Reduced Labial Temperature in Response to Sexual Films with Distractors among Women with Lower Sexual Desire

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ABSTRACT

Introduction. Sexual desire variation traditionally has been treated as due to variance in affective response to sexual stimulation, but differences in attention to the stimuli may better account for differences in sexual desire.

Aim. Determine whether sexual desire varies due to attention biases towards sexual stimuli.

Main outcome measures. Sexual arousal was quantified by physiological (labia minus temperature) and experienced (continuously adjusting a potentiometer) indicators.

Methods. Twenty-two women who varied in their level of sexual desire attended one laboratory session during which they viewed a neutral nature film, a sexual film, and a sexual film with distractors while their labial temperature and self-reported sexual arousal were recorded.

Results. Participants reported and displayed lower sexual arousal during the sexual stimulus with distractors as compared to the sexual film without distractors. While all women reported lower sexual arousal to the sexual film with distractors, women with relatively lower sexual desire also reported lower sexual arousal to the sexual film with no distractors than women with higher sexual desire. Physiologically, women with lower sexual desire exhibited lower labial temperature.

Conclusions. Since the predicted lower self-reported and physiological sexual arousal to the sexual stimulus with distractors for the women with lower sexual desire did not emerge, this study does not support that sexual desire levels vary due to differential attention to sexual stimuli.


Key Words. Labial Temperature; Hypoactive Sexual Desire Disorder; Distraction; Sexual Arousal

Introduction

Although sexual desire level can vary tremendously by person, situation, and time, what causes individuals to experience and report their sexual desire as higher or lower is unclear. For example, those reporting lower sexual desire may only report that their desire is low due to its contrast with an intimate partner's desire level [1]. Although little is written about women with higher levels of sexual desire, men reporting higher sexual desire may use it as an attribution of their motivation to engage in risky sexual behaviors [2]. The surprising few (and rarely empirically supported) treatments for sexual desire problems [3] (for exception see [4,5]), may be due to the lack of a testable, unifying theory to fully describe correlates, or explain the causes of individual differences in sexual desire. Empirical evidence increasingly suggests that attention to sexual stimuli should be a central component of a theory of individual differences in sexual desire levels (e.g., [6]). To that end, the current study examines whether women with different levels of sexual desire vary in their sexual response to film stimuli in the presence of distractors.

Attention to sexual stimuli has been hypothesized as an important factor in several prominent...
existing models of sexual desire. Here, “sexual desire” is used to describe the cognitive component of sexual arousal (cp., [6]). Specifically, sexual desire is conceptualized as one result of sexual stimulation and sexual response initiation, rather than as the initiating state [9]; thus, research addressing sexual arousal and arousability is included. “Spectatoring” is taking the perspective of an evaluative third person while engaged in sexual activity [10]. Spectatoring remains a common framework for understanding differences in sexual arousal (e.g., [11]). When a person is spectatoring, s/he is thought to direct attention to their own sexual performance, and, if the person is experiencing sexual problems [12], then they experience a negative affective response (e.g., anxiety). The negative affective response inhibits further sexual response. This is consistent with Barlow’s [13] model of sexual functioning, except for the order of operations. Barlow also posits that less attention to sexual cues results in no/low sexual response, but in his model, the attention directed to sexual cues is determined by the affective response to the sexual cue. Thus, both models suggest that attention to facilitating sexual cues is an important facet of the development of sexual response, but the role of emotion modulation of attention varies.

Sexual stimuli appear to require processing resources beyond those required to process otherwise matched neutral, unpleasant, and pleasant stimuli. For example, during a simple search for a target, sexual word distractors slowed target identification more than other emotional (positive or negative) or neutral distractor words [14]. In addition, startle responses to probes administered soon after a picture stimulus onset were inhibited during sexual stimuli more than neutral stimuli [15]. Finally, sexual stimuli contribute to higher late positive potentials in evoked response potentials as compared with neutral stimuli [16] and differences earlier in evoked response potentials as compared with other emotional (positive or negative) stimuli [17]. If sexual stimuli require significant amounts\(^1\) of attentional resources to process, it is reasonable that other demands on attention might interfere with the development of sexual desire during sexual stimulation. In fact, lower sexual arousal has been demonstrated in response to sexual cues when presented with increasingly complex math operations [18–22] and a probe identification task [23].

