



Effects of a Mindfulness Task on Women's Sexual Response

Julia Velten and Jürgen Margraf

Mental Health Research and Treatment Center, Ruhr-Universität Bochum

Meredith L. Chivers

Department of Psychology, Queen's University

Lori A. Brotto

Department of Obstetrics and Gynaecology, University of British Columbia

Mindfulness-based interventions are effective at improving symptoms of sexual dysfunction in women. The mechanisms by which mindfulness improves sexual function are less clear. The main objective of our study was to investigate the impact of a mindfulness task on sexual response in women. Forty-one women (mean age = 27.2, SD = 5.6) participated in two laboratory sessions that each included two erotic films and one attention task that were presented in counter-balanced order. Both attention tasks consisted of a six-minute audio recording of either a modified body scan, focusing on genital arousal sensations (mindfulness condition), or a visualization exercise. Subjective and genital sexual arousal were measured continuously during stimulus presentation. The mindfulness task led to greater subjective and lower genital arousal. The agreement of subjective and genital sexual arousal (i.e., concordance) was greater in the mindfulness condition. Trait mindfulness was related to lower sexual arousal but also greater sexual concordance in women. Mindfulness-based interventions that encourage women to focus on physical arousal sensations in the here and now may be associated with women's improved sexual function by enhancing feelings of sexual arousal during sexual activity and by increasing concordance between subjective and genital sexual arousal.

Women's sexual arousal includes emotional, behavioral, and physiological responses to sexual stimulation that are inter-related but also at least partly independent (Laan & Everaerd, 1995). The genital sexual response is a neurovascular process that includes increased blood flow to the genitals (Levin & Wylie, 2008; Traish, Botchevar, & Kim, 2010), and the subjective dimension of sexual arousal reflects an individual's experience of being sexually aroused or "turned on." The level of agreement between subjective and genital arousal is termed sexual (arousal) concordance (Chivers et al., 2010), and the finding that women vary widely in their levels of sexual concordance has elicited debate in the field about the relevance of this end point for understanding women's sexual response more generally (Brotto, Chivers, Millman, & Albert, 2016). While some women exhibit very high sexual concordance, others show very low or even negative concordance (Chivers et al., 2010).

Women's Sexual Response and Sexual Dysfunction

What contributes to a woman having high versus low sexual arousal concordance is not entirely known, and how this is relevant to her experience of distressing sexual difficulties, such as low sexual desire or arousal, also remains unclear (Chivers & Brotto, 2017). Increasingly, researchers have been exploring the relevance of women's sexual response for their sexual functioning. Some have found significant differences in sexual response between women with and without sexual difficulties (e.g., Brody, Laan, & Van Lunsen, 2003; Meston, Rellini, & McCall, 2010; Sarin, Amsel, & Binik, 2016); however, at the present time, findings are equivocal because others have also found women's sexual response not to be associated with clinical symptoms of low desire and distress (Brotto et al., 2016). To further clarify the relationship between women's sexual response and sexual function is important to improve our understanding of women's sexual experiences, especially as epidemiological studies indicate that more than 40% of adult women report at least one sexual difficulty in the past year (Bancroft, Loftus, & Long, 2003; Fugl-Meyer et al., 2010; Lewis et al., 2010; Mitchell et al., 2016).

Correspondence should be addressed to Julia Velten, Ruhr-Universität Bochum, Mental Health Research and Treatment Center, Massenbergr. 9-13, 44787 Bochum, Germany. E-mail: julia.velten@rub.de

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Does Mindfulness Influence Women's Sexual Response?

When women encounter an effective sexual stimulus (e.g., an attractive sexual partner), subjective and genital sexual arousal are usually triggered to prepare her for sexual activity (Singer & Toates, 1987; Toates, 2009). A sexual response will, however, be triggered only when women pay attention to an erotic stimulus and are not distracted by, for example, nonsexual thoughts or other diversions. One potential means of affecting those attentional mechanisms relevant for erotic stimulation is mindfulness (Chivers & Brotto, 2017), an ancient Eastern practice with roots in Buddhist meditation, defined as present-moment, nonjudgmental awareness (Hanh, 1976). Within the past 10 years, mindfulness-based interventions have been found effective for the treatment of various female sexual difficulties, including genital pain (Brotto et al., 2014), sexual arousal disorder (Brotto, Seal, & Rellini, 2012) and low sexual desire (Brotto & Basson, 2014; Paterson, Handy, & Brotto, 2017). However, the mechanisms by which mindfulness leads to improvements in women's sexual concerns are not clear (Arora & Brotto, 2017). It has been hypothesized that mindfulness increases sexual function by reducing spectating—defined by Masters and Johnson (1970) as the process of watching oneself during sexual activity from a third-person perspective—thereby decreasing distraction by nonsexual thoughts, increasing acceptance and nonjudgment with respect to a sexual experience, and/or directly influencing the different levels of women's sexual arousal response (Both, Laan, & Everaerd, 2011; Brotto et al., 2016). Preliminary data also suggest that increases in women's ability to attend to the present moment may mediate the effects of mindfulness on sexual desire (Paterson et al., 2017).

To date, two studies have directly examined the influence of a mindfulness-based intervention on women's sexual arousal and concordance (Brotto et al., 2016; Brotto et al., 2012). Group mindfulness therapy for women with sexual distress and a history of sexual abuse led to a significant increase in sexual concordance from pre- to posttreatment (Brotto et al., 2012). In the other study, group mindfulness for women seeking treatment for loss of sexual desire also led to higher concordance (Brotto et al., 2016).

