova robustness: might 1.5 be the limit? *Behavior Research Methods, 50*(3), 937–962. <https://doi.org/10.3758/s13428-017-0918-2>
- Borg, C. & de Jong, P.J. (2017). Psychological Approaches for Low Sexual Arousal. In: D. McKay, J.S. Abramowitz, & E.A. Storch (Eds.) *Treatments for Psychological Problems* (p.263-280). Wiley Blackwell. <https://doi.org/10.1002/9781118877142.ch18>
- Borg, C., Lakhsassi, L., & de Jong, P.J. (2022). Sexual Arousal and Sexual Pain Disorders in Women. In: S. Sarikaya, G.I. Russo, & D. Ralph, (Eds) *Andrology and Sexual Medicine*. (Ser. Management of Urology). (p. 227-241). Springer, Cham. https://doi.org/10.1007/978-3-031-12049-7_12
- Brauer, M., Kuile, M. M., Janssen, S. A., & Laan, E. (2007). The effect of pain-related fear on sexual arousal in women with superficial dyspareunia. *European Journal of Pain, 11*(7), 788–798. <https://doi.org/10.1016/j.ejpain.2006.12.006>
- Brauer, M., ter Kuile, M. M., & Laan, E. (2009). Effects of appraisal of sexual stimuli on sexual arousal in women with and without superficial dyspareunia. *Archives of Sexual Behavior: The Official Publication of the International Academy of Sex Research, 38*(4), 476–485. <https://doi.org/10.1007/s10508-008-9371-8>

- Brooks, J. L. (2012). Counterbalancing for serial order carryover effects in experimental condition orders. *Psychological Method, 17*(4), 600-614.
<https://doi.org/10.1037/a0029310>
- Coates, A. (2021, March 3). *Nothing treats period pain quite like an orgasm-it's science*. British VOGUE. <https://www.vogue.co.uk/beauty/article/orgasm-period-pain-treatment>
- Coslar, S. D. (2022). Sexual frustration, binary gender, and coercion: A mixed-method experimental study [Unpublished master's thesis]. University of Groningen
- Crutzen, R., & Peters, G.-J. Y. (2017). Targeting next generations to change the common practice of underpowered research. *Frontiers in Psychology, 8*.
<https://doi.org/10.3389/fpsyg.2017.01184>
- Day, S. J., & Altman, D. G. (2000). Statistics notes: blinding in clinical trials and other studies. *BMJ (Clinical research ed.), 321*(7259), 504.
<https://doi.org/10.1136/bmj.321.7259.504>
- de Bruin, M., McCambridge, J., & Prins, J. M. (2015). Reducing the risk of bias in health behaviour change trials: improving trial design, reporting or bias assessment criteria? a review and case study. *Psychology and Health, 30*(1), 8–34.
<https://doi.org/10.1080/08870446.2014.953531>
- de Wied, M., & Verbaten, M. N. (2001). Affective pictures processing, attention, and pain tolerance. *Pain, 90*(1-2), 163–72.
- de Witte, M., Van Lankveld, J., & Crombez, G. (2011). Understanding sexual pain: a cognitive-motivational account. *Pain, 152*(2), 251–253.
<https://doi.org/10.1016/j.pain.2010.10.051>
- Ernst, A. F. & Albers, C.J. (2017). Regression assumptions in clinical psychology research

practice—a systematic review of common misconceptions, *PeerJ*, 5, e3323.

<https://doi.org/10.7717/peerj.3323>

Flannelly, K. J., Flannelly, L. T., & Jankowski, K. R. B. (2018). Threats to the internal validity of experimental and quasi-experimental research in healthcare. *Journal of Health Care Chaplaincy*, 24(3), 107-130.

<https://doi.org/10.1080/08854726.2017.1421019>

Fleischman, D. S., Hamilton, L. D., Fessler, D. M. T., Meston, C. M., & Mazza, M. (2015). Disgust versus lust: exploring the interactions of disgust and fear with sexual arousal in women. *Plos One*, 10(6). <https://doi.org/10.1371/journal.pone.0118151>

Grauvogl, A., de Jong, P., Peters, M., Evers, S., van Overveld, M., & van Lankveld, J. (2015). Disgust and sexual arousal in young adult men and women. *Archives of Sexual Behavior: The Official Publication of the International Academy of Sex Research*, 44(6), 1515-1525. <https://doi.org/10.1007/s10508-014-0349-4>

Hodes, R. L., Rowland, E. W., Lightfoot, N., & Cleeland, C. S. (1990). The effects of distraction on responses to cold pressor pain. *Pain*, 41(1), 109–114.

