PAIN

Effects of Aversive Classical Conditioning on Sexual Response in Women With Dyspareunia and Sexually Functional Controls

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ABSTRACT

Introduction: In dyspareunia—a somatically unexplained vulvovaginal pain associated with sexual intercourse—learned pain-related fear and inhibited sexual arousal are supposed to play a pivotal role. Based on research findings indicating that enhanced pain conditioning is involved in the etiology and maintenance of chronic pain, in the present study it was hypothesized that enhanced pain conditioning also might be involved in dyspareunia.

Aim: To test whether learned associations between pain and sex negatively affect sexual response; whether women with dyspareunia show stronger aversive learning; and whether psychological distress, pain-related anxiety, vigilance, catastrophizing, and sexual excitation and inhibition were associated with conditioning effects.

Methods: Women with dyspareunia (n = 36) and healthy controls (n = 35) completed a differential conditioning experiment, with one erotic picture (the CS+;) paired with a painful unconditional stimulus and one erotic picture never paired with pain (the CS−).

Main Outcome Measures: Genital sexual response was measured by vaginal photoplethysmography, and ratings of affective value and sexual arousal in response to the CS+ and CS− were obtained. Psychological distress, pain cognitions, and sexual excitation and inhibition were assessed by validated questionnaires.

Results: The two groups showed stronger negative affect and weaker subjective sexual arousal to the CS+ during the extinction phase, but, contrary to expectations, women with dyspareunia showed weaker differential responding. Controls showed more prominent lower genital response to the CS+ during acquisition than women with dyspareunia. In addition, women with dyspareunia showed stronger expectancy for the unconditional stimulus in response to the safe CS−. Higher levels of pain-related fear, pain catastrophizing, and sexual inhibition were associated with weaker differential conditioning effects.

Conclusions: Pairing of sex with pain negatively affects sexual response. The results indicate that a learned association of sex with pain and possibly deficient safety learning play a role in dyspareunia.


Key Words: Dyspareunia; Pain; Sexual Dysfunction; Conditioning; Photoplethysmography

INTRODUCTION

Dyspareunia, a persistent or recurrent vulvovaginal pain associated with sexual intercourse (described as genito-pelvic pain/penetration disorder in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition) is a relatively common sexual complaint. Prevalence figures in premenopausal women range from 10% to 20%.1,2 Research considering psychosomatic factors have reported evidence for a higher prevalence of (previously diagnosed) anxiety and depression,3,4 comorbidity with other chronic pain conditions,5 increased pain hypervigilance and catastrophizing,4,6,7 and hyperalgesia8 in women with dyspareunia, indicating that, in the pathogenesis of dyspareunia, similar emotional and cognitive mechanisms could be active as in other chronic pain conditions.9,10

Importantly, apart from the vulvovaginal pain, women with dyspareunia report sexual dysfunction, more specifically low sexual desire, and complaints of decreased sexual arousal and vaginal lubrication.7,11–13 Whether these sexual complaints precede, follow, or develop parallel to the sexual pain complaints is unclear. In clinical practice, many women with dyspareunia report a loss of
effects of pain conditioning and fear on sexual response.\textsuperscript{21,22} Functional women have provided the initial evidence for negative stimuli can elicit anticipatory defensive responses and impede the stimuli and pain has occurred, previously appetitive sexual When, during sexual encounters, repeated pairing of sexual result in chronic dysfunction.\textsuperscript{10}

A cognitive behavioral model of dyspareunia (Figure 1) integrates the pain and sexual aspects of dyspareunia. According to this explanatory model, an initial experience of pain can lead to fear of pain in new sexual situations. That fear can result in decreased sexual arousal and vaginal lubrication\textsuperscript{17} and increased pelvic floor muscle tone tightening the vaginal entrance,\textsuperscript{18,19} which increases the likelihood of pain during attempted penetration. In addition, fear of pain can result in avoidance behavior and, hence, in a lack of opportunity to overcome fear of pain, resulting in chronic dysfunction.\textsuperscript{10}

The focus in this model on learned fear through initial pain experiences is in agreement with views that recognize an important role of basic learning mechanisms in chronic pain.\textsuperscript{26} These views emphasize that animals and humans are built with a system to signal potential threat or pain and equipped with the capability to learn to predict pain by associative learning mechanisms. However, these adaptive associative learning mechanisms can contribute to pain, pain-related distress, and disability when it results in avoidance behavior and, hence, in a lack of opportunity to overcome fear of pain, facilitating chronic pain conditions.

One form of associative learning is classic conditioning. A pain stimulus can be considered an unconditional stimulus (US) that elicits fear, and conditional stimuli (CSs) can be stimuli that precede or coincide with the pain stimulus. Through repeated pairing of stimuli with pain, these stimuli can elicit conditioned fear responses. Extended to pain conditioning in a sexual situation, different stimuli, such as the naked partner or the sensation of specific caresses, can become signals for impending pain. When, during sexual encounters, repeated pairing of sexual stimuli and pain has occurred, previously appetitive sexual stimuli can elicit anticipatory defensive responses and impede the sexual arousal response. Recent studies in healthy sexually functional women have provided the initial evidence for negative effects of pain conditioning and fear on sexual response.\textsuperscript{21,22}

Interestingly, experimental studies have indicated stronger effects of pain conditioning in patients with chronic pain. Compared with pain-free controls, patients with chronic back pain and headache showed enhanced conditioned muscular responses and less extinction of these responses\textsuperscript{23,24} and patients with fibromyalgia showed enhanced avertively conditioned eye-blink reflexes.\textsuperscript{25} Although the number of studies in individuals with chronic pain is limited, and more research is needed, the initial evidence suggests that enhanced pain conditioning might be involved in the etiology and maintenance of chronic pain conditions.