Although distraction from a sexual stimulus impairs the development of sexual response, it is unclear if differences between individuals in their baseline attention to sexual stimuli contribute to individual differences in sexual arousability. Sexual desire differences between individuals might represent a stable predisposition to allocate attention to sexual cues. Conaglen [24] found that those with very high and very low sexual desire were slower than moderate sexual desire participants to identify a sexual word as being a real word, but the delay to sexual stimuli in those groups was not replicated in a subsequent study [25]. Participants with lower sexual desire were found to have greater prepulse inhibition, an index of sensory gating (cp. [26]), to sexual stimuli than participants with higher sexual desire [27]. This indicates that participants with lower sexual desire did not experience a dampening of response to subsequent stimuli because of a sexual prestimulus, which suggests that sexual stimuli absorbed less attention in those participants. Another study indicated that those with lower sexual desire actually attend more to sexual stimuli when those stimuli were presented simultaneously with nonemotional distractors than persons with higher sexual desire [6]. Studies examining gender differences are also informative if one assumes, as many have documented [28], that men have higher sexual desire than women on average. Women typically are slower to respond to sexual than nonsexual targets [29]. Because the delay to the sexual stimuli also increased as the sexual target was less “socially acceptable,” the authors interpreted the finding as reflecting a more nuanced, socially intermediated response by women. However, it is unclear how simple novelty may account for the effects observed.

Although distractors clearly decrease sexual response, baseline individual differences in attention to sexual stimuli seem to have mixed effects on sexual response. The mixed effects may be due to the nature of the distractor(s) used, thus, difference would only emerge in interaction with certain effective distractors. For example, women with high and low sexual self-focus, an index of “propensity to be introspective and to monitor bodily responses, thoughts, and feelings during sexual interaction with a partner” (p. 519), were compared in one study [30]. High sexual self-focus women experienced decreased physiological sexual response during conditions when also directed to turn attention toward their own body. In contrast, another study did not find differences between distracting and non-distracting conditions between women with or without sexual dysfunction [22].
However, the “dysfunction” sample in that study was very heterogeneous, making it difficult to suggest that there was any stable individual difference underlying everyone in the “dysfunction” group. Another study comparing participants who varied in their orgasm frequency, classified as “frequent” or “infrequent,” also did not find differences in their physiological or subjective sexual arousal when distracted (adding numbers) during a sexual stimulus [19].

**Aims**

The current study expands this literature by (i) using physiological measures appropriate for between-subject designs; (ii) recruiting women who vary in their level of sexual desire; and (iii) using a more naturalistic method of distracting. It is hypothesized that, although all women’s responses will decrease when a distractor occurs during the sexual film, women with low sexual desire will experience a greater declination in response. In other words, women with lower sexual desire are thought to attend less to sexual cues at baseline, thus the addition of a distractor would result in a more marked decline in response than for women with higher sexual desire.

**Methods**

**Participants**

Volunteers were recruited through flyers and newspaper advertisements. These ads requested women over age 18 for a paid study in which “instruments monitor genital responses” during the viewing of “emotional” films. Additionally, ads requested women with either “low or absent” or “very high” sexual desire. The advertisements provided both a website and phone number to contact for more information. Women were provided additional information before asking if they would like to volunteer, including the expected length of the study, laboratory setting, instruments to be used, and films to be viewed. Each woman received $25 for participating. The study was approved by the university’s Human Subjects Committee.

**Film Stimuli**

The film stimuli in this study included two, 5-minute sexual film excerpts and neutral films during baseline periods. Each of the two sexual films depicted consensual, erotic, heterosexual encounter, edited to equal parts of kissing/foreplay, oral sex being performed on the man and then the woman, and penile–vaginal intercourse [31,32]. Sexual behaviors rated by women as less appealing were excluded (e.g., anal sex [33]). These two sexual films were selected as maximally, sexually arousing in a previous study [34]. The neutral film was a documentary about underwater sea creatures that did not portray any sexual activity [35].

A distracting version of each sexual film was created to permit the use of a balanced design. The distracting version was designed to create the impression of poor VHS tape quality, including brief losses of sound, picture flickering, and uneven film speed. Although several other published distraction methods exist, such as performing simultaneous math calculations, those methods do not resemble real distractors that women report experiencing during sexual stimulation [36]. Previous distraction methods also may interact with individual differences in attention to different aspects of sexual cues [8], which could obfuscate sexual desire level differences under study. For instance, directing participants to visual targets may reduce individual differences that would have existed in attending to contextual or sexual elements of the scene portrayed. By integrating nonspecific distractors into the film itself, the idiosyncratic cognitive distracters of each participant were free to vary. The decrease in experimental control yields increased face validity, and potentially, increased external validity. In sum, each woman viewed a high-intensity sexual film (SEXUAL) and a high-intensity distracting sexual film (DISTRACTING), and the neutral film (BASELINE) started before and continued between sexual films.