[https://doi.org/10.1016/0304-3959\(90\)91115-Y](https://doi.org/10.1016/0304-3959(90)91115-Y)

Karanicolas, P. J., Farrokhyar, F., & Bhandari, M. (2010). Practical tips for surgical research: blinding: who, what, when, why, how?. *Canadian Journal of Surgery. Journal Canadien De Chirurgie*, 53(5), 345–8.

Khajehei M, & Behroozpour E. (2018) Endorphins, oxytocin, sexuality and romantic relationships: An understudied area. *World J Obstet Gynecol.*, 7(2), 17-23.

<http://doi.org/10.5317/wjog.v7.i2.17>

King, B. E., & Alexander, G. M. (2000). Pain sensitivity and individual differences in self-reported sexual behavior. *Journal of comparative psychology*, 114(2), 193–199.

<https://doi.org/10.1037/0735-7036.114.2.193>

- Komisaruk, B. R., & Whipple, B. (1986). Vaginal stimulation-produced analgesia in rats and women. In D. D. Kelly (Ed.), *Stress-induced analgesia* (pp. 30–39). New York Academy of Sciences. <https://doi.org/10.1111/j.1749-6632.1986.tb14616.x>
- Komisaruk, B. R., & Whipple, B. (2000). How does vaginal stimulation produce pleasure, pain, and analgesia? In R. B. Fillingim (Ed.), *Sex, gender, and pain* (Ser. Progress in pain research and management, v. 17) (pp. 109–134). IASP Press
- Laan, E., Everaerd, W., van Bellen, G., & Hanewald, G. (1994). Women's sexual and emotional responses to male- and female-produced erotica. *Archives of Sexual Behavior*, 23(2), 153–69. <https://doi.org/10.1007/BF01542096>
- Lakhsassi, L. (2023). *The influence of sexual arousal and disgust on pain tolerance and subjective pain*. Unpublished manuscript, Department of Psychology, University of Groningen, Groningen, Netherlands.
- Lakhsassi, L., Borg, C., Martusewicz, S., van der Ploeg, K., de Jong, P. J., & Hinojosa, J. A. (2022). The influence of sexual arousal on subjective pain intensity during a cold pressor test in women. *Plos One*, 17(10). <https://doi.org/10.1371/journal.pone.0274331>
- Levin, R. J., & van Berlo, W. (2004). Sexual arousal and orgasm in subjects who experience forced or non-consensual sexual stimulation -- a review. *Journal of Clinical Forensic Medicine*, 11(2), 82–8. <https://doi.org/10.1016/j.jcfm.2003.10.00>
- Lorenz, T. A., Harte, C. B., Hamilton, L. D., & Meston, C. M. (2012). Evidence for a curvilinear relationship between sympathetic nervous system activation and women's physiological sexual arousal. *Psychophysiology*, 49(1), 111–7. <https://doi.org/10.1111/j.1469-8986.2011.01285.x>
- Meagher, M. W., Arnau, R. C., & Rhudy, J. L. (2001). Pain and emotion: effects of affective

picture modulation. *Psychosomatic Medicine*, 63(1), 79–90.

<https://doi.org/10.1097/00006842-200101000-00010>

Melles, R., Dewitte, M. D., Ter Kuile, M. M., Bonnemayer, C., & Peters, M. M. L. (2018).

The Vaginal Pressure Inducer: A New Device to Test the (Un)pleasurableness and Tolerance of Vaginal Pressure and the Influence of Sexual Stimuli. *Journal of sex & marital therapy*, 44(2), 189–200. <https://doi.org/10.1080/0092623X.2017.1342728>

Mitchell, L. A., MacDonald, R. A. R., & Brodie, E. E. (2004). Temperature and the cold pressor test. *Journal of Pain*, 5(4), 233–237.

<https://doi.org/10.1016/j.jpain.2004.03.004>

Oaten, M. J., Stevenson, R. J., & Case, T. I. (2015). The effect of disgust on pain sensitivity. *Physiology & Behavior*, 138, 107–112.

<https://doi.org/10.1016/j.physbeh.2014.10.023>

Pawłowska, A., Borg, C., & de Jong, P. J. (2021). Up-regulating sexual arousal and down-regulating disgust while watching pornography: effects on sexual arousal and disgust. *Journal of Sex Research*, 58(3), 353–363.

<https://doi.org/10.1080/00224499.2020.1863316>

Peng, C.-Y. J., Harwell, M., Liou, S.-M., & Ehman, L.H. (2007). Advances in missing data methods and implications for educational research. In Sawilowsky, S. S. *Real data analysis (Ser. Quantitative methods in education and the behavioral sciences)*. (p.31-78). Information Age Publishing

Pilozzi, A., Carro, C., & Huang, X. (2020). Roles of β -endorphin in stress, behavior, neuroinflammation, and brain energy metabolism. *International Journal of Molecular Sciences*, 22(1). <https://doi.org/10.3390/ijms22010338>

Renjith, V. (2017). Blinding in randomized controlled trials: what researchers need to know?. *Manipal Journal of Nursing and Health Sciences (MJNHS)*, 3(1), 45-50.