In the present study, we investigated the effects of aversive pain conditioning on sexual arousal and affect in women with dyspareunia and sexually functional controls. It was expected that repeated pairing of a sexual stimulus with pain would result in decreased sexual arousal and in increased negative affect in response to this stimulus and that these conditioning effects would be stronger in women with dyspareunia compared with sexually functional controls. Based on previous research,\textsuperscript{3,4,6,7} we expected higher levels of trait anxiety, psychological distress, pain-related anxiety, vigilance, and catastrophizing in women with dyspareunia compared with controls, and we expected higher scores on these variables to be associated with stronger effects of pain conditioning on sexual arousal and affect. Also, we examined whether the tendency toward sexual excitation and sexual inhibition differed between women with dyspareunia and controls and whether these tendencies were associated with effects of pain conditioning on sexual arousal responses. According to the dual control model, individuals differ in their propensity for sexual excitation and sexual inhibition, a variability that might be genetically determined or might be the result of early learning experiences.\textsuperscript{26} Individuals with a propensity for sexual excitation get easily aroused in response to sexual stimuli, whereas the propensity for sexual inhibition reflects easily losing one’s sexual arousal because of inhibiting cues. We hypothesized that individual differences in sexual excitation and inhibition would be related to the strength of the effect of pain conditioning and predicted that a stronger tendency for sexual inhibition would be associated with stronger pain conditioning effects and that a stronger tendency for sexual excitation would be associated with weaker pain conditioning effects.

**METHODS**

**Recruitment and Inclusion**

In previous sexual conditioning studies from our laboratory, medium to large effects were observed.\textsuperscript{22,27} An a priori power analysis, with a chosen $\alpha$ value of 0.05 and a power of 80%, determined that a minimum of 26 women would be needed per group to detect large differences ($d = 0.8$) in responding between groups. In the present study, 36 women with dyspareunia and 35 controls participated. All women were paid (35€) for taking part in the study. Women with dyspareunia were recruited by sending a letter to patients on the waiting list for treatment of
dyspareunia at the outpatient clinic of psychosomatic gynecology and sexology. In addition, women with and without sexual pain complaints were recruited through advertisements at the universities of Amsterdam and Leiden, in local newspapers, and on noticeboards of regional health care centers. Following adherence by e-mail, women were screened for eligibility by phone by a trained female experimenter who used a brief structured interview. After initial screening, women visited the hospital for a brief structured interview, based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition criteria for dyspareunia, about sexual functioning and psychiatric and somatic problems and to complete the questionnaires. For women with dyspareunia, this visit also included an examination by a gynecologist, including the cotton-swab test, to examine provoked vulvodynia, a sharp, burning pain at the entrance of the vagina provoked by vestibular touch.

General inclusion criteria were age 18 to 45 years and, because of the heterosexual stimulus material, a heterosexual orientation. Additional inclusion criteria for women with dyspareunia were complaints of pain during at least 50% of (attempted) penile penetration events, with a duration of complaints of at least 6 months. Women with dyspareunia with and without provoked vulvodynia were included in the study. Inclusion criteria for women in the control group were sexual activity during the past year and no sexual problems. General exclusion criteria were pregnancy or lactation; affective, psychotic, or substance-related disorders; having undergone a hysterectomy or prolapse surgery; using medication that could affect sexual response; and medical disorders that could influence sexual arousal or pelvic floor responses or the measurement of these responses. Specific exclusion criteria for women with dyspareunia were a somatic explanation of the pain complaints (e.g., signs of a vaginal infection or lichen scleroses) as confirmed by the physical examination by the gynecologist or chronic vulvar pain unrelated to (attempted) intercourse.

Preceding participation, all women received written information including a description of the procedure, the pain stimulation, and the physiologic measurements. Participants were not tested during menstruation. The study was conducted in accordance with the Declaration of Helsinki and approved by the human subjects ethical review board of the Leiden University Medical Centre (Leiden, The Netherlands). Informed consent, in which confidentially, anonymity, and the opportunity to withdraw from the experiment without penalty were assured, was obtained from all participants.

Materials, Conditioning Procedure, and Measurements

Conditional Stimuli

Two explicit erotic pictures as used in previous studies served as CSs. Two pictures portrayed a nude heterosexual couple engaging in sexual intercourse with the woman in the superior position. The two pictures differed in the male and female actors involved and the orientation of the picture (landscape or portrait). The CSs were shown in the middle of a computer monitor, approximately 1.5 m in front of the participant. The size of the pictures was 14 × 21 cm. During the intervals between pictures, a white screen was presented. One of the pictures (CS+) was followed by the US, whereas the other picture (CS−) was never followed by the US. Assignment of pictures as CS+ and CS− was counterbalanced across participants.

Pain Stimulus

The pain stimulus (US) was an electro-cutaneous stimulus with a duration of 50 ms delivered by a safe muscle stimulation apparatus (Grass S48, Grass Technologies, West Warwick, RI, USA) with an isolation unit. The pain stimulus was administered by electrodes fastened at the wrist of the non-dominant arm. The pain stimulus produces a painful, stinging sensation and has been used in several experimental studies. The intensity of the US was set at a level that the participant described as painful and demanding some effort to tolerate.

A computer program developed at the University of Amsterdam (Amsterdam, The Netherlands; Versatile Stimulus Response Registration Program) timed the administration of the pictures and the pain stimuli and the sampling of the physiologic measurements.

Conditioning Procedure and Design

The experimental procedure involved differential conditioning with one stimulus (the CS+) being followed by the painful stimulation (US) during the acquisition phase, whereas the other stimulus (CS−) was never followed by a painful shock. Which of the two pictures served as the reinforced CS (the CS+), or the non-reinforced CS (the CS−) was counterbalanced across participants. During the entire experiment, measurements of genital arousal were recorded. During the preconditioning and extinction phases, ratings of subjective affect and subjective sexual arousal were collected.

In the preconditioning phase, participants viewed four non-reinforced presentations of the CS+ and four presentations of the CS− for 11 seconds each. Subsequently, in the acquisition phase, the contingency between the CS+ and the US was learned: the CS+ and CS− were presented 10 times each, and the CS+ was always followed by the US. The US was delivered for 50 ms, starting 10 seconds after the onset of the CS+. The extinction phase consisted of four unreinforced CS+ presentations and four unreinforced CS− presentations. There were two random stimulus orders for each phase, with the restriction of only two successive presentations of each CS. Half the participants saw the pictures in order 1, and the other half saw the pictures in order 2.

There was no interval among the preconditioning, acquisition, and extinction phases. During the entire procedure, intertrial intervals were 20, 25, or 30 seconds. The order of the length of
the intertrial interval was random, with the restriction of only two similar successive lengths. The procedure, timing of the US, and intertrial interval were adapted from previous studies that demonstrated a conditioned sexual response.21,22

The basic design for testing group and conditioning effects was a 2 (group: dyspareunia vs controls) × 2 (stimulus: CS+ vs CS−) × (trial) design, with group as the between-subject variable and stimulus and trial as within-subject variables.