As postulated by Chivers and Brotto (2017), mindfulness may strengthen the association between an erotic stimulus and a reward, and/or it may expand the range of erotic stimuli that are considered sexually rewarding. Though these mechanisms have not been studied, we have speculated that mindfulness may lead women to appraise stimuli in a more sexual and less judgmental way; it may also increase women's attention to those stimuli, as well as to their own body sensations. The studies cited earlier (Brotto et al., 2016; Brotto et al., 2012) delivered a mindfulness intervention over several group sessions; therefore, it is unclear what aspects of the intervention influenced sexual concordance. One possible mechanism for change in sexual concordance after mindfulness training is the cultivation of nonjudgmental attention to sexual stimuli.

Attention Manipulation Tasks and Women's Sexual Response in The Laboratory

Experimental studies manipulating attention in the Laboratory setting suggest that mindfulness elicited in a similar setting may also affect sexual response in women (Both et al., 2011). For example, directing one's attention to the imagined bodily sensations (i.e., including changes in the genitals or faster heartbeat) of a female actor in an erotic film was associated with *greater* subjective arousal, but not genital arousal, in women compared to a condition in which the women were invited to take a more distanced perspective as the "director of the film." The authors concluded that it may be helpful for women to deliberately use an attentional focus on their own bodily sensations to bring sensory information into awareness during sexual activity (Both et al., 2011).

Another study reported *lower* genital sexual response in sexually functional women who experienced a state of self-focused attention, induced by a semireflecting television screen (Meston, 2006). While subjective sexual arousal was not influenced by self-focus, concordance between subjective and genital arousal was *lower* in the self-focus condition. The study also explored the role of trait self-consciousness on sexual response. Participants with *higher* self-consciousness scores showed a trend toward *lower* genital response in the self-focus versus the no-self-focus condition, while individuals with lower scores on the same scale showed the opposite pattern. In her discussion of these results, Meston suggested an inverted curvilinear relationship between self-focused attention and sexual response, such that low and high levels of self-focus may impair women's sexual responding.

The impact of attention on sexual arousal has been demonstrated in experimental studies of voluntary attention. In these studies, participants have been able to manipulate their level of arousal by changing their cognitive strategy. For example, fantasizing and positive thoughts can be used to increase arousal, while concentrating on nonsexual and negative thoughts (e.g., including distraction, thinking about nonsexual situations, or taking an objective perspective of the sexual act) may be used to suppress genital and psychological sexual responding in men and women (Anderson & Hamilton, 2015; Beck & Baldwin, 1994; Laan, Everaerd, Van Aanhoud, & Rebel, 1993). Furthermore, nonerotic and distracting thoughts significantly interfere with attention to erotic stimuli and have been associated with low levels of sexual response in women (Nobre & Pinto-Gouveia, 2008).

These findings suggest that women's sexual response is influenced by their attentional focus, such that an appropriate level of self-focus may improve sexual response, whereas distraction can interfere with it. In addition, focusing on physical sexual sensations in the present moment is related to greater self-reported arousal. What remains unclear is the extent to which these attention-regulating strategies, which are elicited through the practice of mindfulness meditation (Malinowski, 2013), can affect sexual concordance in women.

Current Study

The goal of the present study was to examine the effects of a single laboratory-based mindfulness task on women's sexual response and sexual arousal concordance. Our main hypothesis was that participating in a single-session mindfulness exercise would lead to increased levels of subjective arousal but not impact genital sexual arousal in women when compared to a visualization exercise. Our second hypothesis was that the mindfulness task would be associated with greater sexual concordance compared to the visualization task. In a third, exploratory, analysis, we tested the relationship between women's self-reported trait levels of mindfulness and sexual response and sexual concordance, given that women may have differed in their baseline levels of mindfulness prior to participating. A better understanding of the impact of mindfulness on sexual response may shed light on the mechanisms by which more comprehensive mindfulness interventions lead to improvements in women's sexual functioning.

Method

Participants

Premenopausal women ages 19 or older (age of majority in British Columbia, Canada), who were fluent in English, not pregnant or breastfeeding, sexually active (at least one event of sexual activity in the past month), not currently experiencing symptoms of a major mental disorder, not taking any medication that might interfere with sexual response, and not experiencing chronic vaginal pain, were eligible for this study. We specified in our recruitment ads that women who do or do not experience sexual difficulties are eligible for this study. Participants were recruited via flyers at the university's campus and via social media (i.e., Facebook, Craigslist, Reddit). A total of 129 women responded to the advertisements and 70 telephone screenings were booked. Of those, 41 women provided written consent and completed both the questionnaires and two in-laboratory sessions. Table 1 provides an overview of the demographic characteristics of the sample.

A total of 18 women (43.9%) scored within the clinical range (values > 10) on the Female Sexual Distress Scale (Derogatis, Rosen, Leiblum, Burnett, & Heiman, 2002), suggesting they were distressed by sexual concerns or difficulties.

Instruments and Measures

Subjective sexual arousal (SSA). Subjective sexual arousal was measured continuously during stimulus presentation with an arousometer that was constructed by a local engineer modeled after the one described by Rellini, McCall, Randall, and Meston (2005). The device consisted of a computer optic mouse mounted on a plastic track with

Table 1. Sample Characteristics and Sociodemographic Variables (n = 41)

Characteristics and Variables	n ^a (%)
Age (in years; range: 19–43), <i>M</i> (<i>SD</i>)	27.22 (5.61)
Ethnicity	
Caucasian	26 (65.0)
East Asian	6 (15.0)
South Asian	3 (7.5)
Other	5 (12.5)
Marital status	
Dating	18 (43.9)
Single	10 (24.4)
Married	4 (9.8)
Other	9 (21.9)
Sexual orientation	
Exclusively heterosexual	21 (52.5)
Mostly heterosexual	17 (37.5)
Other	2 (5.0)
Education	
High school	2 (5.1)
Some college	6 (15.4)
Graduated 2- or 4-year college	17 (43.6)
Postgraduate degree	9 (31.1)
Other	5 (12.8)
Occupation	
Full-time occupation	12 (30.8)
Part-time occupation	7 (17.9)
Student	16 (41.0)
Other	4 (10.3)

^a Samples sizes vary due to missing data.