**Procedure**

All of the women who expressed an interest in participating were contacted by phone. During this phone contact, a female research assistant described the instruments used in the research and the protocol in detail. After providing the opportunity for the women to ask additional questions, interested participants were scheduled for an informational tour of the laboratory. During the tour, each woman received an Informed Consent Statement to take home to read privately and was shown the room and instruments involved in the assessment. Although many women asked questions during the tour, none declined to participate at this stage. Then, the woman could contact the
laboratory if she were still interested to schedule the 2-hour testing session.

If the woman elected to participate, she was tested individually. Upon arrival at the laboratory, the participant was assured of her confidentiality, the female experimenter verbally reviewed the procedure with her, asked whether she still would like to participate, and then asked her to sign the informed consent statement if they indicated a continued desire to participate. No one declined to participate at this stage. The woman then completed questionnaires on a computer in a private testing room, which is expected to increase reporting of socially undesirable behaviors [37]. When she indicated that she had completed the questionnaires, she was accompanied by the first author into a private, temperature-controlled testing room furnished with a gynecological exam table fitted with an adjustable computer monitor and keyboard. The temperature of the testing room was noted at this time by a digital wall gauge (VWR International, West Chester, PA, USA, 61161-324) accurate to 0.1°C. Ambient temperature varied little (mean [M] = 23.9, standard deviation [SD] = 0.5) during testing and was not related to labial temperature during baseline periods.

The first author oriented the woman to the room, instructed the participant to sit on an inclined gynecological exam table, solicited questions, provided a paper drape for the participant to cover herself with, and left the testing room. When the participant signaled that she was ready, the first author returned and placed the labial instrument to ensure proper placement in the labial folds. To permit adequate dissipation of heat, the paper drape remained at her knee level and her legs remained slightly apart, aided by knee supports and foot stirrups. These supports were adjusted to the comfort of each woman. The experimenter then reviewed the use of a potentiometer to continuously indicate their level of sexual arousal during the study to the participant (see the “Self-reported sexual arousal” section for more information), closed the testing room door, and retired to the adjoining room.

The experimental phase of the study started with a 15-minute adaptation phase, during which the participant was shown the neutral, nonsexual film excerpt to help her acclimation to the setting and instruments. Participants then filled out subjective measures (not reported here) on the computer. This was followed by the presentation of one of the two test films, in a counterbalanced order. Between the presentations of each sexual film, a continuation of the neutral film was shown for 10 minutes to permit participants to return to their baseline response levels. After the film presentations, a post-experimental interview was completed on the computer and feedback was provided by the experimenter if desired by the participant.

Main Outcome Measures
Physiological Sexual Arousal

The labial thermistor is a metal clip padded at the end of one arm by medical-grade silicone and a thermistor permanently affixed to the facing arm with a sliding bead to adjust the clip tension. The device is placed on the widest portion of the labium minus (see Figure 1). The tension is increased by sliding the adjustable bead until the thermistor cord can be lightly tugged without dislodging the device. Labial temperature measured using this method as an indicator of sexual arousal has demonstrated convergent validity by covariation with visual sexual stimulation and self-reports of sexual arousal [38] and discriminant validity by not varying with arousing, nonsexual stimuli [39]. Despite early concerns regarding the instrument’s return to baseline that provoked cooling interventions [40], more recent research suggests participants return to baseline sufficiently following such brief stimuli [39].

The labial thermistor was constructed of a pediatric thermistor (Yellow Springs Instruments, Figure 1 Placement of the labial thermistor indicating the measurement distal to the introitus. Note: Used with permission: McGill University, Kimberly Payne, Ph.D.
Yellow Springs, OH, USA) affixed to one side of a small metal clip (Hector Engineering Co., Inc., Bloomington, IN, USA). A new disposable, silicone pad was placed over the other side of the metal clip for each participant. The instrument (thermistor and clasp) was disinfected for each participant. Specifically, it was rinsed with tap water, wiped with gauze, washed in a sodium dodecyl sulfate solution [41,42], high-level disinfected using CidexPlus (glutaraldehyde 3.4%), with a 20-minute immersion time [43], and rinsed with sterile water. Temperature was oversampled at 200 Hz and is reported in Celsius. The instrument was placed on the widest part of the left labium minus with the thermistor toward the introitus.