Genital Response

Genital response was measured using a vaginal photoplethysmograph assessing vaginal pulse amplitude (VPA).31 Depth of the probe and orientation of the light-emitting diode were controlled by a device (a 6- × 2-cm plate) attached to the base of the photoplethysmograph. Participants were instructed to insert the photoplethysmograph such that the plate touched their labia. The vaginal photoplethysmograph was sterilized by plasma sterilization. Genital response was measured continuously during the resting baseline, preconditioning, acquisition, and extinction phases.

Galvanic Skin Conductance

To determine autonomic nervous system arousal during the conditioning procedure, skin conductance level (SCL) was measured. SCL was measured using a pair of Ag-AgCl electrodes (Con-Med, Technical Department Psychology, University of Amsterdam) attached to the middle phalanx of the middle and index fingers of the non-dominant hand. The electrodes were connected to an input device with a peak-peak sine-shaped excitation voltage (0.5 V) of 50 Hz. The signal was led through a signal-conditioning amplifier and the output was sampled at 100 Hz by a 16-bit AD converter (NI-6224; National Instruments, Austin, TX, USA).

Subjective Affective and Sexual Arousal Value

Participants were asked to rate, after each stimulus presentation, the affective value of the CSs by answering the question, “What kind of feeling does this picture evoke in you?” The question could be answered, using a button box, on a seven-point scale that varied from very negative to very positive. In addition, the sexual arousal intensity of the CSs was rated by answering the question, “To what degree do you find this picture sexually arousing?” The question could be answered on a seven-point scale that varied from not sexually arousing at all to extremely sexually arousing. The first question was presented at the monitor 1 second after the end of picture presentation. The time the questions were shown was paced by the participant’s response, but had a maximum of 45 seconds each. Immediately after answering the first question, the second question was shown. For the benefit of the conditioning procedure, a consistent interval between the CS presentations was maintained. After answering the questions, a white screen remained until the next picture was presented.

Other Measurements

Sexual Function

Data on sexual functioning were collected by the Female Sexual Function Index (FSFI).32,33 The FSFI consists of six subscales: desire, arousal, lubrication, orgasm, satisfaction, and pain. Higher scores indicate better sexual function, and a total score lower than 26.55 is considered indicative of sexual dysfunction.32 The FSFI has good internal reliability and can differentiate well between clinical samples and non-dysfunctional controls.32

Sexual Distress

The Female Sexual Distress Scale (FSDS)32,34 was used to assess sexuality-related personal distress. The FSDS consists of 12 items related to negative feelings about sexual functioning, such as sadness, guilt, and dissatisfaction. Higher scores indicate greater sexual distress, and a score higher than 7 is considered indicative of clinically significant sexual distress. The FSDS has good internal reliability and can differentiate well between clinical samples and non-dysfunctional controls.32

Sexual Abuse History

Data on sexual abuse experiences were collected with the Sexual and Physical Abuse Questionnaire. This is a self-report questionnaire consisting of seven items that measure the presence and severity of sexual and physical abuse experiences.35

Anxiety

To assess trait anxiety levels, the State-Trait Anxiety Inventory (STAI)36; Dutch adaptation37 was used. The STAI measures state (momentary, reactive) and trait (stable, dispositional) anxiety and has 20 items for assessing trait anxiety and 20 items for state anxiety. Higher scores indicate greater anxiety. The STAI has good internal reliability and good test-retest reliability.37

Psychological Distress

The Symptom Check List (SCL-90)38; Dutch adaptation39, containing 90 items, was used to assess psychological distress. A higher total score indicates more psychological distress. The SCL-90 has good internal reliability and good test-retest reliability.32,39

Pain-Related Emotions and Cognitions

To assess pain-related anxiety, the Pain Anxiety Symptoms Scale (PASS-20)40 was used. The PASS-20 consists of four subscales: fearful evaluation of pain, cognitive anxiety, physiologic anxiety, and flight and avoidance behavior. Higher scores indicate higher levels of pain-related anxiety. The PASS-20 has good internal reliability and validity.32,41

To assess pain vigilance, the Pain Vigilance and Awareness Questionnaire (PVAQ)42,43 was used. The PVAQ consists of two subscales: attention for pain and attention for changes in pain. Higher scores indicate stronger attention for pain. The PVAQ has good internal reliability and validity.43
To assess pain catastrophizing, the Pain Catastrophizing Scale (PCS)\textsuperscript{44,45} was used. This scale consists of three subscales: rumination, magnification, and helplessness. Higher scores indicate higher levels of pain catastrophizing. The PCS has good internal reliability and good test-retest reliability.\textsuperscript{44}

**Sexual Excitation and Inhibition**

The Sexual Excitation and Sexual Inhibition Inventory for Women (SESII-W)\textsuperscript{46,47} is a self-report questionnaire containing 36 items. The SESII-W consists of two factors, the sexual excitation (SE) factor and the sexual inhibition (SI) factor. Higher scores on the factors indicate a stronger tendency for sexual excitation and sexual inhibition. The internal consistency and test-retest reliability of the Dutch version of the SESII-W are satisfactory.\textsuperscript{47}

**Procedure**

An instructed female experimenter tested the participants individually. On arrival at the laboratory, the experimenter explained all the details of the procedure and the participant read and signed the informed consent form. Participants were instructed that the purpose of the experiment was to measure responses to different erotic pictures and to pain stimuli. They were told that during picture viewing, pain stimuli would be provided. The level of the pain stimulus was determined individually for each participant. The participant was exposed to repeated pain stimuli (50 ms) of increasing intensity until she rated the pain stimulus as “painful and demanding some effort to tolerate.” The experimenter determined at what stimulus intensity level the participant considered the stimulus as painful but tolerable. After this procedure, the experimenter emphasized that the intensity of the stimulus would not be changed during the experiment. After determination of the pain stimulus, the participant inserted the vaginal probe privately. After insertion of the probe, the experimenter entered the participant room again to attach the skin conductance electrodes. After she left the room, the experimental procedure started. The procedure started with an adaptation period of 2 minutes, followed by a 2-minute baseline assessment of VPA and SCL, during which music was presented. Then, the conditioning procedure started.

After the conditioning procedure, the participants completed a brief questionnaire in which they were asked to indicate on a seven-point scale, which varied from never to always, to what extent they experienced the pain stimuli as unpleasant and how anxious they were for the pain stimuli.

