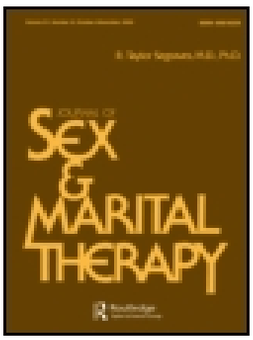

Journal of Sex & Marital Therapy

ISSN: 0092-623X (Print) 1521-0715 (Online) Journal homepage: https://www.tandfonline.com/loi/usmt20

The Relationship Between Sexual Functioning and Sexual Concordance in Women

Kelly D. Suschinsky, Jackie S. Huberman, Larah Maunder, Lori A. Brotto, Tom Hollenstein & Meredith L. Chivers

To cite this article: Kelly D. Suschinsky, Jackie S. Huberman, Larah Maunder, Lori A. Brotto, Tom Hollenstein & Meredith L. Chivers (2019): The Relationship Between Sexual Functioning and Sexual Concordance in Women, Journal of Sex & Marital Therapy, DOI: 10.1080/0092623X.2018.1518881

To link to this article: https://doi.org/10.1080/0092623X.2018.1518881

JOURNAL OF SEX & MARITAL THERAPY
https://doi.org/10.1080/0092623X.2018.1518881

Routledge
Taylor & Francis Group

The Relationship Between Sexual Functioning and Sexual Concordance in Women

Kelly D. Suschinsky[a], Jackie S. Huberman[a], Larah Maunder[a], Lori A. Brotto[b], Tom Hollenstein[a], and Meredith L. Chivers[a]

[a]Department of Psychology, Queen's University, Kingston, Ontario, Canada; [b]Department of Obstetrics & Gynaecology, University of British Columbia, Vancouver, British Columbia, Canada

ABSTRACT

Previous research using clinical samples has shown a positive relationship between women's sexual functioning and *sexual concordance* (i.e., agreement between genital and subjective sexual arousal). We further examined this relationship using concurrent measures of vaginal, clitoral, and subjective sexual responses in a community sample of women ($N = 64$, with 59.4% and 34.1% reporting sexual desire and/or arousal difficulties, respectively). Contrary to studies using clinical samples, sexual desire and arousal difficulties were associated with stronger sexual concordance, specifically when changes in subjective arousal predicted changes in genital responses. The subjective experience of arousal may be particularly important in influencing genital responses in women with sexual desire and arousal difficulties compared to unaffected women.

Introduction

Sexual arousal is a multifaceted emotional state, involving changes in physiology, cognitions, emotions, and behaviors (e.g., Frijda, 1986; Rosen & Beck, 1988). *Sexual concordance* is the relationship between physiological and subjective sexual responses (Chivers, Seto, Lalumière, Laan, & Grimbos, 2010), conceptualized as synchrony between these components of sexual response. There is substantial variation in women's sexual concordance across a range of methodologies, with positive, negative, and no relationships between women's self-reported sexual arousal and their genital responses (Boyer, Pukall, & Holden, 2012; Chivers et al., 2010; Huberman, Dawson, & Chivers, 2017; Rellini, McCall, Randall, & Meston, 2005).

Recently, individual differences explaining variation in women's sexual concordance have been identified, including cognitive schemas and propensity for sexual inhibition and excitation (see Clifton, Seehuus, & Rellini, 2015; Velten et al., 2016). Studies using clinical samples report stronger sexual concordance in women with better sexual functioning (e.g., Meston, Rellini, & McCall, 2010; Sarin, Amsel, & Binik, 2016). The purpose of the current study was to further investigate women's sexual concordance and its relationship with sexual functioning in a community sample of women.

Women's sexual concordance and sexual functioning

Sexual functioning broadly describes the ability to adequately respond to sexual stimuli and engage in pleasurable and pain-free sexual activity. In contrast, sexual dysfunction involves impairment in domains related to sexual response, as well as distress regarding these difficulties.

CONTACT Meredith L. Chivers meredith.chivers@queensu.ca

A variety of sexual dysfunctions is associated with lower sexual concordance in women (Chivers et al., 2010). Concordance is often lower in samples of women with sexual arousal and sexual desire difficulties (Laan, van Driel, & van Lunsen, 2008; Morokoff & Heiman, 1980), including women meeting *DSM-IV-TR* (American Psychiatric Association [APA], 2000) diagnostic criteria for female sexual arousal disorder (Meston et al., 2010), hypoactive sexual desire disorder, or both (Sarin et al., 2016) compared to unaffected women. Notably, Brotto, Basson, and Gorzalka (2004) found that women with the genital arousal subtype of female sexual arousal disorder had stronger sexual concordance than unaffected women. These findings suggest that sexual concordance is related to women's sexual arousal and desire, although this relationship is not straightforward.

Sexual concordance may be an important component of sexual functioning in light of recent reconceptualizations of women's sexual difficulties. Sexual interest/arousal disorder (SIAD) was recently introduced in the *DSM-5* (APA, 2013), replacing female sexual arousal disorder and hypoactive sexual desire disorder for women. The diagnostic criteria for SIAD reflect contemporary conceptualizations that sexual desire, or the motivation to engage in sexual activity, is responsive rather than spontaneous (Both, Everaerd, Laan, & Janssen, 2007; Chivers & Brotto, 2017). Specifically, awareness of genital responses, and the recognition that these responses are sexual—coupled with subjective feelings of sexual arousal—may kindle sexual desire. If women have difficulty detecting their genital responses and labeling them as sexual, this could lead to low sexual desire. Consequently, sexual concordance—the integration of genital and subjective aspects of sexual response—may contribute to women's sexual functioning.