10 intervals, affixed to the armrest of the reclining chair. Women were instructed to use the arousometer continuously to indicate changes in mental sexual arousal from 7 (*Highest level of arousal*) to 0 (*No sexual arousal*) and –2 (*Sexually turned off*) during the entire duration of the erotic films. Similar devices have been used to assess subjective sexual arousal in previous laboratory studies (Clifton, Seehuus, & Rellini, 2015; Rellini et al., 2005).

Genital sexual arousal. Vaginal pulse amplitude (VPA) was used as a measure of genital sexual response using a vaginal photoplethysmograph equipped with an orange-red spectrum light source (Behavioral Technology Inc., Salt Lake City, UT) during the experimental procedure. The signal was sampled at 200 Hz, band pass filtered (0.5 to 30 Hz), and recorded continuously during the stimulus presentation. Data were acquired and processed using a data acquisition unit Model MP150 and AcqKnowledge version 3.8.1 (BIOPAC Systems, Inc., Santa Barbara, CA).

Mindfulness. Trait mindfulness was measured with the 39-item Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2008). Each item was rated on a 5-point Likert scale ranging from 1 (*Never or very rarely true*) to 5 (*Very often or always true*). It measures five facets of mindfulness: observing, describing, acting with awareness, nonjudging of inner experience, and nonreactivity to inner experience. The

observing subscale (nine items) describes the degree to which individuals are noticing or attending to internal and external experiences, such as sensations, cognitions, emotions, sights, sounds, and smells. Describing (eight items) refers to the ability to find words or labels for those internal experiences. The acting with awareness subscale (eight items) assesses how individuals attend to their activities of the moment and can be contrasted with behaving mechanically while attention is focused elsewhere. The nonjudging scale includes eight items and describes how individuals are taking a nonevaluative stance toward thoughts and feelings. Lastly, the nonreactivity scale (seven items) assesses how people are able to allow thoughts and feelings to come and go without getting caught up in or carried away by them. The FFMQ has been found to have adequate to good internal consistency with alphas ranging from .72 to .92 (Baer et al., 2008). In this sample, Cronbach's alpha ranged from .83 for the observe subscale to .94 for the describe subscale.

Procedure

An experienced research assistant with specialized training in the assessment and diagnosis of sexual dysfunctions conducted telephone interviews to assess the eligibility of potential participants. Following the telephone screen, she mailed or e-mailed a consent form to eligible women interested in participating. She also provided a link to an online questionnaire.

The sexual arousal assessments took place in a sexual psychophysiology laboratory located at a university hospital. Following informed consent, participants were tested by a female researcher. Participants were first shown the vaginal photoplethysmograph and encouraged to ask any questions about how to insert it. Participants were also reminded to use the arousometer to capture their subjective sexual arousal throughout the erotic film presentations by monitoring their "subjective feelings of sexual arousal." The researcher also explained that "subjective feelings of sexual arousal" means how mentally sexually aroused the participant feels while watching the film. Once the film began, the researcher did not remind participants to use the arousometer.

The female researcher left the room while participants inserted the probe and informed the researcher via intercom of their readiness. The researcher then initiated the video sequence. Women watched a six-minute nature documentary followed by a 13-minute erotic film that depicted a female–male couple engaging in foreplay, cunnilingus, fellatio, and penile–vaginal intercourse. The selection criteria for the neutral stimuli were pleasantness of the pictures and no display of aggression. The erotic stimuli criteria included displayed different stages of sexual interaction between two actors, pleasant sound, an unobtrusive setting, and a background. Similar films were used in a previous study and were rated as pleasant and sexually arousing by women (Brotto & Basson, 2014). After the first sexual film, the

women listened to a six-minute audio recording, which was either a mindfulness or a visualization exercise delivered via headphones. Both tasks were presented to participants as exercises designed to focus their attention, and they were invited to sit back, relax, and listen to the recordings. The women were also invited to close their eyes during the exercises if that felt comfortable for them. The second 13-minute erotic film was presented immediately following this exercise. After the second film, they were instructed to remove the probe, place it in a plastic bag, and meet the researcher in a separate room. After a debriefing period, the researcher disinfected the probe in a solution of Cidex OPA (ortho-phthalaldehyde 0.55%), a high-level disinfectant (Advanced Sterilization Products, Irvine, CA, USA), promptly following each session.

Using novel video stimuli (of identical content) and the second attention exercise not administered in the first session (i.e., mindfulness versus visualization), the in-laboratory testing procedure was repeated between one and four weeks later ($M_{\text{days}} = 9.93$, $SD = 5.64$, range = 5 to 28 days) on approximately the same day of the week. The sessions were scheduled for a day of the week that was within a 72-hour time frame of the day that participants reported being the most likely to be sexually active. The four erotic video stimuli and the two attention tasks were presented in counterbalanced order. A total of 23 women (56.1%) listened to the mindfulness exercise in their first lab session, 18 women (43.9%) in their second session. All procedures were approved by the Clinical Research Ethics Board at the University of British Columbia and Vancouver General Hospital. All procedures were carried out in accordance with the provisions of the 2013 World Medical Association Declaration of Helsinki.