**Data Reduction, Scoring, and Analysis**

VPA data were entered into a computer program (developed by the Technical Support Department of Psychology, University of Amsterdam) that enables off-line graphic inspection of the data. Artifacts in the channel monitoring VPA are caused by movements of the lower part of the body or by voluntary or involuntary contractions of the pelvic muscles. A two-pass algorithm for automatic artifact removal was used to analyze the VPA data. After artifact removal, mean VPA level during the 2-minute baseline period was calculated, and mean VPA during the 5 to 10 seconds after the CS was calculated. The period of 5 to 10 seconds is based on data from our laboratory showing that vaginal blood engorgement is a relatively slow physiologic response and, hence, that differences in responding might not be observable during the first seconds after stimulus presentation. VPA change scores were calculated for each CS presentation by subtracting mean resting baseline VPA from mean VPA after CS presentation.

SCL data were measured as mean SCL during the 5 to 10 seconds after the onset of the CS (first interval response [FIR]) and the 10 to 15 seconds after the onset of the CS (second interval response [SIR]) to capture autonomic nervous system responses in anticipation of the pain stimulus and during or shortly after the delivery of the pain stimulus. SCL change scores were calculated by subtracting mean baseline SCL score from each SCL trial score.

Effects of the conditioning procedure on VPA, SCL, and ratings of subjective sexual arousal and affect were tested with mixed-factor univariate analysis of variance (ANOVA) procedures (general linear model in SPSS; SPSS, Inc, Chicago, IL, USA), with stimulus and trial as within-subject factors and group as a between-subject factor. The Greenhouse-Geisser correction was used to adjust for violation of the sphericity assumption in testing repeated measures designs.\textsuperscript{48} Preconditioning, acquisition, and extinction phases were analyzed separately. Effect sizes are reported as proportions of partial variance (partial $\eta^2$).\textsuperscript{49}

To test whether individual differences in trait anxiety, pain-related anxiety, pain vigilance, and pain catastrophizing and in the tendency toward sexual excitation and sexual inhibition were associated with conditioning effects, correlations were calculated between the STAI trait, PASS-20, PCS, PVAQ, and SE and SI scores and the genital and subjective responses after the acquisition phase.

Owing to technical problems, VPA data were missing for two participants, SCL data were missing for three participants, and subjective ratings were missing for two participants. Therefore, analyses of the SCL data were run over 35 women with dyspareunia and 33 controls, VPA data were run over 35 women with dyspareunia and 34 controls, and subjective ratings were run over 35 women with dyspareunia and 34 controls.

**RESULTS**

**Participant Characteristics and Questionnaire Scores**

Table 1 presents the demographic characteristics and questionnaire scores of the two study groups and test results. Mean
Table 1. Demographic characteristics, sexual pain characteristics, and mean scores on sexual function, anxiety, and pain-related emotion and cognition questionnaires for women with dyspareunia and control group