Relationship between sexual concordance and sexual functioning across methodologies

The majority of research examining sexual concordance and sexual functioning has used vaginal photoplethysmography (VPP; Laan et al., 2008; Meston et al., 2010; Morokoff & Heiman, 1980), but see Boyer et al., 2012 and Sarin et al., 2016) to assess genital vasocongestion. Concordance estimates with VPP are typically small to medium in magnitude with substantial variability across women (see Chivers et al., 2010 for a meta-analysis). VPP may not be ideal for assessing concordance because it measures changes to internal genitalia (i.e., vasocongestion in the vaginal walls), which may be less perceptible to women than changes to the external genitalia (e.g., Henson & Rubin, 1978). Internal genital responses may not provide sufficient interoceptive feedback for awareness of physiological sexual arousal, unlike the sensations provided during vasocongestive responses in the external genitalia (Waxman & Pukall, 2009).

The clitoral photoplethysmograph (CPP) assesses blood volume of the clitoral (i.e., vestibular) bulb (Gerritsen et al., 2009) and may be a useful alternative for assessing the relationship between sexual concordance and sexual functioning. Changes in clitoral blood volume (CBV) are specific to sexual stimuli, decreasing in response to sexual stimuli, and thus correlating negatively with vaginal pulse amplitude (VPA; the signal produced by the VPP) and self-reported sexual arousal (Gerritsen et al., 2009; Suschinsky et al., 2015). Consistent with other measures of genital response (Boyer et al., 2012; Huberman et al., 2017; Rellini et al., 2005), there is individual variability in the concordance of CBV and self-reported sexual arousal, Pearson $r(19) = -.86$ to .11 (Suschinsky et al., 2015).

The current study

The objectives of the current study were to (a) assess sexual concordance between subjective reports of arousal and concurrent measures of female genital response (vaginal and clitoral photoplethysmography); and (b) examine relationships between sexual concordance and sexual functioning, focusing on sexual desire and arousal. We used correlations and multilevel modeling

(MLM) to test hypotheses associated with these objectives. Although within-subject correlations were used for replication purposes, MLM quantifies and compares within-subject variation across subjects (Page-Gould, 2016), allowing us to examine whether individual variation in the slope of the relationship between genital and subjective sexual responses (i.e., sexual concordance) varied significantly across individuals with different sexual functioning.

Given the limited previous work examining directionality, we used MLM to investigate genital responses predicting subjective sexual arousal (SSA) and vice versa. Although models of sexual response suggest that genital responses would change before subjective arousal (e.g., Janssen, Everaerd, Spiering, & Janssen, 2000), there is some evidence for bidirectional relationships, particularly among women with sexual difficulties (e.g., Prause & Heiman, 2010). We predicted that women with better sexual functioning would have stronger sexual concordance, and that there would be a stronger relationship between sexual functioning and sexual concordance when genital responses were assessed using CBV versus VPA.

Method

Participants

Seventy-four women were recruited from a university campus and surrounding area using posters and social media advertisements. Forty-eight women were recruited for a study that focused on sexual functioning (Sample 1); advertisements for this study were directed at either "healthy, premenopausal women without sexual difficulties" or "premenopausal women experiencing low sexual arousal or desire." Exclusion criteria were (1) being younger than 18 or older than 65 years of age; (2) inability to speak and write English fluently; (3) daily use of blood pressure, cold, or allergy medications; (4) active sexually transmitted infection; (5) current pregnancy; and (6) postmenopausal. Participants were required to have experienced vaginal penetration and to not be currently experiencing pain during sexual activity, which was defined as feeling superficial pain during more than half of sexual activity or insertion.

The remaining 26 women were recruited for a broader sexual psychophysiological study (Sample 2) that used the same stimuli, equipment, and general procedures. Advertisements were directed at "healthy heterosexual women." Eligibility criteria were identical to the study above, with the following exceptions: (1) must be between 18 and 25 years of age; (2) must experience some attraction to members of the opposite gender/sex; (3) must be free from current and previous mental illness and substance abuse; and (4) must have regular menstrual cycles between 25 and 31 days. There were no significant differences between the two samples for age, relationship status, education, sexual identity, and sexual attractions (all $ps \geq .14$), therefore samples were combined (see Manipulation Check for comparisons of sexual responses). Of note, the samples' average sexual functioning scores (based on Total, Sexual Desire, and Sexual Arousal Female Sexual Function Index scale scores) did not significantly differ (all $ps \geq .24$).

Data from 10 women were not useable. Five women had uninterpretable VPA and five did not report any change in self-reported sexual arousal to the sexual stimulus, precluding sexual concordance calculations. The remaining 64 women ($M_{age} = 21.3$, $SD = 6.3$) had interpretable genital and self-reported sexual response data, and complete data for the Female Sexual Function Index (FSFI) Sexual Desire subscale (see Table 1a for biographic data). Using a clinical cutoff of 4.28 for FSFI Sexual Desire scores (Wiegel et al., 2005), 38 out of 64 women reported desire difficulties ($n = 21$ were from Sample 1).