Self-Reported Sexual Arousal
A ±5 mV potentiometer made adjustable by a lever was calibrated to produce a signal ranging from 1, indicating no sexual arousal, to 100, indicating maximum sexual arousal. Maximum sexual arousal was defined for the participants as the most sexually aroused the participant could recall ever experiencing. Women rarely indicated 100 using this scale. Participants were instructed to move the lever during the test films to indicate how sexually aroused they felt (cp. [44]).

Questionnaires
Demographic and Sexual History Form
An unstandardized questionnaire requested demographic and sexual information. Demographic questions included age, education, and relationship status. Sexual information questions included the number of lifetime sexual partners, number of lifetime sexual intercourse partners, and masturbation frequency. Women also were asked when their last menses ended (six response options from “last couple of days” to “3+ weeks”, including the option that they did not experience menses), their menopause status (premenopausal, perimenopausal, or postmenopausal), and to list any medications that they were taking.

Sexual Desire Inventory (SDI)
This questionnaire measures static levels of sexual desire using two, seven-item self-report scales: the Solitary Sexual Desire scale, which measures an individual’s desire for autoerotic sexual activity, and the Dyadic Sexual Desire scale, which measures an individual’s desire for sexual activity with a partner (SDI) [45]. Scores on the SDI are not dependent upon participants being sexually experienced. The two subscales were internally consistent (Cronbach’s α: Dyadic scale = 0.86; Solitary scale = 0.96) and modestly correlated (r = 0.35), which suggests that they capture different variance and may be thought of as measuring separable constructs. Although this study was not designed to investigate clinical populations, the Dyadic subscale of the SDI and the desire subscale of the Female Sexual Function Index [46] clinical instrument were strongly related (r = 0.78, P < 0.001) in a previously published study [6]. The SDI is the instrument that best represents the conceptualization of sexual desire as the cognitive component of sexual arousal and for which the psychometric properties are published. For example, it includes questions about the frequency of cognitions of “sexual thoughts involving a partner,” but also asks about possible indicators of physical arousal and sexual approach behaviors including the strength of urges and liking “to engage in sexual activity.”

Data Analysis
Data were collected using AcqKnowledge Software (BIOPAC Systems, Goleta, CA, USA, v0.3.5.7) and processed using MatLab (v 6.5, The Mathworks, Natick, MA, USA). Continuous sexual arousal measures were epoched into 10-second, nonoverlapping intervals. Statistical analyses were conducted using SPSS (v0.15.0). The Greenhouse–Geisser [47] correction was applied to all repeated-measure ANOVAs for sphericity violations, although uncorrected degrees of freedom are reported as is convention. An alpha of 0.05 was selected for significance testing. Exact significance values are reported for values below 0.05 except in cases where P < 0.001.

Sexual desire groups were created using the Dyadic sexual desire subscale of the SDI, which is consistent with previous research [6,27]. Women were divided equally into a higher and lower desire group by median-split. Although the potential problems with median-splits are well-known [48,49], it was necessary to transform the variable to a nominal form to permit the examination of interactions with the film conditions per the hypotheses.

Finally, correlations and cross-correlations of physiological and self-reported sexual arousal are presented. These explore the possibility that any interactions observed between films and sexual desire are characterized by differences in the time course of self-reported and physiological sexual arousal. Temperature measures of sexual response appear to have particularly strong correspondence with self-reported sexual arousal [50], so these data
Table 1  Demographic and sexual information by sexual desire group