- Rhudy, J. L., Williams, A. E., McCabe, K. M., Russell, J. L., & Maynard, L. J. (2008). Emotional control of nociceptive reactions (econ): do affective valence and arousal play a role? *Pain, 136*(3), 250–261. <https://doi.org/10.1016/j.pain.2007.06.031>
- Rupp, H. A., & Wallen, K. (2009). Sex-specific content preferences for visual sexual stimuli. *Archives of Sexual Behavior : The Official Publication of the International Academy of Sex Research, 38*(3), 417–426. <https://doi.org/10.1007/s10508-008-9402-5>
- Schmider, E., Ziegler, M., Danay, E., Beyer, L., & Buhner, M. (2010). Is it really robust?: reinvestigating the robustness of anova against violations of the normal distribution assumption. *Methodology, 6*(4), 147–151. <https://doi.org/10.1027/1614-2241/a000016>
- Sun, C., Bridges, A., Wosnitzer, R., Scharrer, E., & Liberman, R. (2008). A comparison of male and female directors in popular pornography: What happens when women are at the helm?. *Psychology of Women Quarterly, 32*(3), 312-325. <https://doi.org/10.1111/j.1471-6402.2008.00439.x>
- Szechtman, H., Hershkowitz, M., & Simantov, R. (1981). Sexual behavior decreases pain sensitivity and stimulates endogenous opioids in male rats. *European Journal of Pharmacology, 70*(3), 279–285. [https://doi.org/10.1016/0014-2999\(81\)90161-8](https://doi.org/10.1016/0014-2999(81)90161-8)
- Villemure, C., & Bushnell, C. M. (2002). Cognitive modulation of pain: how do attention and emotion influence pain processing? *Pain, 95*(3), 195–199. [https://doi.org/10.1016/S0304-3959\(02\)00007-6](https://doi.org/10.1016/S0304-3959(02)00007-6)
- Whipple, B., & Komisaruk, B. R. (1988). Analgesia produced in women by genital self-stimulation. *The Journal of Sex Research, 24*(1), 130–140. <https://doi.org/10.1080/00224498809551403>
- Whipple, B., Ogden, G., & Komisaruk, B. R. (1992). Physiological correlates of imager-

induced orgasm in women. *Archives of Sexual Behavior: The Official Publication of the International Academy of Sex Research*, 21(2), 121–133.

<https://doi.org/10.1007/BF01542589>

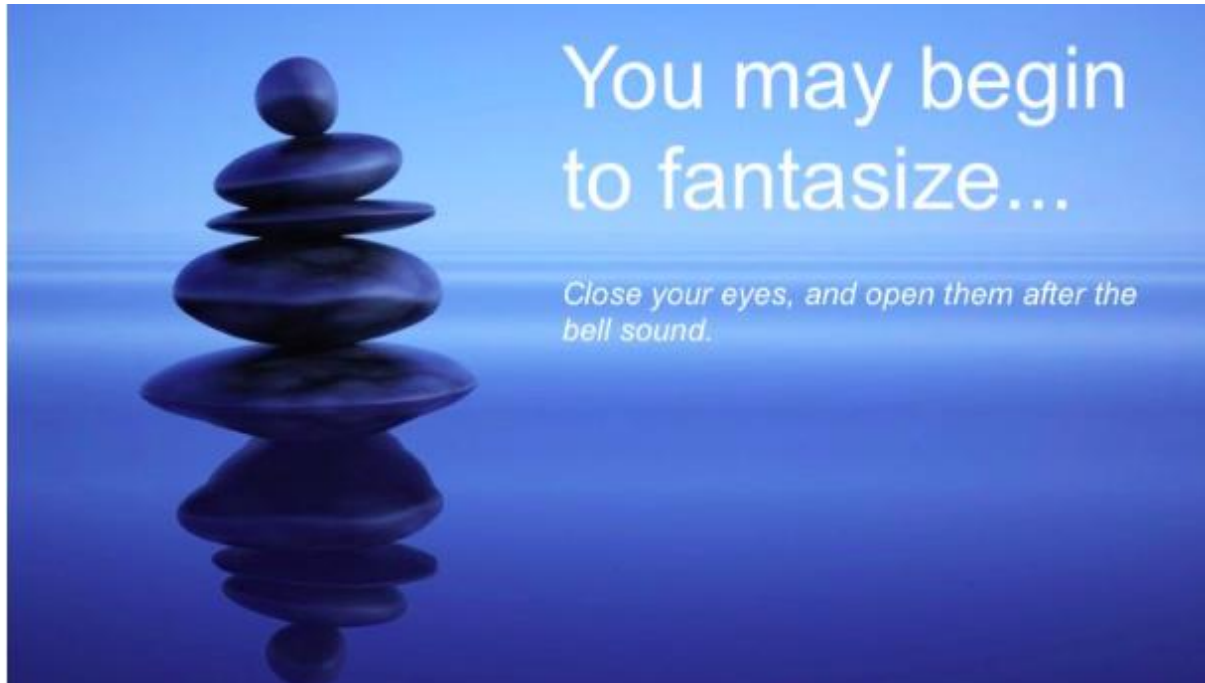
Zuckerman, M. (1971). Physiological measures of sexual arousal in the human.