For analyses using the FSFI Sexual Arousal subscale, an additional 20 women were excluded because they had not engaged in any sexual activity in the past four weeks, leaving a sample of 44 women ($M_{age} = 21.1$, $SD = 7.3$; see Table 1b for biographic data). Using a clinical cutoff score of 5.08 (Wiegel et al., 2005), 15 out of 44 women reported sexual arousal difficulties ($n = 10$ were

Table 1a. Biographic information for women with and without sexual difficulties based on FSFI Sexual Desire subscale scores.

	Full Sample	Lower Sexual Desire Women	Higher Sexual Desire Women
n	64	38	26
Mean age in years (*SD*)	21.3 years (6.3)	21.3 years (7.7)	21.2 years (3.5)
Relationship status (%)			
Single	35.9%	42.2%	26.9%
Dating	60.9%	52.6%	73.1%
Engaged	1.6%	2.6%	0.0%
Married	1.6%	2.6%	0.0%
Highest level of education achieved (%)			
Some high school (grades 9–11)	1.6%	2.6%	0.0%
High school diploma or equivalent completed	3.1%	2.6%	3.8%
Undergraduate degree (in progress or completed)	82.8%	84.2%	80.8%
Graduate or professional degree (in progress or completed)	12.5%	10.5%	15.4%
Sexual attractions (%)			
Men only	50.0%	57.9%	38.5%
Men mostly, but women occasionally too	42.2%	34.2%	53.8%
Men mostly, but women frequently but not more than toward men)	4.7%	5.3%	3.8%
Prefer not to respond	1.6%	2.6%	0.0%
Missing response	1.6%	0.0%	3.8%
Sexual identity (%)			
Heterosexual	84.6%	89.5%	84.6%
Not heterosexual	12.5%	10.4%	15.4%
Bisexual	4.7%	5.3%	3.8%
Lesbian or gay	0.0%	0.0%	0.0%
Queer	3.1%	2.6%	3.8%
Prefer not to use a label	10.9%	10.5%	11.5%
Other	6.3%	5.3%	7.2%
FSFI Sexual Desire score (*SD*)	4.31 (1.02)	3.60 (0.59)	5.35 (0.48)

Note. Women were classified as having lower sexual desire if their Female Sexual Function Index (FSFI) Sexual Desire subscale score was less than 4.28 (Wiegel et al., 2005), and as having higher sexual desire if their scores were greater than 4.28. Participants were asked to select as many sexual identity labels that they identified with. Some women identified with multiple labels, resulting in percentages that sum to greater than 100%.

from Sample 1). Chi-square analyses and independent samples *t* tests revealed no significant demographic differences between women who were above and below the clinical cutoff score for either sexual desire or arousal difficulties.

Materials

Genital responses

The genital devices, data acquisition settings, and procedures were identical across samples. Vaginal and clitoral responses were continuously measured throughout stimulus presentation using a combined vaginal and clitoral photoplethysmograph (Emotional Brain, Almere, The Netherlands). This device consists of a plastic, tampon-shaped probe that is inserted in the vagina (VPP) and a rounded, triangular-shaped CPP that is positioned above the introitus and between the labia minora (Gerritsen et al., 2009). Both photoplethysmographs contain light-emitting diodes and resistors to measure light reflectance from respective tissues; VPA was sampled at 256 Hz and filtered (high-pass 1 Hz, low-pass 1.5 Hz; Gerritsen et al., 2009). CBV was sampled at 256 Hz and low-pass filtered (0.3 Hz; Gerritsen et al., 2009).

Self-reported responses

During each stimulus, participants continuously reported their feelings of sexual arousal, or how turned on they were feeling, using a scale of 0 (*not at all sexually aroused*) to 100 (*extremely*

Table 1b. Biographic information for women with and without sexual difficulties based on FSFI Sexual Arousal subscale scores.

	Full Sample	Lower Sexual Arousal Women	Higher Sexual Arousal Women
n	44	15	29
Mean age in years (*SD*)	21.1 years (7.3)	23.1 years (12.2)	20.1 years (2.1)
Relationship status (%)			
Single	20.5%	26.2%	17.2%
Dating	75.0%	66.7%	79.3%
Engaged	2.3%	0.0%	3.4%
Married	2.3%	6.7%	0.0%
Highest level of education achieved (%)			
Some high school (grades 9–11)	2.2%	6.7%	0.0%
High school diploma or equivalent completed	4.5%	0.0%	6.9%
Undergraduate degree (in progress or completed)	81.8%	86.7%	79.3%
Graduate or professional degree (in progress or completed)	11.5%	6.6%	13.8%
Sexual attractions (%)			
Men only	53.5%	46.7%	57.1%
Men mostly, but women occasionally too	39.3%	46.7%	35.7%
Men mostly, but women frequently, but not more than toward men)	4.5%	6.7%	3.6%
Prefer not to respond	2.3%	0.0%	3.6%
Sexual identity (%)			
Heterosexual	81.8%	73.3%	86.2%
Not heterosexual	18.2%	16.0%	13.9%
Bisexual	6.8%	13.3%	3.4%
Lesbian or gay	0.0%	0.0%	0.0%
Queer	4.5%	0.0%	6.9%
Prefer not to use a label	9.1%	13.3%	6.9%
Other	6.8%	13.3%	3.4%
FSFI Sexual Arousal score (*SD*)	5.15 (0.9)	4.14 (0.8)	5.68 (0.4)

Note. Women were classified as having lower sexual desire if their Female Sexual Function Index (FSFI) Sexual Arousal subscale score was less than 5.08 (Wiegel et al., 2005), and as having higher sexual arousal if their scores were greater than 5.08. Participants were asked to select as many sexual identity labels that they identified with. Some women identified with multiple labels, resulting in percentages that sum to greater than 100%.

sexually aroused, feelings experienced right before reaching an orgasm). Continuous SSA was reported using a button press on a keypad, which lowered or raised a vertical bar on the television screen that displayed the audiovisual stimuli (see Procedure for more details).