Attention Manipulation

To assess the impact of a brief laboratory-based attention task on sexual response in women, two different audio recordings were presented to the participants between the two erotic films in each session. The first attention exercise (mindfulness) was a modified body scan, called the "Sexual Sensations" exercise, adapted from a therapy manual for women with low sexual desire (Brotto, Paterson, Basson, Driscoll, & Grabovac, 2015). A female narrator guided the woman through a six-minute body scan during which the participants were asked to focus on sensations in their body in the present moment with a deliberate focus on feelings in their genitals as a whole and on sensations in specific areas of their genitals. Principles of mindfulness were woven throughout the exercise, and women were guided to continually redirect their focus on their body sensations when they became distracted, and to do so nonjudgmentally and compassionately. The second attention exercise (visualization) invited the women to visualize a walk through a lush forest and encouraged them to imagine sensations (e.g., scents) related to this setting. Unlike the mindfulness task, which encouraged women to deliberately guide their

attention to sensations in the “here and now,” the forest walk exercise invited women to use visualization to imagine themselves elsewhere. Women were guided to create the forest scene in their mind, and there was no mention of focusing on any present-moment sensations (e.g., breathing, body sensations). The audio recordings were of equal length (six minutes) and were narrated by the same female speaker.

Data Reduction and Analysis

Offline, photoplethysmography data were band-pass filtered (0.5 to 20 Hz). Then, in agreement with standardized procedures, movement artifacts, defined by sudden and drastic changes in pulse amplitude, were visually identified and deleted by being marked as missing for data analysis (Prause & Janssen, 2006). Data inspection and manual artifact rejection were performed using ANSLAB Version 6.0 (Wilhelm & Peyk, 2005).

For descriptive purposes, and to increase comparability of our results to previous studies, we calculated the mean subjective and genital response for each stimulus category. Mean genital response, calculated using the average VPA of the 30-second bins per film, is reported as mean VPA during the erotic stimulus (in millivolts). In addition, the means of the continuously measured SSA, as well as within-subject correlations, were calculated.

To address hypotheses 1 and 2, data from the second erotic film in each session, presented directly after one of the two attention tasks, were analyzed.¹ A baseline proxy of genital response was calculated using the three-minute interval directly before the start of the second film. We used this section instead of the true baseline that was measured before the first erotic film, as VPA did not fully return to baseline in approximately 25% of sessions. To include the complete range of genital sexual response, these baseline arousal values were added as a first data point in our multilevel analysis. Data from the arousometer and the vaginal photoplethysmograph during the erotic film presentation were averaged across 30-second intervals, resulting in a total of 104 data points, 52 for each session per participant.

Two baseline models, specified only with a fixed intercept and a random intercept, were run to calculate intraclass correlation coefficients (ICCs) for VPA and SSA as dependent variables using data from the second film. The ICC is an effect size that indicates to what degree observations from the same participant covary for a dependent variable (Cohen, 1988; Page-Gould, 2016). ICC values above .10 indicate a small, above .30 a medium, and values above .50, a large effect size (Cohen, 1988). The ICC was .57 for VPA and .39 for SSA, which demonstrates that the sexual response measurements were significantly clustered within participants. Therefore, a series of mixed linear models was

calculated using SPSS 24 (IBM, 2012). For this study, the major advantage of multilevel modeling (MLM) was that it conducts a within-subject analysis of the relationship between VPA and continuously measured SSA and uses the coefficients that describe this relationship (i.e., slope and intercept) as outcome variables to test differences between participants.

Two different models were calculated to test the impact of the attention task (mindfulness versus visualization) on SSA and VPA (hypothesis 1) and to investigate the impact of the attention task on sexual response and sexual concordance (hypothesis 2).² The model calculated to predict SSA used the following formula:

$$\begin{aligned} \text{SSA}_{ij} = & \beta_{0i} + \beta_1(\text{VPA})_{ij} + \beta_2(\text{Attention task})_{ij} \\ & + \beta_3(\text{VPA} * \text{Attention task})_{ij} + \\ & r_{0i} + r_{1i}(\text{Time} * \text{Assessment point})_{ij} + \varepsilon_{ij} \end{aligned}$$

where SSA_{ij} is the i th individual's SSA at the j th time point. In all multilevel models, β_{0i} is the individual-specific intercept, β_1 is the individual-specific slope, r_{0i} describes the random intercept, r_{1i} describes the random slope, and ε_{ij} indicates the residuals. The slopes and intercepts were allowed to vary across time (first to 26th bin per stimulus) and assessment points (first versus second lab session) to take into account differences in the baseline levels and time courses of the continuously measured VPA or SSA.

To explore the role of different facets of mindfulness on sexual response and sexual concordance, a second series of models was calculated, including SSA and VPA as dependent variables and the five lower-order factors of the FFMQ as predictors. For these models, only data from the first erotic film of the first in-laboratory assessment were used to limit the potential impact of sequence effects. The following formula describes the model to investigate the impact of the observing scale to predict SSA:

$$\begin{aligned} \text{SSA}_{ij} = & \beta_{0i} + \beta_1(\text{VPA})_{ij} + \beta_2(\text{FFMQ Observing scale})_i \\ & + \beta_3(\text{VPA} * \text{FFMQ Observing scale}) \\ & + r_{0i} + r_{1i} * (\text{Time})_{ij} + \varepsilon_{ij} \end{aligned}$$

where SSA_{ij} is the i th individual's SSA at the j th time point.