<table>
<thead>
<tr>
<th></th>
<th>Dyspareunia (n = 36)</th>
<th>Controls (n = 35)</th>
<th>$\chi^2/F$ value</th>
<th>$P$ value</th>
<th>Partial $\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>25.4 6.3</td>
<td>25.5 5.2</td>
<td>0.01</td>
<td>.91</td>
<td>0.00</td>
</tr>
<tr>
<td>Steady partner, n (%)</td>
<td>32 (88.9)</td>
<td>26 (74.3)</td>
<td>2.53</td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>Children, n (%)</td>
<td>1 (2.8)</td>
<td>3 (8.6)</td>
<td>1.45</td>
<td>.48</td>
<td></td>
</tr>
<tr>
<td>University, bachelor level, n (%)</td>
<td>17 (47.2)</td>
<td>22 (62.8)</td>
<td>1.16</td>
<td>.28</td>
<td></td>
</tr>
<tr>
<td>History of sexual abuse, n (%)</td>
<td>15 (41.7)</td>
<td>7 (20.0)</td>
<td>3.89</td>
<td>.048</td>
<td></td>
</tr>
<tr>
<td>Duration of pain complaints (y)</td>
<td>4.9</td>
<td>4.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifelong dyspareunia, n (%)</td>
<td>18 (50)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnosis of PVD, n (%)</td>
<td>27 (73)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSFI subscales*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desire</td>
<td>3.43 0.93</td>
<td>4.13 0.85</td>
<td>10.85</td>
<td>&lt;.001†</td>
<td>0.14</td>
</tr>
<tr>
<td>Arousal</td>
<td>4.30 1.38</td>
<td>5.15 1.14</td>
<td>7.82</td>
<td>&lt;.05†</td>
<td>0.10</td>
</tr>
<tr>
<td>Lubrication</td>
<td>3.83 1.03</td>
<td>4.49 0.83</td>
<td>8.75</td>
<td>&lt;.004‡</td>
<td>0.11</td>
</tr>
<tr>
<td>Orgasm</td>
<td>4.29 2.05</td>
<td>5.02 1.43</td>
<td>3.86</td>
<td>&lt;.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>3.92 1.45</td>
<td>4.77 1.61</td>
<td>5.37</td>
<td>&lt;.02†</td>
<td>0.07</td>
</tr>
<tr>
<td>Pain</td>
<td>1.42 1.13</td>
<td>4.98 2.09</td>
<td>80.22</td>
<td>&lt;.001§</td>
<td>0.54</td>
</tr>
<tr>
<td>FSFI full scale</td>
<td>21.11 6.32</td>
<td>28.54 5.71</td>
<td>27.02</td>
<td>&lt;.001‡</td>
<td>0.28</td>
</tr>
<tr>
<td>SCL-90 total</td>
<td>120.74 32.48</td>
<td>104.89 12.86</td>
<td>7.21</td>
<td>&lt;.01†</td>
<td>0.10</td>
</tr>
<tr>
<td>STAI trait</td>
<td>36.83 10.24</td>
<td>31.66 5.55</td>
<td>6.96</td>
<td>&lt;.01†</td>
<td>0.10</td>
</tr>
<tr>
<td>PASS subscales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fearful evaluation of pain</td>
<td>3.58 3.80</td>
<td>3.60 2.78</td>
<td>0.00</td>
<td>&lt;.09</td>
<td>0.00</td>
</tr>
<tr>
<td>Cognitive anxiety</td>
<td>8.72 5.76</td>
<td>9.77 3.76</td>
<td>0.82</td>
<td>&lt;.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Physiologic anxiety</td>
<td>6.42 4.75</td>
<td>5.91 4.20</td>
<td>0.22</td>
<td>&lt;.04</td>
<td>0.00</td>
</tr>
<tr>
<td>Flight and avoidance behavior</td>
<td>8.03 4.44</td>
<td>7.97 3.34</td>
<td>0.004</td>
<td>&lt;.05</td>
<td>0.00</td>
</tr>
<tr>
<td>PASS full scale</td>
<td>26.75 16.32</td>
<td>27.26 10.56</td>
<td>0.02</td>
<td>&lt;.88</td>
<td>0.00</td>
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<tr>
<td>PVAQ subscales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attention for pain</td>
<td>16.72 6.77</td>
<td>16.60 6.66</td>
<td>0.01</td>
<td>&lt;.94</td>
<td>0.00</td>
</tr>
<tr>
<td>Attention for changes in pain</td>
<td>12.75 5.39</td>
<td>13.51 5.86</td>
<td>0.33</td>
<td>&lt;.57</td>
<td>0.01</td>
</tr>
<tr>
<td>PVAQ full scale</td>
<td>29.47 11.23</td>
<td>30.11 11.38</td>
<td>0.06</td>
<td>&lt;.81</td>
<td>0.00</td>
</tr>
<tr>
<td>PCS subscales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ruminination</td>
<td>6.69 3.65</td>
<td>5.83 2.67</td>
<td>1.29</td>
<td>&lt;.26</td>
<td>0.02</td>
</tr>
<tr>
<td>Magnification</td>
<td>2.03 2.05</td>
<td>1.51 1.65</td>
<td>1.35</td>
<td>&lt;.25</td>
<td>0.02</td>
</tr>
<tr>
<td>Helplessness</td>
<td>4.67 4.45</td>
<td>2.54 2.01</td>
<td>6.65</td>
<td>&lt;.01†</td>
<td>0.09</td>
</tr>
<tr>
<td>PCS full scale</td>
<td>13.39 9.37</td>
<td>9.89 5.26</td>
<td>3.75</td>
<td>&lt;.06</td>
<td>0.05</td>
</tr>
<tr>
<td>SES subscales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arousability</td>
<td>2.84 0.39</td>
<td>2.97 0.23</td>
<td>3.01</td>
<td>&lt;.06</td>
<td>0.06</td>
</tr>
<tr>
<td>Sexual power dynamics</td>
<td>2.59 0.48</td>
<td>2.76 0.37</td>
<td>1.95</td>
<td>&lt;.17</td>
<td>0.03</td>
</tr>
<tr>
<td>Smell</td>
<td>2.74 0.72</td>
<td>3.04 0.50</td>
<td>3.65</td>
<td>&lt;.06</td>
<td>0.06</td>
</tr>
<tr>
<td>Partner characteristics</td>
<td>2.47 0.49</td>
<td>2.67 0.47</td>
<td>2.25</td>
<td>&lt;.14</td>
<td>0.03</td>
</tr>
<tr>
<td>Setting</td>
<td>2.21 0.55</td>
<td>2.43 0.46</td>
<td>0.37</td>
<td>&lt;.55</td>
<td>0.01</td>
</tr>
<tr>
<td>SES full scale</td>
<td>2.55 0.30</td>
<td>2.79 0.20</td>
<td>6.03</td>
<td>&lt;.02†</td>
<td>0.09</td>
</tr>
<tr>
<td>SIS subscales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship importance</td>
<td>2.89 0.42</td>
<td>2.76 0.39</td>
<td>1.25</td>
<td>&lt;.27</td>
<td>0.02</td>
</tr>
<tr>
<td>Arousal contingency</td>
<td>2.53 0.71</td>
<td>1.94 0.40</td>
<td>17.06</td>
<td>&lt;.001‡</td>
<td>0.21</td>
</tr>
<tr>
<td>Concerns functioning</td>
<td>2.69 0.65</td>
<td>2.52 0.34</td>
<td>4.04</td>
<td>&lt;.05</td>
<td>0.06</td>
</tr>
<tr>
<td>SIS full scale</td>
<td>2.74 0.47</td>
<td>2.49 0.23</td>
<td>10.6</td>
<td>&lt;.002†</td>
<td>0.15</td>
</tr>
</tbody>
</table>

FSFI = Female Sexual Function Index; PASS = Pain Anxiety Symptoms Scale; PCS = Pain Catastrophizing Scale; PVAQ = Pain Vigilance and Awareness Questionnaire; PVD = provoked vulvodynia; SCL-90 = Symptom Check List; SES = Sexual Excitation Scale; SIS = Sexual Inhibition Scale; STAI = State-Trait Anxiety Inventory.

*Range for FSFI subscales: desire (1–6), arousal (1–6), lubrication (1–6), orgasm (1–6), satisfaction (1–6), and pain (1–6). Lower scores indicate worse sexual functioning.

†$P < .05$; ‡$P < .01$; §$P < .001$. 

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age of the participants in the two study groups was 25 years (range = 19–45 years). Most women had a steady partner, no children, and a high educational level. There were no significant differences between groups in demographic characteristics, but women with dyspareunia significantly more often had a history of sexual abuse. As expected, the FSFI total score of the control group was within the normal range, whereas the score in the dyspareunia group was in the sexual dysfunctional range. All group was within the normal range, whereas the score in the dyspareunia group than in the control group, except for the orgasm domain score. Table 1 also presents dyspareunia characteristics; mean duration of the pain complaints was 4.9 years (range = 0.67–26.0 years), half the women with dyspareunia had lifelong pain complaints, and in most women provoked vulvodynia was determined based on the cotton-swab test during the physical examination.

As presented in Table 1, women with dyspareunia scored significantly higher on the trait anxiety scale and on the SCL-90. Scores on the PASS and PVAQ did not significantly differ between groups, but women with dyspareunia scored significantly higher on the PCS helplessness subscale. Furthermore, women with dyspareunia scored significantly lower on the SE factor and significantly higher on the SI factor compared with controls.

### US Characteristics

Table 2 presents US painfulness and fear and US expectancy for women with dyspareunia and controls.