Questionnaire

Female Sexual Function Index (FSFI; Rosen et al., 2000). The FSFI is a reliable measure assessing women's sexual functioning over a four-week period ($\alpha > .80$; Wiegel et al., 2005), with scores higher than 26.55 reliably differentiating between women with and without clinically significant sexual difficulties (Wiegel et al., 2005). The internal consistency of the FSFI in the current sample was similar to previous research ($\alpha = .89$ for the FSFI Total; $\alpha = .68$ for the FSFI Desire subscale; $\alpha = .84$ for the FSFI Arousal subscale).

Experimental stimuli

The audiovisual stimuli consisted of one 5.5-minute and one 10.5-minute sexual stimulus, depicting a man and woman kissing and caressing, progressing to cunnilingus, fellatio, and penile-vaginal intercourse, and ending with postcoital kissing and caressing. One 10-minute nature film was used as an adaptation stimulus. Our analyses focused on the 5.5-minute sexual stimulus, given that the genital responses being assessed tend to stabilize over time (e.g., Huberman et al., 2017;

Lake Polan et al., 2003), limiting variability for examining sexual concordance in longer stimuli. Sample 1 participants also viewed two 90-second neutral stimuli and four 90-second stimuli depicting solitary masturbation. Sample 2 participants also viewed a 90-second female-male sexual stimulus and three 3-minute neutral stimuli during their testing session. We examined responses to the neutral stimuli in a manipulation check, to ensure participants had significant responses to the 5.5-minute sexual stimulus. Responses to all other stimuli were not analyzed in the current study.

Procedure

Prospective participants contacted the laboratory, were informed of the general study procedures, and were screened to determine eligibility. Eligible women were scheduled for appointments when they were not menstruating and were tested by a female experimenter. Participants were instructed to refrain from the following activities for 24 hours prior to their appointment: (1) dyadic and solitary sexual activity; (2) using medications that may interfere with sexual arousal (e.g., cold medications); and (3) using drugs or alcohol. Participants were also instructed to refrain from engaging in aerobic exercise for three hours prior to their session because sympathetic nervous system activation can increase genital responding in women (Meston & Gorzalka, 1995). Most participants complied with the instructions. One woman reported using a thyroid medication, five women reported exercising within three hours of their laboratory session, and two women reported that they had either masturbated or had sexual contact with a partner in the 24 hours prior to their laboratory session; their data were retained because their change in vaginal and clitoral responses (i.e., dependent variables used in the manipulation check) were not outliers.

After providing informed consent, participants undressed from the waist down in a private, dimly lit room, attached the genital devices, and repositioned their underwear to keep the devices in place. The experimental stimuli were presented on a 1.02 m flat-screen television monitor. Participants were seated comfortably in a recliner 1.2 m away from the monitor and wore headphones. The stimuli were presented in a quasi-randomized order in Sample 1: all participants viewed the 10-minute adaptation stimulus first, followed by a randomized order of experimental stimuli. The stimuli were presented in a fixed order for Sample 2 participants: these women viewed the 10-minute adaptation stimulus first, followed by the 90-second, 5.5-minute, and 10.5-minute sexual stimuli. The sexual stimuli were separated by the three-minute neutral stimuli. Responses returned to approximate pretrial baseline levels prior to the start of each experimental (sexual) stimulus. SSA was reported continuously throughout each stimulus in both samples. Participants in Sample 1 were compensated $50 and participants in Sample 2 received $40. All procedures were approved by the university's research ethics committee.

Data reduction

Manipulation check

VPA and CBV data were inspected for artifacts that were removed prior to data analysis using procedures outlined by Suschinsky et al. (2015). We computed change scores (mean response relative to prestimulus baseline levels) for each stimulus and measure. Responses to the neutral stimuli were averaged. SSA was on a standardized (0%–100%) scale, so we computed mean minus baseline change scores for the SSA variable. For VPA and CBV, we computed percent change scores [(mean–baseline)/baseline] X 100]. CBV data were corrected using the protocol outlined by Gerritsen et al. (2009). Outliers were defined as change scores +/– 3 standard deviations away from the mean. There was one outlier for change in VPA and three outliers for change in CBV. Outliers were winsorized, such that they were replaced with the next highest value plus one.

All data points were retained for this analysis. For all ANOVAs, Greenhouse-Geisser corrected values are reported where the assumption of sphericity was violated.

Within-subjects correlation for sexual concordance

The raw means for SSA, VPA, and CBV data were each calculated in 30-second epochs or bins (11 data points) for the sexual stimulus and used to compute within-subjects Pearson *r* correlations between VPA and SSA ("vaginal concordance") and CBV and SSA ("clitoral concordance"). To examine relationships with sexual functioning, vaginal and clitoral concordance were correlated with sexual desire and arousal subscale scores from the FSFI using bootstrapped Pearson correlations (5,000 iterations), due to skewed clitoral concordance scores.