Psychological Bulletin, 75(5), 297–329.

Appendix A.

Figure A1.

Picture of the Instruction to start fantasizing during Experiment



Appendix B.

Consent form and experiment information 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:

Full name of researcher present:	Researcher's signature:	Date:

The researcher declares that the participant has received extensive information about the research.

You have the right to a copy of this consent form.

Information about the Experiment for participants

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 vanJaarsveld, 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 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. We will process your SONA id to be able to give you credits for the study. However, when data collection is finished, we will remove your SONA id from the data and there will be no other data that could identify you.

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)

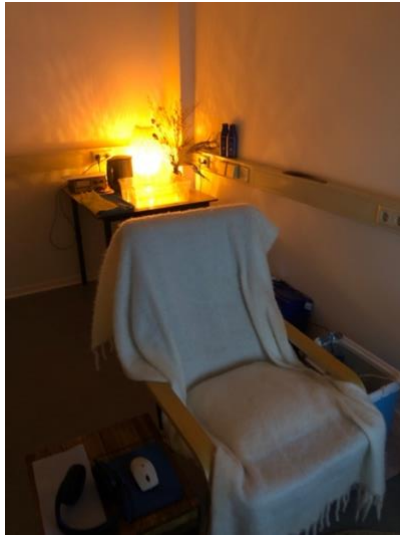
Do you have questions/concerns about your rights as a research participant or about the conduct of the research? You may also contact the Ethics Committee of the Faculty of Behavioural and Social Sciences of the University of Groningen: ec-bss@rug.nl.

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 C.**Pictures of research set up****Figure C1**

Chair for the Participant during the Experiment



Note: Picture taken by B. Kay, 2023 at the University of Groningen Heymans Building room 149.

Figure C2.

Research Table with Tepid Tub and Aquarium Pump during Experiment



Note: Picture taken by B. Kay, 2023 at the University of Groningen Heymans Building room 149.

Figure C3.

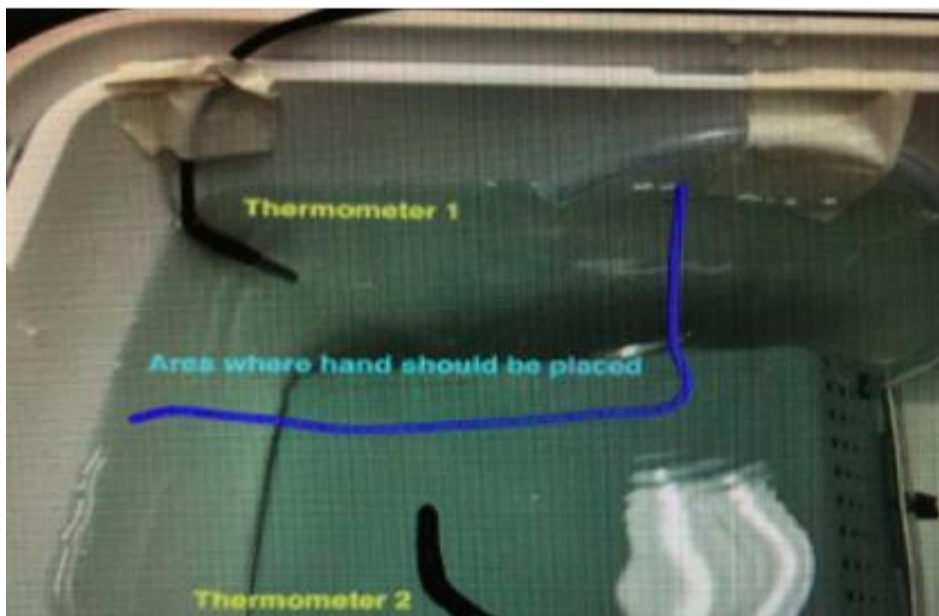
Research Set up during Experiment with Lights on



Note: Picture taken by B. Kay, 2023 at the University of Groningen Heymans Building room 149.

Figure C4.

Set up of the Cold Pressor with hand placement indication



Note: Picture taken by L. Lakhsassi, 2022 at the University of Groningen Heymans Building

Full script for researchers with instructions for participants

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 2h

## Appendix D.

### Checklist for researchers

#### **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.