All predictors were group mean centered before data analysis. Data were estimated using maximum likelihood estimation. We specified the covariance matrices of all tested models as first-order autoregressive structures to fit our model to the correlation between the repeated measures within participants (for an overview, see Singer & Willett, 2003). We also computed semipartial R^2 effect sizes, representing the variance in the dependent variables (SSA or VPA) that is uniquely explained by the model parameter of each fixed effect (Page-Gould, 2016). The magnitude of

¹ Analyses including both pre- and postmanipulation stimuli were comparable to those reported here. Therefore, to increase interpretability of the models and analyses, we elected to report analyses using the postmanipulation data only.

² Two sets of analyses were conducted, one using the complete sample and another using only a subset of participants that indicated low distress by sexual concerns. As both analyses yielded similar results, only the results from the complete sample are reported.

semipartial R^2 may be classified as small ($0.02 \leq R^2 < .13$), medium ($.13 \leq R^2 < .26$), or large ($.26 \leq R^2$; Cohen, 1988; Page-Gould, 2016).

Results

Descriptive and Preliminary Analyses

Table 2 depicts the descriptive data for three sexual response measurements (SSA, VPA, and within-subject correlations) as well as the scores of the FFMQ scales. As a preliminary analysis for hypotheses 1 and 2, we used aggregated values averaged across participants to assess if differences in sexual arousal or concordance between the two in-laboratory sessions could be found. However, using these averaged values, none of the sexual response measures differed significantly between the two testing sessions (SSA: $t(39) = -1.48, p = .148, d = 0.25$; VPA: $t(36) = 0.22, p = .826, d = 0.04$; within-subject correlation: $t(34) = -0.66, p = .516, d = 0.17$). The values of the FFMQ subscales indicated that our participants had trait levels of mindfulness that were comparable to other student and community-based samples (Baer et al., 2008). Bivariate associations between the different sexual response measurements are presented in Table 3.

Because of the nonnormality of the data, Kendall's tau correlation coefficients were calculated. SSA and VPA showed positive correlations across both sessions, meaning that higher levels of subjective/genital sexual arousal in the mindfulness session were related to higher levels of subjective/genital sexual arousal in the visualization session. In contrast, within-subject correlations between genital and subjective sexual arousal, a measure of sexual concordance, were not correlated across testing sessions. Across sexual response measures, VPA showed positive correlations with within-subject concordance measured in the visualization session.

Table 4 shows the bivariate correlations between the three sexual response measurements during the first erotic film in the first lab session and the FFMQ subscales. SSA was negatively correlated with nonjudging, and VPA was negatively correlated with both nonjudging and nonreactivity, with small to

Table 3. Nonparametric Bivariate Correlations (Kendal's Tau) Between Sexual Arousal Measurements After Mindfulness and Visualization Tasks

		1	2	3	4	5	6
Mental sexual arousal (arousometer, mean)	Mindfulness	1	1	.31*	.15	.04	-.01
	Visualization	2	1	.07	.01	-.13	.00
Genital response (VPA in mV, mean)	Mindfulness	3		1	.30*	.13	.28*
	Visualization	4			1	.13	.23*
Within-subject correlations	Mindfulness	5				1	-.13
	Visualization	6					1

* $p < .05$; ** $p < .01$.

medium effects. In other words, subjective and genital arousal measured during an erotic stimulus presentation were negatively associated with women's baseline scores on the non-reactivity and nonjudging domains of the FFMQ, suggesting women with high nonreactivity and nonjudging scores experienced lower levels of sexual arousal. As expected, most subscales of the FFMQ were positively intercorrelated, with small to large effects.

Mindfulness Exercise and Sexual Response

To address hypotheses 1 and 2, two multilevel models are analyzed. In Model 1, we investigated the influence of an attention task (mindfulness versus attention task) on VPA as well as on the relationship between SSA and VPA (i.e., sexual concordance). In this model, concordance was indicated by the significant prediction of VPA by SSA, $b = 2.18^{-03}, SE = 3.65^{-04}, t(df) = 5.96(1942.39), p < .001, R^2 = .018$. The mindfulness exercise (compared to the visualization exercise) predicted lower VPA, $b = -3.10^{-03}, SE = 6.79^{-04}, t(df) = -4.56(1917.76), p < .001, R^2 = .011$, and also moderated the relationship between VPA and SSA in a way that the mindfulness condition was associated with greater sexual arousal concordance, $b = 8.12^{-04}, SE = 3.63^{-04}, t(df) = 2.24(1923.87), p = .025, R^2 = .003$ (Figure 1).

In Model 2, we included the same set of predictors but used SSA as the dependent variable. In line with Model 1, sexual

Table 2. Descriptive Values of Sexual Arousal Measurements After Attention Tasks and Trait Mindfulness (n = 41)

	Attention Task	Min.	Max.	M	SD
Mental sexual arousal (arousometer, mean)	Mindfulness	0.03	6.25	3.34	1.61
	Visualization	0.14	5.19	2.95	1.41
Genital response (VPA in mV, mean)	Mindfulness	0.0144	0.2119	0.0729	0.0495
	Visualization	0.0114	0.2462	0.0761	0.0505
Within-subject correlations	Mindfulness	-0.84	0.87	0.14	0.50
	Visualization	-0.74	0.94	0.17	0.42
Five Facet Mindfulness Questionnaire (lower-order factors)	Observe	16	40	28.27	5.73
	Describe	13	40	28.54	7.04
	Awareness	9	36	24.20	6.10
	Nonjudge	15	40	27.00	6.58
	Nonreact	13	32	21.44	4.58

Table 4. Nonparametric Bivariate Correlations (Kendal’s Tau) Between Sexual Arousal Measurements (First Erotic Stimulus, First Session) and Trait Mindfulness