Relationship between sexual concordance and sexual functioning using MLM

Using R Studio Version 1.1.383 (R Studio Inc.), we modeled the predictive relationships between VPA and SSA (vaginal concordance; level 1) or CBV and SSA (clitoral concordance; level 1) with sexual functioning as a level 2 predictor (FSFI Sexual Desire or FSFI Sexual Arousal subscale scores). We ran separate models for each subscale given that sexual arousal and sexual desire scores were only modestly correlated ($r = .29$, $p = .06$), suggesting partial independence of these constructs. Our data were clustered within participants (evidenced by large intraclass correlation coefficients (ICC $\geq$0.56) for baseline models of SSA, VPA, and CBV), indicating that a multilevel approach was appropriate (see Cohen, 1992; Page-Gould, 2016).

As with the correlation analysis, the current analysis included SSA, VPA, and CBV data binned into eleven 30-second epochs. We included the pre-stimulus baseline period as the first epoch to assess change in responses from baseline. Therefore, twelve 30-second epochs were included in the MLM analyses. We conducted a series of two-level linear mixed-effects models with random intercepts and unstructured covariance matrices, using the lme4 package in R (Bates, Mäechler, Bolker, & Walker, 2015). VPA and CBV data were skewed, however, all MLM results were the same when using a nonparametric bootstrapped approach compared to the aforementioned parametric approach. We report the parametric results because their statistical indices were more easily interpretable. In Models 1a and 1b, VPA predicted SSA at level 1, providing the vaginal concordance slope for each participant. Sexual desire (Model 1a) and sexual arousal (Model 1b) were included as level 2 independent variables. In a second pair of models, CBV predicted SSA at level 1, providing the clitoral concordance slope for each participant. Sexual desire (Model 2a) and sexual arousal (Model 2b) were used as level 2 independent variables. We ran these same models again but with SSA predicting VPA (Models 3a and 3b) or CBV (Models 4a and 4b). A random-intercept model was chosen because response magnitudes were expected to vary between participants, leading to different SSA, VPA, or CBV intercepts.[1]

Prior to analyses, continuous predictors were centered to ensure meaningful zero points (Page-Gould, 2016). Level 1 continuous predictors were group-mean centered, with scores reflecting each participant's deviation from her mean response (i.e., within-subject deviations). Level 2 continuous predictors (sexual desire and sexual arousal) were grand-mean centered, with scores reflecting each participant's deviation from the overall sample mean for that measure. Significant cross-level interactions (i.e., interactions between level 1 predictors with sexual desire or sexual arousal) were followed up using Aiken and West's (1991) simple effects tests, examining effects at low (1 *SD* below the mean) and high (1 *SD* above the mean) FSFI domain scores. Semipartial R^2 was calculated to represent the amount of variance uniquely explained by each of the fixed effects, classified as small (0.02), medium (0.13), or large (0.26; Cohen, 1992; Edwards, Muller, Wolfinger, Qaqish, & Schabenberger, 2008; Page-Gould, 2016).

[1]Please contact the corresponding author for full model specifications.

Results

Manipulation check

Table 2 provides the means and standard deviations for SSA and for the genital measures (VPA and CBV) by sexual functioning status. Separate 2 (Stimulus: Neutral, Sexual) × 2 (Sexual Functioning: Low, High FSFI Total Score) × 2 (Sample: Sample 1, Sample 2) within-between ANOVAs were conducted for each dependent variable (% change in SSA, VPA, and CBV) to ensure that the sexual stimulus evoked significantly greater sexual response than the neutral stimulus, and that this effect was consistent across samples and sexual functioning groups. For each dependent measure, we found a significant main effect of Stimulus, $Fs > 53.57$, $ps < .001$, $\eta_p^2 > .56$, such that the sexual stimulus elicited significantly greater responses (reflected by increases in SSA and VPA and decreases in CBV) than the neutral stimulus. There were no further significant main effects or interactions.

Relationship between sexual concordance and sexual functioning using within-subject correlations

The average Pearson within-subject correlations are reported in Table 3a. Overall, there was a statistically significant negative correlation between clitoral and subjective sexual responses, regardless of sexual functioning status, as expected. Vaginal concordance was not statistically significant, regardless of sexual functioning status. We computed the correlation between concordance (vaginal or clitoral concordance for the sexual stimulus) and sexual desire and sexual arousal based on FSFI subscale scores (see Table 3b). Clitoral concordance scores were not normally distributed, thus bootstrapped Pearson correlations were used. As seen in Table 3b, only the FSFI sexual arousal subscale significantly correlated with clitoral concordance. Greater agreement between CBV and SSA responses (reflected by more strongly negative clitoral concordance) was associated with lower arousal scores (i.e., poorer sexual functioning). Relationships between

Table 2. Descriptive statistics for sexual responses by sexual functioning status.

	Neutral *M* (*SD*)	Sexual *M* (*SD*)
SSA		
Women without difficulties	−12.23 (11.12)	27.58 (16.47)
Women with difficulties	−7.91 (7.79)	30.62 (22.36)
VPA		
Women without difficulties	−3.33 (8.46)	55.96 (55.01)
Women with difficulties	−6.38 (9.89)	64.48 (53.39)
CBV		
Women without difficulties	2.67 (12.08)	−19.12 (18.27)
Women with difficulties	2.64 (3.79)	−24.02 (14.31)

Note. SSA = subjective sexual arousal; VPA = percent change in vaginal pulse amplitude; CBV = percent change in clitoral blood volume.
Means and standard deviations are presented for participants' classification based on their total Female Sexual Function Index scores.