<table>
<thead>
<tr>
<th></th>
<th>Higher sexual desire</th>
<th>Lower sexual desire</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>20.91 (1.45)</td>
<td>25.73 (10.40)</td>
<td>0.14</td>
</tr>
<tr>
<td>Lifetime sexual intercourse partners*</td>
<td>13.3 (8.2)</td>
<td>12.1 (13.4)</td>
<td>0.14</td>
</tr>
<tr>
<td>Concern about sexual desire level†</td>
<td>1.36 (0.50)</td>
<td>2.45 (1.04)</td>
<td>0.01</td>
</tr>
<tr>
<td>Menopause status (premenopausal)</td>
<td>10 (8)</td>
<td>8 (11)</td>
<td>0.46</td>
</tr>
<tr>
<td>Taking hormonal birth control</td>
<td>2 (8)</td>
<td>2 (6)</td>
<td>0.61</td>
</tr>
<tr>
<td>Education (completed high school)</td>
<td>10 (8)</td>
<td>8 (11)</td>
<td>0.53</td>
</tr>
<tr>
<td>Heterosexual (self-defined)‡</td>
<td>9 (5)</td>
<td>5 (5)</td>
<td>0.18</td>
</tr>
<tr>
<td>Currently monogamous relationship</td>
<td>9 (4)</td>
<td>4 (7)</td>
<td>0.09</td>
</tr>
<tr>
<td>History of “very negative” sexual experience§</td>
<td>3 (6)</td>
<td>6 (6)</td>
<td>0.19</td>
</tr>
<tr>
<td>Orgasm within last 24 hours</td>
<td>8 (6)</td>
<td>6 (6)</td>
<td>0.66</td>
</tr>
</tbody>
</table>

*One person indicated 100 sexual partners. When included, the Mean (M) = 20.4 and standard deviation (SD) = 29.3.
†Response options range from 1, not at all concerned, to 5, very strongly concerned.
‡Although one woman identified as homosexual, she did not emerge as an outlier in any analyses. For example, during the sexual film, she reported peak arousal of 35.9 (of 100) and evinced a linear increase in labial temperature to 0.09°C increase. Chi-square analysis includes bisexual (N = 2 and N = 5, respectively) and homosexual (N = 0 and N = 1, respectively) participants.
§Although these experiences could impact women’s sexual response, these data were not sufficiently detailed to permit additional, unplanned analyses.

present a unique opportunity to investigate issues of concordance of these indicators of sexual arousal. Cross-correlations are essentially bivariate correlations with two time series (in this case, 10-second intervals of self-reported and physiological sexual arousal) that are shifted by “lags” or units of time. One time period of a measure can be compared against different time shifts of the other measure (e.g., Time 1 of measure 1 with time 2 of measure 2). The prominence of a positive or negative lag suggests one time series is changing before (or after) the other, rather than only examining simultaneous change as typically done with bivariate correlations. Because this was not a primary hypothesis of the study, they are presented for descriptive purposes to suggest directions for future research.

Results

Subject Characteristics
Twenty-three female participants between the ages of 18 and 55 (M = 23.1, SD = 7.5) were recruited through flyers and newspaper advertisements. Because the labial thermistor fell off one participant twice during the study, her data were not analyzed further. Eighteen participants reported being Caucasian and four as Black/African-American. Other demographic and sexual history information are presented in Table 1, including participant reports of concern about their sexual functioning, menstrual status, and use of hormonal birth control.

Participants’ scores on the scales of the Dyadic subscale of the SDI were highly variable (M = 44.05, SD = 16.85). This permitted meaningful use of the median-split at a score (Median = 48.5). The “higher” and the “lower” sexual desire groups each contained 11 participants. The lowest possible score on the dyadic sexual desire scale is 8. Unpublished data from 3,164 university women (age M = 19.1, SD = 1.84) on this measure indicate that 58.9% of that sample fell at or below the cutoff score used for the median split in this study (48). The study sample size was not sufficient to restrict analyses to more extreme responders.

Sexual Arousal Reported
Participants’ feelings of sexual arousal as assessed by the continuous lever were analyzed by a 3 (Film Condition: Baseline, SEX, DISTRACT) x 2 (Group: higher sexual desire, lower sexual desire) mixed analysis of variance (ANOVA). The average sexual arousal reported for each condition was analyzed. Significant main effects of Film Condition (F[2,40] = 17.30, P < 0.001, η² = 0.46, ε = 0.95) and Group (F[1,20] = 5.18, P = 0.03, η² = 0.21) were evident. These were qualified by a Film x Group interaction (F[2,40] = 3.83, P = 0.03, η² = 0.16). Contrasts demonstrated that the interaction was due to participants with lower sexual desire reporting less of an increase in sexual arousal to the SEX film as compared with their baseline, F(1,20) = 7.08, P = 0.02, η² = 0.26, than participants with higher sexual desire who reported a greater increase in sexual arousal to the SEX film as compared with their baseline (see Figure 2). Thus, although both groups reported more sexual arousal to the sexual as compared with the neutral...
film, this increase was greater for women with higher sexual desire. Contrasts of the group interaction with the SEX and DISTRACTING film differences were not significant.