		1	2	3	4	5	6	7	8	
Mental sexual arousal (arousometer, mean)		1	1	.16	.02	-.19	-.12	-.13	-.31**	-.21
Genital response (VPA in mV, mean)		2	1	.17	-.01	.01	-.08	-.22*	-.24*	
Within-subject concordance		3		1	.07	-.02	-.17	-.16	-.09	
Five Facets of Mindfulness Questionnaire	Observing	4			1	.22*	.19	.15	.36**	
	Describing	5				1	.26*	.27*	.20	
	Acting with awareness	6					1	.44**	.37**	
	Nonjudging	7						1	.44**	
	Nonreactivity	8							1	

* $p < .05$; ** $p < .01$.

concordance was indicated by the significant prediction of SSA by VPA, $b = 8.21$, $SE = 1.28$, $t(df) = 6.42$ (1400.81), $p < .001$, $R^2 = .029$. In addition, the mindfulness condition was predictive of greater SSA, $b = 0.16$, $SE = 0.04$, $t(df) = 3.77$ (1941.37), $p < .001$, $R^2 = .007$. This means that women reported greater mental sexual arousal during film presentation after the mindfulness versus visualization task. In line with Model 1, mindfulness was also predictive of greater sexual arousal concordance, $b = 2.89$, $SE = 0.91$, $t(df) = 3.17$ (1991.23), $p = .002$, $R^2 = .007$ (Figure 2).

Trait Mindfulness and Sexual Response

As an exploratory analysis, we investigated the relationships between trait mindfulness, sexual response, and sexual arousal concordance. Four lower order factors of the FFMQ—observing, acting with awareness, nonjudging, and nonreactivity—were negative predictors of VPA. Nonjudging was also a negative predictor of SSA. One significant interaction effect was found, indicating that the

describing factor of trait mindfulness was predictive of greater sexual concordance (Table 5).

Discussion

The main aim of this study was to evaluate the impact of a laboratory-based single mindfulness exercise versus a visualization exercise on subjective and genital sexual arousal (hypothesis 1) as well as sexual arousal concordance (hypothesis 2) in women. A second objective was to explore the relationship between different facets of trait mindfulness and sexual response. Our results provide evidence that a single experience of a mindfulness task can influence subsequent sexual response in women. In line with our first hypothesis, subjective sexual arousal was greater following the mindfulness task compared to the visualization task (Model 2). Overall, our findings were in line with previous research suggesting that nonjudgmental observation, present moment focus, and acceptance of physical sensations in the body, including the genitals, may be effective for increasing

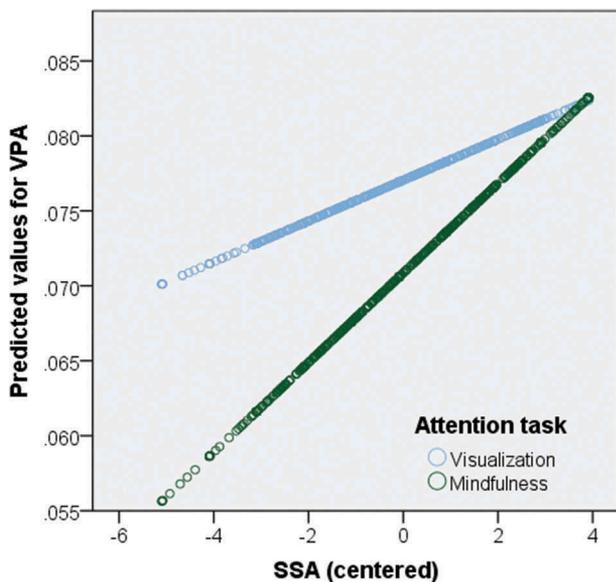


Figure 1. Interaction between attention task and subjective sexual arousal (SSA) for the prediction of genital sexual arousal (VPA).

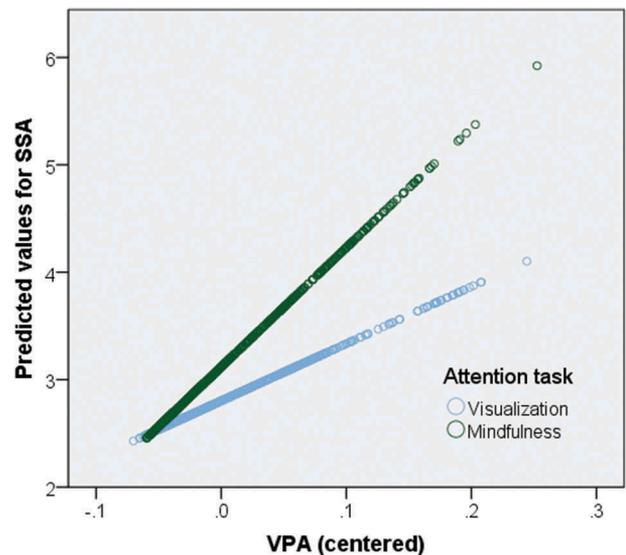


Figure 2. Interaction between attention task and genital sexual arousal (VPA) for the prediction of subjective sexual arousal (SSA).

Table 5. Prediction of Genital/Subjective Sexual Arousal by the Five Facets of Mindfulness Questionnaire.