Table 3a. Averages (and standard deviations) of vaginal and clitoral concordance scores by sexual functioning status.

	Vaginal Concordance	Clitoral Concordance
Sexual desire		
Women without sexual difficulty ($n = 26$)	.19 (.59)	−.53 (.54)*
Women with sexual difficulty ($n = 38$)	.36 (.53)	−.70 (.29)**
Sexual arousal		
Women without sexual difficulty ($n = 29$)	.19 (.55)	−.59 (.47)*
Women with sexual difficulty ($n = 15$)	.40 (.54)	−.65 (.35)*

Note. Values in parentheses denote standard deviations for Pearson *r* correlations.
*$p < .05$;
**$p < .01$.

Table 3b. Correlations between sexual concordance during the sexual stimulus and measures of sexual functioning.

	Vaginal Concordance	Clitoral Concordance
FSFI subscale		
Sexual desire ($n = 64$)	−.24 [−.47, .01]	.14 [−.08, .32]
Sexual arousal ($n = 44$)	−.19 [−.47, .14]	.25 [.02, .42]*

Note. Vaginal concordance refers to the relationship between vaginal pulse amplitude and subjective sexual arousal. Clitoral concordance refers to the relationship between clitoral blood volume and subjective sexual arousal. Values in brackets denote 95% confidence intervals for Pearson *r* bootstrapped correlations (5,000 iterations); when 95% confidence intervals do not include 0, the correlation should be interpreted as statistically significant.
*$p < .05$.

Table 4. Summary of MLM results for models including desire.

	b	*t* (*df*)	*p*	Semipartial R^2
Model 1a				
Level 1: VPA → SSA	3.58	8.95 (702)	.001	.07
Level 2: VPA*Desire → SSA	0.67	1.24 (702)	.22	.002
Model 2a				
Level 1: CBV → SSA	−0.22	−17.37 (702)	< .001	.30
Level 2: CBV*Desire → SSA	0.004	0.41 (702)	.68	< .001
Model 3a				
Level 1: SSA → VPA	0.04	9.91 (702)	< .001	.13
Level 2: SSA*Desire → VPA	−0.01	−2.57 (702)	.01	.01
Low Desire: SSA → VPA	0.05	9.36 (702)	< .001	.11
High Desire: SSA → VPA	0.03	5.07 (702)	< .001	.04
Model 4a				
Level 1: SSA → CBV	−1.37	−17.70 (702)	< .001	.31
Level 2: SSA*Desire → CBV	0.27	3.59 (702)	< .001	.02
Low Desire: SSA → CBV	−1.64	−15.98 (702)	< .001	.27
High Desire: SSA → CBV	−1.10	−9.72 (702)	< .001	.12

Note. MLM = multilevel modeling; VPA = vaginal pulse amplitude; SSA = subjective sexual arousal; CBV = clitoral blood volume. Level 1 effects reflect the direct relationship between VPA or CBV and SSA, or vice versa (i.e., average concordance). Level 2 effects reflect the extent to which sexual desire explains variation in the slope of the level 1 effect (i.e., variation in strength of concordance). Follow-up models at low and high levels of desire are shown for models with significant level 2 effects. Semipartial R^2 interpretations: small = .02, medium = .13, large = .26 (Cohen, 1992).

VPA and SSA showed similar trends of more agreement (more strongly positive vaginal concordance) being associated with lower sexual arousal/desire.

Relationship between sexual concordance and FSFI Sexual Desire subscale using MLM

Results are outlined below and summarized in Table 4.

Genital responses and sexual functioning predicting SSA

Model 1a: VPA and sexual desire predicting SSA

VPA significantly predicted SSA (i.e., vaginal concordance was significant, on average), $b = 3.58$, $t(702) = 8.95$, $p < .001$, semipartial $R^2 = .07$, with one unit (mV) increase in VPA associated with 3.58 units increase in SSA. At level 2, sexual desire did not significantly predict average SSA (i.e., the intercept), $b = 2.00$, $t(62) = 0.79$, $p = .43$, semipartial $R^2 = .01$. Sexual desire did not significantly explain variation in the VPA-SSA slope, $t(702) = 1.24$, $p = .22$, semipartial $R^2 = .002$, indicating that individual variability in the VPA-SSA slope (i.e., vaginal concordance) was not significantly affected by sexual desire.

Model 2a: CBV and sexual desire predicting SSA

At level 1, CBV significantly predicted SSA (i.e., clitoral concordance was significant, on average), $b = -0.22$, $t(702) = -17.37$, $p < .001$, semipartial $R^2 = .30$, with one unit (mV) increase in CBV

associated with 0.22 unit decrease in SSA (recall that CBV decreases with sexual arousal). At level 2, sexual desire did not significantly predict SSA intercept variation, $b = 2.00$, $t(62) = 0.79$, $p = .43$, semipartial $R^2 = .01$, consistent with Model 1a. Sexual desire did not significantly predict variation in the CBV-SSA slope, $t(702) = 0.41$, $p = .68$, semipartial $R^2 < .001$, indicating that individual variability in the CBV-SSA slope (i.e., clitoral concordance) was not significantly affected by sexual desire.