**Genital Responses**

To test whether women returned to baseline before each test film, the two baselines (before sexual film, before distracting sexual film) were compared. The average of the entire 10-minute baseline immediately preceding each test film was used. Baselines did not differ significantly \( F(1, 21) = 3.15, \ P = 0.09 \), so raw temperature values were used in analyses. “Baseline” in subsequent analyses refers to the average of both baselines for each participant.

A 3 (Film: Baseline, SEX, DISTRACT) \( \times 2 \) (Group: Higher sexual desire, lower sexual desire) mixed ANOVA was performed predicting labial temperature. There were main effects of Film, \( F(2, 40) = 6.92, \ P = 0.01, \ \eta_p^2 = 0.26, \ \varepsilon = 0.75 \), and sexual desire Group, \( F(1, 20) = 13.64, \ P = 0.001, \ \eta_p^2 = 0.41 \). Contrasts indicated that the film effect was due to lower labial temperature at baseline as compared with the SEX \( F(1, 20) = 12.18, \ P = 0.002, \ \eta_p^2 = 0.38 \), and lower temperature to the DISTRACT as compared with the SEX \( F(1, 20) = 6.60, \ P = 0.02, \ \eta_p^2 = 0.25 \) films \(^2\) (see Figure 3). The main effect of sexual desire group indicated that women in the lower sexual desire group exhibited lower labial temperature \( \left( C^\circ \right): M = 33.33, \text{ standard error } [\text{SE}] = 0.20 \) than women in the higher sexual desire group \( (M = 34.36, \text{ SE} = 0.20) \). There was no interaction of condition and sexual desire group.

\(^2\)With Bonferroni-correction for multiple comparisons \( \alpha = 0.05/3 = 0.017 \), this contrast would not be significant. It is included, given that it was the planned comparison among the three possible, and the effect size suggests it is an important difference in the main effect.

The effect of sexual desire group could be due to one group reaching a higher temperature during the sexual films and not fully returning to baseline, although the entire sample on average did return to baseline between test films. An independent t-test was conducted to determine whether the two desire groups differed in the averaged, final minute of the baselines before each test film: women with higher sexual desire \( (M = 34.27, \text{ SD} = 0.55) \) did exhibit higher labial temperature during the last minute of the baselines than women with lower sexual desire \( (M = 33.27, \text{ SD} = 0.78; \ t(20) = 3.48, \ P = 0.002, \ \text{d}_{\text{pooled}} > 1) \). This difference may have emerged if arousal increased more rapidly in women with a higher sexual desire, resulting in a somewhat higher final temperature that did not return to baseline. If true, the temperature of women with higher sexual desire should exhibit a stronger linear acceleration. An exploratory 2 (Film: SEX, DISTRACT) \( \times 30 \) (Interval) \( \times 2 \) (Sexual desire group: High, Low) mixed ANOVA was conducted to test this possibility. There was only a main effect of Interval \( F(29, 580) = 16.41, \ P < 0.001, \ \eta_p^2 = 0.45, \ \varepsilon = 0.04 \) due to a linear \( F(1, 20) = 17.51, \ P < 0.001, \ \eta_p^2 = 0.47 \), and cubic \( F(1, 20) = 7.95, \ P = 0.01, \ \eta_p^2 = 0.29 \), pattern of increase. Because there was no interaction with group, it is unlikely that group differences in physiological baselines between sexual films were due merely to a more rapid increase in sexual arousal.

**Correlations between Subjective and Physiological Arousal by Condition**

Between-subject\(^3\) correlations and cross correlations were conducted between the lever and labial

\(^3\)Within-subjects correlations also are possible and have been used with these data in the past. However, labial temperature is an absolute measure that does not require the correlations be conducted within participant as does, for instance, the vaginal photoplethysmograph.
Temperature and self-reported sexual arousal were averaged across participants within each sexual desire group. The correlation of self-reported and physiological sexual arousal was high during both the sexual and distracting sexual films (see Table 2).