<table>
<thead>
<tr>
<th>US Characteristics</th>
<th>Dyspareunia (n = 36)</th>
<th>Controls (n = 35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Painfulness of US*</td>
<td>Mean</td>
<td>3.74</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>0.56</td>
</tr>
<tr>
<td>Fear of the US*</td>
<td>Mean</td>
<td>2.36</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>0.96</td>
</tr>
<tr>
<td>US expectancy at CS+ presentation†</td>
<td>Mean</td>
<td>6.03</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.15</td>
</tr>
<tr>
<td>US expectancy at CS− presentation‡</td>
<td>Mean</td>
<td>4.09</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>2.05</td>
</tr>
<tr>
<td>Fear at CS+ presentation†</td>
<td>Mean</td>
<td>3.47</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>2.10</td>
</tr>
<tr>
<td>Fear at CS− presentation‡</td>
<td>Mean</td>
<td>2.42</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.52</td>
</tr>
</tbody>
</table>

CS+ = conditional stimulus without painful shock; CS− = conditional stimulus with painful shock; US = painful unconditional stimulus.

*Scoring 1 = not at all to 5 = very strong.
†Scoring 1 = never to 7 = always.
‡Scoring 1 = not at all to 7 = very strong.
P < .05.

### Physiologic Data

#### Preconditioning Phase

Figure 2 presents a summary of SCL in response to CS+ and CS− across preconditioning, acquisition, and extinction trials for each group. Unexpectedly, the 2 (stimulus) × 4 (trial) × 2 (group) mixed ANOVA to verify equal SCL levels during presentation of the CSs in the preconditioning phase showed a significant main effect of stimulus for SCL FIR and SIR (F1,66 = 7.66, P < .01, partial η2 = 0.10; SIR F1,66 = 5.73, P < .05, partial η2 = 0.08). Mean SCL was higher during presentation of the CS− than during presentation of the CS+. There were no significant effects of group or group × stimulus interactions.

Figure 3 presents a summary of VPA to CS+ and CS− across preconditioning, acquisition, and extinction trials for each group. The 2 (stimulus) × 4 (trial) × 2 (group) mixed ANOVA to verify equal VPA levels during presentation of the CSs in the preconditioning phase also unexpectedly showed a significant main effect of stimulus (F1,65 = 5.66, P < .05, partial η2 = 0.08). Mean VPA was higher during presentation of the CS− than during presentation of the CS+. There was no significant main effect of group and no group × stimulus interaction. To control for the unexpected initial difference in physiologic responding to the CS− and the CS+, in all further analyses of the SCL and VPA data, the mean difference between the response to the CS+ and the CS− during the preconditioning trials was included as a covariate.

#### Acquisition Phase

The 2 (stimulus) × 10 (trial) × 2 (group) mixed analysis of covariance (ANCOVA) of SCL FIR showed no significant effects. However, the 2 (stimulus) × 10 (trial) × 2 (group) mixed ANCOVA of SCL SIR showed a significant main effect of stimulus (F1,576 = 8.58, P < .01, partial η2 = 0.12). As expected, SCL SIR was higher in response to the CS+. There were no significant trial or group interactions.
Figure 2. Panels A and B show skin conductance level FIR and SIR change scores, respectively, in response to the CS\(^+\) and CS\(^-\) during the preconditioning, acquisition, and extinction phases for women with dyspareunia and controls. Skin conductance level SIRs during the acquisition phase are responses to the CS\(^+\) and the unconditional stimulus. CS\(^-\) = conditional stimulus without painful shock; CS\(^+\) = conditional stimulus with painful shock; FIR = first interval response; SIR = second interval response.
The 2 (stimulus) × 10 (trial) × 2 (group) mixed ANCOVA of VPA showed no significant main effect of stimulus but did show a stimulus × trial interaction approaching significance (F9,540 = 1.82, P = .09, partial $\eta^2 = 0.03$) and a stimulus × trial × group interaction approaching significance (F9,540 = 1.91, P = .07, partial $\eta^2 = 0.03$). Separate analyses for the two groups showed a significant stimulus × trial interaction in controls (F9,288 = 2.70, P < .05, partial $\eta^2 = 0.08$), whereas no significant effects were found in the dyspareunia group. Comparison of VPA responses to the CS+ and CS− at each acquisition trial for the two groups separately showed significant or borderline significant lower VPA in response to the CS+ compared with the CS− in the dyspareunia group.

Extinction Phase

The 2 (stimulus) × 4 (trial) × 2 (group) mixed ANCOVA of SCL FIR and SIR showed no significant main or interaction effects of group, stimulus, or trial. The 2 (stimulus) × 4 (trial) × 2 (group) mixed ANCOVA of VPA showed a significant stimulus × trial × group interaction (F3,195 = 3.04, P < .05, partial $\eta^2 = 0.05$). Separate analyses for the two groups showed no significant effects in the control group, whereas a significant stimulus × trial interaction was observed in the dyspareunia group (F3,96 = 3.06, P < .05, partial $\eta^2 = 0.09$). Comparison of VPA responses to the CS+ and CS− at each extinction trial for the two groups separately showed a significant higher VPA in response to the CS+ compared with the CS− for the dyspareunia group at trial 3 (F1,33 = 6.34, P < .05, partial $\eta^2 = 0.16$), whereas no significant differences in responding to the CS+ and CS− were observed on any trial in the control group (P > .3 for all comparisons).

Subjective Affect Ratings

Preconditioning

The 2 (stimulus) × 4 (trial) × 2 (group) mixed ANOVA of ratings of affect during the preconditioning phase did not show significant effects, indicating similar affect ratings to the CS+ and CS− and no differences between groups (P > .5 for all comparisons).

Extinction

Figure 4 presents a summary of affect ratings to CS+ and CS− during the extinction trials for each group. The 2 (stimulus) × 4 (trial) × 2 (group) mixed ANOVA of affect ratings in the extinction phase showed a significant main effect of stimulus (F1,67 = 18.42, P < .001, partial $\eta^2 = 0.22$) and a
stimulus × group interaction approaching significance (F_{1,67} = 2.79, P = .09, partial η^2 = 0.04). Affect ratings were lower to the CS^+, showing more negative affect in response to the CS^+ compared with the CS^- . This difference was less prominent in the dyspareunia group. There was no stimulus × trial interaction, indicating no extinction of the conditioned affective response, which was confirmed by the observation of a significant lower affect rating at trial 4 for the CS^+ compared with the CS^- (F_{1,64} = 12.82, P < .001, partial η^2 = 0.17).

Sexual Arousal Ratings

Preconditioning

The 2 (stimulus) × 4 (trial) × 2 (group) mixed ANOVA of ratings of sexual arousal during the preconditioning phase did not show significant effects, indicating similar sexual arousal ratings to the CS^+ and CS^- and no differences between groups (P > .6 for all comparisons).