SSA and sexual functioning predicting genital responses

Model 3a: SSA and sexual desire predicting VPA

At level 1, SSA significantly predicted VPA (i.e., vaginal concordance was significant, on average), $b = 0.04$, $t(702) = 9.91$, $p < .001$, semipartial $R^2 = .13$, with one unit (%) increase in SSA associated with 0.04 unit (mV) increase in VPA. At level 2, sexual desire did not significantly predict average VPA, $b = -1.07$, $t(62) = -1.33$, $p = .19$, semipartial $R^2 = .03$. Sexual desire did significantly predict variation in the SSA-VPA slope, $b = -0.01$, $t(702) = -2.57$, $p = .01$, semipartial $R^2 = .01$, indicating that individual variability in the SSA-VPA slope (vaginal concordance) was a function of sexual desire score (see top portion of Figure 1). This interaction was followed up using simple effects analyses for Sexual Desire status (Low or High). SSA significantly predicted VPA in both the Low Sexual Desire women, $b = 0.05$, $t(702) = 9.36$, $p < .001$, semipartial $R^2 = .11$, and the High Sexual Desire women, $b = 0.03$, $t(702) = 5.07$, $p < .001$, semipartial $R^2 = .04$. At low levels of desire, mean VPA (i.e., the intercept) was 8.67 mV, with one unit increase in SSA being associated with 0.05 mV increase in VPA; by comparison, at high levels of desire, mean VPA was 6.49, with one unit increase in SSA being associated with 0.03 mV increase in VPA. SSA was therefore a stronger predictor of VPA in the Low Desire women compared to the High Desire women.

Model 4a: SSA and FSFI Sexual Desire predicting CBV

At level 1, SSA significantly predicted CBV (i.e., clitoral concordance was significant, on average), $b = -1.37$, $t(702) = -17.70$, $p < .001$, semipartial $R^2 = .31$, with one unit (%) increase in SSA associated with a 1.37 unit (mV) decrease in CBV. At level 2, sexual desire did not significantly predict CBV intercept variation, $b = 13.95$, $t(62) = 0.16$, $p = .88$, semipartial $R^2 < .001$. Sexual desire did significantly predict variation in the SSA-CBV slope. In other words, and consistent with Model 3a (SSA predicting VPA), there was a significant interaction between clitoral concordance and sexual desire, $t(702) = 3.59$, $p < .001$, semipartial $R^2 = .02$, indicating that individual variability in the SSA-CBV slope was a function of sexual desire score (see bottom portion of Figure 1). This interaction was followed up using simple effects analyses for Sexual Desire status (Low or High). SSA significantly predicted CBV in both the Low Sexual Desire women, $b = -1.64$, $t(702) = -15.98$, $p < .001$, semipartial $R^2 = .27$, and the High Sexual Desire women, $b = -1.10$, $t(702) = -9.72$, $p < .001$, semipartial $R^2 = .12$. At low levels of desire, mean CBV (i.e., the intercept) was 172.39 mV, with one unit increase in SSA being associated with 1.64 mV decrease in CBV; by comparison, at high levels of desire, mean CBV was 200.79 mV, with one unit increase in SSA being associated with 1.10 mV decrease in CBV. SSA was therefore a stronger predictor of CBV in the Low Desire women compared to the High Desire women.

Relationship between sexual concordance and sexual arousal using MLM

When examining the above models using FSFI Sexual Arousal subscale scores as a level 2 predictor, all patterns of results were consistent. For simplicity, we do not repeat the results in text; rather, we present the arousal model findings in Table 5 and Figure 2.

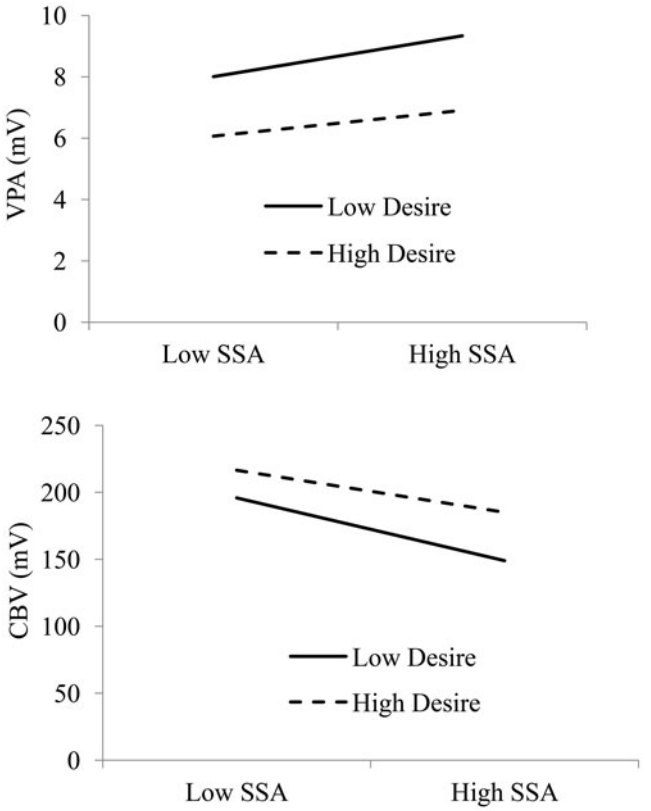

Figure 1. The relationship between vaginal concordance (top portion) and clitoral concordance (bottom portion) and sexual desire. SSA = subjective sexual arousal; VPA = vaginal pulse amplitude; CBV = clitoral blood volume. Simple slopes of the relationship between SSA and VPA (level 1, model 3a) and SSA and CBV (level 1, model 4a) at low and high levels of the level 2 predictor (FSFI desire scores). Note that VPA increases with sexual arousal, whereas CBV decreases.