The averaged values for reported and physiological sexual arousal were then cross-correlated to seven lags (7, 10-second bins) forward and backward (see Figure 4). The lower sexual desire group exhibited maximum correlations across four positive lags, indicating that changes in their feelings of sexual arousal generally preceded changes in their physiological response by up to 40 seconds. Figure 5 displays the average sexual arousal reported and the physiological response over time for the two sexual desire groups. It suggests that women with lower sexual desire tend to experience changes in their self-reported sexual arousal before changes in their physiological arousal. This ultimately contributed to a lower physiological sexual response, which is seen in the asymptotic flattening of the physiological response, following decreased feelings of sexual response toward the end of the sexual stimulus. The higher sexual desire group, on the other hand, reported changes in sexual arousal simultaneous with (at least, within the same 10 seconds) the change that occurred in their physiological arousal. This means that the maximum cross-correlation occurred at zero lags for the higher sexual desire group, which is the equivalent of the Pearson's correlation.

The groups also were compared within measure. In other words, cross-correlations of self-reported sexual arousal between the average time series for the higher sexual desire group and lower sexual desire group were conducted. Then, the same analysis for temperature was conducted. Interestingly, the groups did not differ in terms of when the changes in their response occurred in either domain (see Figure 6). Given the condition differences, this suggests that group differences were not due to differences in the latency of their physiological or reported sexual arousal; rather, the magnitude of the responses and the relation-

Table 2 Correlation of self-reported and physiological sexual arousal across participants within sexual desire group*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Sexual</th>
<th>Distracting</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>22</td>
<td>0.94</td>
<td>0.87</td>
</tr>
<tr>
<td>Lower sexual desire</td>
<td>11</td>
<td>0.83</td>
<td>0.82</td>
</tr>
<tr>
<td>Higher sexual desire</td>
<td>11</td>
<td>0.94</td>
<td>0.88</td>
</tr>
</tbody>
</table>

*All correlations were significant for degree of freedom = 20 at P < 0.01.
ship within individuals (physiological as compared with self-reported) differed.

**Discussion**

The purpose of this study was to test if women with lower sexual desire would exhibit decreased physiological and self-reported sexual response to a sexual stimulus with distracters than women with higher sexual desire. If women with lower sexual desire tend to attend less to sexual stimuli, they would not necessarily differ from other women in their sexual response to a strong sexual stimulus such as a film; however, women with lower sexual desire should display a markedly lower sexual response when a sexual stimulus is paired with distractors than women with higher sexual desire. The study results generally do not support this.

**Figure 5** Self-reported and physiological sexual arousal of the low sexual desire group over time during the sexual film.

**Figure 6** Cross correlations between the higher and lower sexual desire groups for each measure (self-reported sexual arousal and physiological sexual arousal).
hypothesis. Women with higher sexual desire reported more sexual arousal to the sexual film as compared with the neutral film than women who were classified as of lower sexual desire. Labial temperature was higher overall in women who were classified as of higher sexual desire. Also, temperature increased maximally during the sexual film and increased moderately during the distracting sexual film across both sexual desire groups. This replicates previous research on general effects of distraction on sexual response. Although there is no probabilistic statistical technique to compare two correlations, exploration of correlations and cross correlations suggested that women with lower sexual desire had lower concordance between their physiological and subjective sexual arousal; cross correlations suggested that this may be due to their felt sexual arousal preceding changes in their physiological sexual arousal by about a 10-second lag. However, the hypothesized interaction of film and sexual desire group predicting physiological sexual response did not emerge.

There was an unexpected difference in labial temperature between sexual desire groups. Women's labial temperature was higher if they reported higher trait sexual desire, and the difference could not be explained by differential patterns of increase during the sexual films. Thus, it appears that women with higher sexual desire in this study simply have higher resting labial temperature. This could have implications for treating problems related to low sexual desire. For example, it may be helpful for women with low sexual desire to feel validation from an objective assessment that could support their feeling of lower baseline sexual desire, although this also may make women feel that they cannot change without medical intervention [51]. It also suggests that women in long-term relationships may not exist in a state of sexual “neutrality” awaiting an appropriate sexual stimulus [52], but rather, may differ in baseline levels of potentiated sexual response. One study did find that women with “genital” arousal disorder exhibited less increase in vaginal pulse amplitude to a sexual film than women with other sexual problems in the sample [53]. However, this group was the smallest among all those tested, suggesting that a lack of statistical power might better explain the apparently lower response of those women. The finding from the present study of lower baseline labial temperature in women with lower sexual desire could be due to a variety of factors. Although it is possible that women with higher sexual desire found the experimental testing situation arousing itself, this difference in arousability appears less likely as there were no differences in genital response patterns during the sexual stimuli between the groups. Another possibility is that women with lower sexual desire may be developing health difficulties known to impact sexual physiological responding, such as diabetes [54], for which their lower sexual desire is an early symptom. Finally, some data suggest that the labia may cool when a woman becomes anxious [39]. It is possible that some level of anxiety might have contributed to the lower labial temperature observed in the women with lower sexual desire. As a part of another study, the women in this study completed the State-Trait Anxiety Inventory (STAI) [55]. STAI scores did not vary as a function of sexual desire group membership ($t(20) = 0.32$, $P = 0.76$), suggesting that differential anxiety is unlikely to explain the observed differences.