Extinction

Figure 5 presents a summary of sexual arousal ratings to CS^+ and CS^- during the extinction trials for each group. The 2 (stimulus) × 4 (trial) × 2 (group) mixed ANOVA of sexual arousal ratings in the extinction phase showed a significant main effect of stimulus (F_{1,67} = 12.75, P < .005, partial η^2 = 0.16) and a stimulus × group interaction approaching significance (F_{1,67} = 3.28, P = .07, partial η^2 = 0.05). Sexual arousal ratings were lower to the CS^+, showing less sexual arousal of the CS^+ compared with the CS^- . This difference was less prominent in the dyspareunia group. There was no stimulus × trial interaction, indicating no extinction of the conditioned sexual arousal response, which was confirmed by the observation of a significant lower sexual arousal rating at trial 4 for the CS^+ compared with the CS^- (F_{1,64} = 8.31, P < .01, partial η^2 = 0.12).

Associations Between Conditional Responding and Trait Anxiety, Pain-Related Emotions and Cognitions, and Sexual Excitation and Inhibition Tendency

To examine associations between the strength of the differential conditioning effects and levels of trait anxiety, psychological distress, pain-related emotions and cognitions and the tendency toward sexual excitation and inhibition, we calculated correlations between the magnitude of the differential physiologic and subjective responses to the CS^+ and CS^- at the first extinction trial (response to CS^+ minus response to CS^- ) and the trait anxiety, SCL-90, PVAQ, PCS, PASS, and SE and SI factor scores (Table 3). There was a significant negative correlation between the PASS scores and the SCL SIR CS^+ - CS^- difference scores and between the PCS scores and the SCL FIR CS^+ - CS^- difference scores. Higher pain anxiety and pain catastrophizing scores were associated with less increased SCL in response to the CS^- compared with the CS^+ . Furthermore, there was a significant positive correlation between SI factor scores and VPA CS^- - CS^- difference scores; higher SI factor scores were...
associated with less decreased VPA in response to the CS$^+$ compared with the CS$^-$. In addition, we examined associations between levels of trait anxiety, psychological distress, pain-related emotions and cognitions and the tendency toward sexual excitation and inhibition, SCL and fear of the US, and US expectancy ratings (Table 4). There was a significant correlation between PASS scores and US expectancy ratings at presentation of the CS$^-$. Higher pain anxiety scores were associated with stronger US expectancy at presentation of the CS$^-$. 

**DISCUSSION**

This study investigated the effects of aversive pain conditioning on sexual arousal and affect in women with dyspareunia and sexually functional controls. As expected, and in agreement with previous studies, pairing of a sexual stimulus with a pain stimulus resulted in decreased feelings of sexual arousal and increased negative affect toward this stimulus. However, in contrast to expectations, the differences in affect and sexual arousal toward the stimulus that was paired with pain and the stimulus that was not paired with pain tended to be less prominent in women with dyspareunia than in controls. VPA responses at the extinction trials did not show decreased genital arousal toward the stimulus that was paired with pain. However, during the acquisition phase, an inhibiting effect of the pain stimulation on VPA was observed over trials but was more prominent in controls than in women with dyspareunia. Furthermore, women with dyspareunia showed, as expected, higher levels of anxiety, pain catastrophizing, and sexual inhibition, but, in contrast to expectations, pain catastrophizing and sexual inhibition were not associated with stronger but with weaker differential aversive conditioning effects.

How can we explain these unexpected outcomes? Remarkably, the two groups showed a significant difference in US expectancy. They reported a similar US expectancy at presentation of the CS$^+$, but women with dyspareunia reported a stronger US expectancy for the CS$^-$ compared with the controls. Thus, women with dyspareunia expected more strongly to receive the pain stimulus at presentation of the “safe” stimulus, the stimulus that was never paired with pain. Possibly, because of the higher pain...
expectancy at presentation of the safe sexual stimulus, and thus less discrimination between the safe and the unsafe stimuli, women with dyspareunia showed weaker differential VPA responses to the two sexual stimuli during the acquisition phase and weaker differential subjective affect and sexual arousal to the two stimuli.

Interestingly, in other conditioning studies in patient groups in which one stimulus was paired with pain and another stimulus was not, often no differential effects toward these stimuli were observed. In fact, studies with patients with anxiety disorders have shown increased fear responding to the threat stimulus and the safety stimulus.50–54 Based on these observations, it has been hypothesized that subjects with anxiety disorders fail in the inhibition of fear, even during the appearance of safety signals.55 Recent studies also have observed deficient safety learning in individuals with high trait anxiety, which is a known risk factor for developing anxiety disorders.56 In this context, it is interesting that higher levels of anxiety have been observed in women with dyspareunia,3,4 including the present study, and that we observed less prominent effects of differential aversive conditioning in this group.

Remarkably, similar learning deficits have been observed in patients with pain. For example, in pain conditioning studies in patients with fibromyalgia, after conditioning, novel stimuli elicited fear responses, irrespective of the perceptual resemblance to the original CS+ and CS−, indicating non-differential generalization of fear.57,58 The investigators suggested that this learning deficit might be involved in the maintenance of chronic pain. When potential harm and safety are not successfully identified, it leads to sustained anxiety and fuels the spreading of fear and avoidance behaviors.59 Our observations of higher pain expectancy at presentation of the safe stimulus, less prominent differential genital responding to the CSs during acquisition, and weaker conditioning effects on subjective affect and sexual arousal in women with dyspareunia indicate that deficient safety learning also might be involved in chronic sexual pain.

Thus, returning to our hypotheses, pairing of a sexual stimulus with pain does result in more negative affect and lower feelings of sexual arousal in response to that stimulus. However, our observations in women with dyspareunia suggest that it might not so much be enhanced pain conditioning, but rather deficient safety learning, that is important in chronic sexual pain. Women with dyspareunia seem to expect pain at the safe stimulus and the unsafe stimulus. When potential harm and safety in sexual situations are not adequately identified, this can lead to a generalized fear of sex and decreased sexual arousal and desire. This is in line with the observations of low sexual desire and complaints of decreased sexual arousal and vaginal lubrication in women with dyspareunia.7,11,12

Apart from the unexpected outcomes in women with dyspareunia, we unexpectedly did not replicate our previous observations of decreased VPA in the extinction phase in response to the sexual stimulus that was paired with pain. Because the aversive conditioning procedure in the present study was similar to the procedure in our previous studies,21,22 procedural differences cannot account for this lack of replication. However, as noted earlier, in the present study, unexpectedly, VPA and SCL levels in response to the CS+ and CS− were significantly different in the preconditioning phase. This is hard to explain, because the two sexual pictures were carefully counterbalanced. We controlled statistically for these unexpected differences, but it could have hampered the observation of differential conditioning effects. In addition, although most participants reported that they perceived the pain stimulus as fairly painful, most reported that fear of the US was only moderate. Possibly, a more fearful pain stimulus would have resulted in stronger and more consistent conditioning effects. However, reported pain and fearfulness of the US in the present study were not lower than in our previous studies; therefore, a difference in US intensity cannot explain lack of replication. We conclude that the effects of sexual conditioning measured by genital responding are not strong and are inconsistent.