Outcome	First Series of Models				Second Series of Models			
	Genital Sexual Arousal (VPA)				Subjective Sexual Arousal (SSA)			
	<i>b</i>	SE (<i>b</i>)	<i>t</i> (<i>df</i>)	<i>p</i>	<i>b</i>	SE (<i>b</i>)	<i>t</i> (<i>df</i>)	<i>p</i>
Observing								
SSA/VPA	4.00 ⁻⁰³	4.99 ⁻⁰³	0.80 (68.45)	.425	22.49	3.04	7.40 (933.35)	< .001
Observing	-1.89 ⁻⁰³	8.53 ⁻⁰⁴	-2.22 (69.71)	.030	-0.07	0.04	-1.82 (32.20)	.077
SSA/VPA × Observing	-1.96 ⁻⁰⁵	8.68 ⁻⁰⁴	-0.02 (68.51)	.982	0.93	0.56	1.65 (929.11)	.100
Describing								
SSA/VPA	3.95 ⁻⁰³	5.15 ⁻⁰³	0.77 (68.53)	.446	25.96	3.12	8.32 (932.61)	< .001
Describing	-2.08 ⁻⁰⁴	7.09 ⁻⁰⁴	-0.29 (69.26)	.771	-0.02	0.03	-0.62 (31.93)	.540
SSA/VPA × Describing	-8.71 ⁻⁰⁶	7.15 ⁻⁰⁴	-0.01 (68.56)	.990	1.59	0.44	3.64 (933.80)	< .001
Acting with awareness								
SSA/VPA	3.94 ⁻⁰³	4.97 ⁻⁰³	0.79 (68.23)	.431	22.54	3.08	7.32 (934.65)	< .001
Acting with awareness	-1.79 ⁻⁰³	7.91 ⁻⁰⁴	-2.26 (68.73)	.027	-0.03	0.04	-0.90 (31.11)	.374
SSA/VPA × Acting with awareness	-1.12 ⁻⁰⁴	7.92 ⁻⁰⁴	-0.14 (68.05)	.888	-0.43	0.53	-0.80 (928.61)	.422
Nonjudging								
SSA/VPA	3.94 ⁻⁰³	4.74 ⁻⁰³	0.83 (67.71)	.410	22.44	3.06	7.34 (935.32)	< .001
Nonjudging	-2.51 ⁻⁰³	7.03 ⁻⁰⁴	-3.57 (68.13)	.001	-0.07	0.03	-2.38 (31.30)	.023
SSA/VPA × Nonjudging	-4.77 ⁻⁰⁵	7.02 ⁻⁰⁴	-0.07 (67.59)	.946	-0.62	0.50	-1.25 (934.01)	.211
Nonreactivity								
SSA/VPA	3.96 ⁻⁰³	4.80 ⁻⁰³	0.83 (68.00)	.412	22.59	3.13	7.22 (936.15)	< .001
Nonreactivity	-3.38 ⁻⁰³	1.03 ⁻⁰³	-3.30 (68.40)	.002	-0.07	0.05	-1.48 (31.10)	.149
SSA/VPA × Nonreactivity	-1.43 ⁻⁰⁴	1.02 ⁻⁰³	-0.14 (67.94)	.890	-0.40	0.82	-0.49 (931.61)	.621

woman's perceptions of sexual arousal (Both et al., 2011; Nobre & Pinto-Gouveia, 2008). It is possible that this effect is mediated by a redirecting of attention away from distracting targets. There is indeed evidence that mindfulness is more effective than a relaxation exercise in reducing distraction (Jain et al., 2007); however, because attention was not directly measured in this study, we can only speculate that attention regulation following the mindfulness task contributed to the observed effects.

Somewhat surprisingly, the mindfulness task was associated with lower genital sexual arousal compared to the visualization task (Model 1). Thus, our first hypothesis was only partially supported. One possible interpretation for this finding stems from the study by Meston (2006), who found that a state of self-focused attention, induced by a semireflecting TV screen, was associated with lower genital sexual response among women. These findings suggest that directing attention to genital sensations may induce a self-focus that might inhibit, rather than increase, genital sexual response in women. Attending to signs of sexual arousal might, at least for some women, bring about feelings of self-consciousness or sexual inhibition, which might lead to subsequent lower levels of genital sexual arousal (Velten, Scholten, Graham, Adolph, & Margraf, 2016).

On the other hand, it may be that the visualization exercise, which invited women to visualize a walk through a lush forest, led to increased levels of genital response compared to the mindfulness condition (not the other way around). Autogenic training, a relaxation technique that aims to restore the balance between parasympathetic and sympathetic branches of the nervous system, has been

shown to lead to increased levels of genital arousal (Stanton & Meston, 2017). Though relaxation and sympathetic tone were not measured, it is possible that the visualization task, but not the mindfulness task, contributed to a state of relaxation and/or alternations in the autonomic nervous system, which led to increased genital response in this study.

In line with hypothesis 2, mindfulness was also significantly related to greater concordance between subjective and genital sexual arousal (Models 1 and 2). This finding is in agreement with other studies that found greater sexual concordance after group mindfulness-based therapy for sexual problems in women (Brotto et al., 2016; Brotto et al., 2012).

Trait Mindfulness and Sexual Response

Our exploratory analyses investigating the effect of different facets of trait mindfulness on sexual response may seem counterintuitive, but they offer important insights into the relationship between trait mindfulness and women's sexual arousal. Four of the five subscales of the FFMQ, namely observing, acting with awareness, nonjudging, and nonreactivity, were negative predictors of genital sexual arousal in women. One of these scales (nonjudging) was also a negative predictor of subjective genital arousal. Women who are less mindful with respect to the observing, nonjudging, and nonreactivity domains may be less inclined to distance themselves from a variety of physical sensations and may be more prone to label physical sensations as desirable or undesirable. Thus, less mindful women may

be *more* prone to focus their attention on genital arousal sensations, to label and categorize these feelings as sexual, which might in turn further increase their greater genital response. On the other hand, women who are more mindful may very well notice the same genital sensations but may not evaluate and label these feelings as sexual given that their higher level of mindfulness may mean that they are noticing all physical sensations in the body with equanimity (Desbordes et al., 2015), defined as “an even-minded mental state or dispositional tendency toward all experiences.” Those women might not specifically focus on their genital sensations but rather notice other sensations in their body, such as their position in the chair or breathing, without judging the different perceptions which may result in lower levels of genital response. This would fit with the aim of mindfulness, to observe and attend to all sensations arising in the moment, without attachment to any particular sensation. In addition, the describing factor of mindfulness was a positive predictor of sexual concordance. Future studies may explore in which way the ability to find words or labels for internal experiences such as physical sexual arousal is relevant for the agreement of subjective and genital arousal.