The lower concordance and lag between physiological and self-reported sexual arousal in women with lower sexual desire suggests that their perception of their sexual arousal may decrease their physiological response, especially at higher levels of sexual arousal. Beck and Barlow [13] did not find that patterns of discordance differentiated men with and without erectile dysfunction. Studies in women using vaginal photoplethysmography to measure sexual response suggest that women with sexual problems report lower sexual arousal despite having similar physiological responses [11]. These studies average across entire conditions to calculate concordance, which leads to low time resolution that would miss the differences documented using smaller time bins. Also, most studies of women use the vaginal photoplethysmograph to measure sexual arousal, which is inappropriate for making between-subjects comparisons due to its relative scale [43]. Evidence also is mounting that measures of external genitalia may be more readily detected by women and incorporated into their judgments of their own sexual arousal than such internal measures [56]. This study offers the first evidence that lower sexual desire may be reported due to truly lower physiological sexual arousal that follows the feeling that sexual arousal is decreasing.

There are a number of factors that might affect labial temperature, so a variety of third variable explanations could be ruled out more strongly in the future. For example, studies of labial temperature typically have not controlled for menstrual cycle phase [57]. The present study only weakly assessed menstrual phase and medications that
affect menstrual phase. It is not clear if and to what extent core temperature fluctuations, known to vary with menses [58], relate to labia minora temperatures. Although these do not appear to vary systematically by sexual desire group, results must be interpreted with usual caution until temperature effects in the labia minora are better characterized. As with any sexual psychophysiological study, volunteers may not be representative of the student population from which they were drawn. For example, they may be somewhat more sexually experienced, experience less sexual performance anxiety, and have viewed more erotica [59,60].

Although the distracting film uniquely resulted in decreased sexual arousal, it remains unclear how a distractor functions with respect to sexual response. Some have suggested that a specialized “attentional subsystem” could be responsible for directing focus to sexual stimuli under limbic-paralimbic control [61], but the evidence for such a specialized system is limited. Neuroimaging investigation suggests that visual attention might be modulated by working memory load [62], although others suggest the nature of the distractor (e.g., goal-relevance, load on frontal brain regions) may determine how attention is modulated by a distractor [63]. Thus, it is unclear whether the distractors produce momentary lapses in attention to the sexual stimulus, less depth of processing of the sexual cues, or something else. To better understand the nature of attention deployment during distractors, it would be useful to test cognitive experimental paradigms [64] that could differentiate, for instance, serial from parallel processing of stimuli presented simultaneously with sexual stimuli. This may even identify different strategies for processing distracters (e.g., [65]) during sexual stimulation that are more or less adaptive for sexual functioning.

The distractor used in this study also could be viewed simply as a degraded stimulus. This would mean that decreased stimulus clarity, rather than the distractors, reduced sexual response to that stimulus. Degradation is any stimulus manipulation that decreases its perceptibility. The decrease in perceptibility following stimulus degradation has been attributed to increasing perceptual interference [66], increasing the skill required to extract visual/auditory information [67,68], or taxing specific perceptual anomalies in clinical populations [69]. Because the film distortions were quite short in this study and the erotic film selected for distortion was balanced between participants, it seems unlikely that a more or less effective sexual stimulus could explain the decreased sexual response. Film distortion, although increasing face validity, clearly would benefit from further characterization of its function as a distractor and could shed light on the types of distraction processes that help or hinder sexual responsiveness.

Conclusions

This study does not support the hypothesis that women with lower sexual desire attend less to sexual stimuli, because the temperature difference did not vary by experimental condition. All women in the study exhibited lower sexual responses to a sexual stimulus with distractors as compared with a sexual stimulus without distractors. Women reporting lower sexual desire exhibited lower labial temperature than women with higher sexual desire. This temperature difference does not appear to be due to women with higher sexual desire reaching higher levels of sexual arousal during the visual sexual stimuli. The study also supports the utility of the labial thermistor for between-subjects designs, because differences between women were documented.

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