Table 4. Correlations between trait anxiety, psychological distress, pain anxiety, pain catastrophizing, pain vigilance, sexual excitation and sexual inhibition, and magnitude of conditioned subjective affect, subjective sexual arousal, vaginal pulse amplitude, and skin conductance level at first extinction trial

<table>
<thead>
<tr>
<th></th>
<th>CS+–CS− affect</th>
<th>CS+–CS− sexual arousal</th>
<th>CS+–CS− VPA</th>
<th>CS+–CS− SCL FIR</th>
<th>CS+–CS− SCL SIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait anxiety</td>
<td>0.09</td>
<td>0.17</td>
<td>0.10</td>
<td>−0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>SCL−90</td>
<td>−0.08</td>
<td>−0.01</td>
<td>−0.03</td>
<td>−0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>PVAQ</td>
<td>−0.07</td>
<td>−0.08</td>
<td>−0.05</td>
<td>−0.06</td>
<td>−0.04</td>
</tr>
<tr>
<td>PASS</td>
<td>−0.03</td>
<td>0.03</td>
<td>−0.14</td>
<td>−0.21</td>
<td>−0.24*</td>
</tr>
<tr>
<td>PCS</td>
<td>−0.03</td>
<td>0.05</td>
<td>−0.06</td>
<td>−0.28*</td>
<td>−0.22</td>
</tr>
<tr>
<td>SES</td>
<td>−0.11</td>
<td>−0.16</td>
<td>−0.13</td>
<td>−0.08</td>
<td>0.09</td>
</tr>
<tr>
<td>SIS</td>
<td>0.12</td>
<td>0.19</td>
<td>0.26*</td>
<td>−0.16</td>
<td>−0.15</td>
</tr>
</tbody>
</table>

CS− = conditional stimulus without painful shock; CS+ = conditional stimulus with painful shock; FIR = first interval response; PASS = Pain Anxiety Symptoms Scale; PCS = Pain Catastrophizing Scale; PVAQ = Pain Vigilance and Awareness Questionnaire; SCL = skin conductance level; SCL-90 = Symptom Check List; SES = Sexual Excitation Scale; SIR = second interval response; SIS = Sexual Inhibition Scale; VPA = vaginal pulse amplitude.

*P < .05.
For future studies, several improvements and additions should be considered. The inclusion of an unpaired or randomized control group could help to distinguish learning about the CS+ (enhanced pain learning) from learning about the CS− (deficient safety learning). Also, expectancy ratings at each trial will provide insight on the association of US expectancy and responses to the CSs over trials. It is important to determine whether the observed stronger pain expectancy at the “safe” CS in women with dyspareunia is a robust phenomenon. Also, it would be interesting to investigate whether women with dyspareunia show non-differential generalization of conditioned responses by including stimuli that vary in perceptual resemblance to the original CS+ and CS−. Furthermore, inclusion of a larger number of extinction trials is needed to investigate resistance of extinction of conditioned responses. In addition, given the important role of the pelvic floor muscle activity in sexual pain problems, it would be interesting to test the effects of aversive pain conditioning on pelvic floor muscle activity.19 Also, because of the suggestion of disgust as an important aversive factor involved in sexual dysfunction19,60 and evidence of disgust responses to sexual stimuli in women with sexual pain disorders,60 it would be interesting to study the effects of repeated sex-disgust pairing.

Although we should be cautious of the generalizability of the study results, because women with dyspareunia who volunteer in a pain conditioning study that includes the insertion of a vaginal measurement device might differ from the clinical dyspareunia population and the experimental setting is obviously different from the experience of pain in actual sexual encounters, the results from the present study have some important clinical implications. The results show that repeated pairing of a sexual stimulus with pain results in stronger negative affect and decreased feelings of sexual arousal. Other findings from our laboratory showed that conditioned affect can be relatively persistent.22 These findings emphasize the importance, as a first step in treatment, to advise women with dyspareunia and their partners to refrain from painful penetration to prevent further acquisition of the link between sex and pain. Because women with dyspareunia can have the tendency to continue with intercourse despite pain because they see intercourse as their duty in a heterosexual relationship,18 it is very important to explain the rationale of this advice carefully to the couple. At the same time, the findings point to the possibility that in subsequent treatment, a combination of extinction and counterconditioning (learning a new opposite response) would plausibly be most effective to restore sexual arousal and positive affect toward sex. Importantly, our results indicate that women with dyspareunia might have a tendency to expect pain even in response to “safe” sexual stimuli, which can result in sustained pain anxiety and avoidance behaviors. Prolonged avoidance and safety behavior, which could be strengthened by a tendency toward pain catastrophizing and sexual inhibition, prevents confrontation with feared stimuli and situations, precluding extinction of learned fear responses. Moreover, avoidance of even safe sexual situations will hinder the recovery of positive sexual associations and through that desire for sex.15 In line with this, avoidance and pain catastrophizing have been identified as predictors of the outcome of cognitive behavioral treatment of dyspareunia.61 Recent studies have shown that partner reactions are important in this respect.62–64 Highly solicitous partners might encourage avoidance of sexual intercourse, which could prevent extinction of fear toward penetration. Interestingly, a recently developed therapist-aided in vivo exposure treatment for women with lifelong vaginismus and their partners, with a strong focus on the prevention of avoidance behavior in the performance of penetration exercises, has been shown to be highly effective.65 Although exposure procedures in sexual pain problems have to be handled with care, it would be interesting to investigate whether systematic approaches to challenge avoidance behavior also could improve cognitive behavioral treatment for patients with dyspareunia.

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REFERENCES


Aversive Conditioning in Dyspareunia