Clinical Implications

Together with previous findings, these results have important clinical implications that should be considered. First, the findings underscore the importance of clearly distinguishing between the different aspects of mindfulness cultivated in mindfulness-based interventions for female sexual dysfunctions. Inviting women to focus on sexual sensations in the here and now can increase women’s perceptions of sexual sensations. Interestingly, however, it is possible that higher levels of trait mindfulness and the nonattachment to sensations, and equanimity that is fostered with long-term mindfulness practice, may not enhance sexual arousal, given that women may be likely to notice genital sensations with the same degree of awareness and attachment/nonattachment as other nonsexual sensations. If this is true, it would suggest that women with lower levels of trait mindfulness may be more likely to observe and become aware of sexual sensations in the body and remain focused on them due to attachment. To our knowledge, no study has examined this in long-term meditators with established mindfulness practices to see whether sexual arousal is impacted. Given that we elicited state mindfulness only in this study, these results do not directly speak to the conventional belief that teaching women to cultivate trait mindfulness may be a tool to target the frequent distraction that arises during sexual activity (e.g., by nonsexual thoughts, sexual concerns, or body image issues) and thus allow women to be more present and engaged during sexual activity. Our findings do, however, suggest that teaching women to label those as *explicitly sexual* might be more helpful than recommending just to observe, to act with awareness, to not judge, or to be nonreactive to those

feelings. In addition, our findings suggest that—at least for some women—other relaxation techniques, such as our visualization exercise or autogenic training, might also be effective to increase genital sexual response; this might be particularly useful for women with specifically genital arousal difficulties.

The findings offer insights into the mechanisms through which mindfulness meditation can improve women’s sexual functioning. Our findings suggest that teaching women to tune into their bodily sensations and to deliberately direct their attention to sexual feelings in their genitals or other parts of their bodies may increase their subjective sexual arousal and lead to a greater concordance between subjective and physical aspects of sexual response. To increase sexual arousal during sexual activity may be particularly relevant for women with sexual interest/arousal disorder (SIAD) or female orgasmic disorder. A significant number of women with SIAD report a lack of sexual excitement or reduced feelings of subjective arousal, even though they experience no difficulties in getting physically aroused (i.e., lubricated) (Basson, Wierman, Van Lankveld, & Brotto, 2010); these women might benefit notably from mindfulness exercises.

Another clinical implication relates to sexual arousal and concordance as end points of clinical trials of treatments for women’s sexual dysfunction (e.g., Basson & Brotto, 2003; Brotto et al., 2016; Brotto et al., 2012; Chivers & Rosen, 2010). The study findings suggest that mindfulness may increase subjective arousal and may lead to *increased* levels of sexual concordance. This is in line with most studies that have emphasized greater sexual concordance as a positive treatment outcome (e.g., Paterson et al., 2017), suggesting that women who show higher concordance between subjective and genital arousal may be more receptive to physical changes of sexual arousal, which may result in better sexual functioning.

Limitations

Several limitations challenge the generalizability of our findings. We were able to recruit a somewhat ethnically diverse sample of women with a wide range of sexual functioning. Our sample was, however, still not representative of the general population of women: Most participants were quite young, highly educated, and heterosexually identified. Therefore, we cannot extend our findings to women with lower education or a nonheterosexual identity. Indeed, there are data showing that heterosexually identified women demonstrate lower sexual concordance than bisexually and lesbian-identified women; similarly, gynephilic women, that is, women who are sexually attracted to women, show greater sexual concordance than women who are exclusively androphilic (see Suschinsky, Dawson, & Chivers, 2017). Although this study was open to women of all sexual identities, and a separate set of erotic stimuli had been created to appeal to women that prefer female–female erotica, only women identifying as heterosexual expressed an interest in our study. Future studies should therefore further improve recruitment

strategies to target this lack of diversity, especially with respect to sexual identities and attractions.

This study was conducted to assess the impact of a mindfulness exercise on sexual response in women. However, the mindfulness exercise in this study was conducted between viewing two erotic movies, which is unlikely to mirror how most individuals practice mindfulness in their lives. In addition, we did not investigate where the women focused their attention during the film presentation. It is possible that the impact of mindfulness on subjective sexual arousal could have been enhanced by instructing women to mindfully notice ongoing sensations in their genitals during film presentation.

For some participants, genital and subjective sexual arousal did not fully return to baseline between film presentations. Therefore, we cannot clarify how previous levels of arousal before the attention tasks impacted our results. Future studies should therefore include a second (neutral) baseline between stimulus presentations and/or investigate how a mindfulness task influences sexual response without previous sexual arousal induction.

Conclusion

Mindfulness-based interventions that encourage women to focus on physical arousal sensations in the here and now may improve women's sexual function by enhancing feelings of sexual arousal during sexual activity. Aspects of trait mindfulness, such as observing, acting with awareness, non-judging, and not reacting to physical sensations, may be associated with lower genital arousal response. Labeling genital sensations during sexual activity as sexual might therefore be effective to improve women's sexual function.

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