Discussion

We assessed genital responses and SSA, sexual concordance, and sexual functioning in women using concurrent clitoral and vaginal measures. Consistent with previous research, women with and without low sexual arousal and desire showed similar magnitudes of change in genital responses and self-reported arousal to the sexual stimulus. Vaginal concordance estimates were weakly to moderately positive, and clitoral concordance was significantly moderately negative, replicating previous findings. Contrary to clinical samples, sexual concordance was stronger among those with poorer sexual functioning (i.e., lower sexual desire and sexual arousal FSFI subscale scores), particularly when changes in SSA predicted changes in genital responses. Our findings highlight that the relationship between sexual concordance and sexual functioning is complex and suggest that the subjective experience of arousal may be particularly significant in influencing genital responses in women with sexual desire and arousal difficulties.

Sexual concordance: Vaginal and clitoral estimates

Analyses using MLM consistently revealed that, regardless of women's sexual functioning, genital responses (VPA and CBV) significantly predicted their self-reported arousal (SSA), and vice versa. These relationships tended to be stronger for clitoral concordance (medium to large effect sizes) compared to vaginal concordance (small to medium effect sizes), consistent with previous work using

Table 5. Summary of MLM results for models including arousal.

	b	*t* (*df*)	*p*	Semipartial R^2
Model 1b				
Level 1: VPA → SSA	3.40	13.24 (482)	< .001	.10
Level 2: VPA*Arousal → SSA	0.51	1.52 (482)	.13	.005
Model 2b				
Level 1: CBV → SSA	−0.29	−12.57 (482)	< .001	.25
Level 2: CBV*Arousal → SSA	−0.01	0.20 (482)	.84	< .001
Model 3b				
Level 1: SSA → VPA	0.03	7.42 (482)	< .001	.10
Level 2: SSA*Arousal → VPA	−0.01	−2.24 (482)	.03	.01
Low Arousal: SSA → VPA	0.04	7.15 (482)	< .001	.10
High Arousal: SSA → VPA	0.02	3.75 (482)	< .001	.03
Model 4b				
Level 1: SSA → CBV	−1.20	−14.05 (482)	< .001	.29
Level 2: SSA*Arousal → CBV	−0.24	2.71 (482)	.01	.01
Low Arousal: SSA → CBV	−1.42	−12.46 (482)	< .001	.24
High Arousal: SSA → CBV	−0.99	−8.14 (482)	< .001	.12

Note. MLM = multilevel modeling; VPA = vaginal pulse amplitude; SSA = subjective sexual arousal; CBV = clitoral blood volume. Level 1 effects reflect the direct relationship between VPA or CBV and SSA, or vice versa (i.e., average concordance). Level 2 effects reflect the extent to which sexual arousal explains variation in the slope of the level 1 effect (i.e., variation in strength of concordance). Follow-up models at low and high levels of arousal are shown for models with significant level 2 effects. Semipartial R^2 interpretations: small = .02, medium = .13, large = .26 (Cohen, 1992).

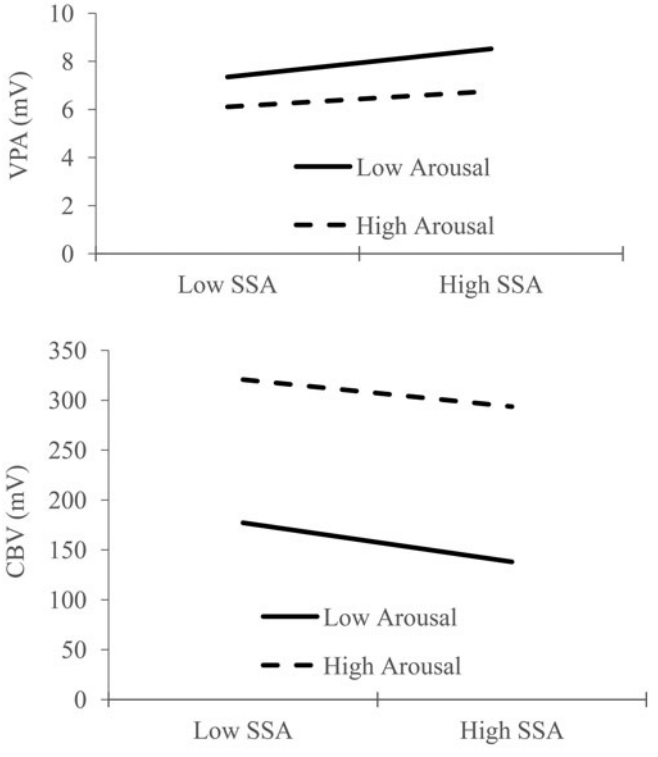

Figure 2. The relationship between vaginal concordance (top portion) and clitoral concordance (bottom portion) and sexual arousal. SSA = subjective sexual arousal; VPA = vaginal pulse amplitude; CBV = clitoral blood volume. Simple slopes of the relationship between SSA and VPA (level 1, model 3b) and SSA and CBV (level 1, model 4b) at low and high levels of the level 2 predictor (FSFI arousal scores). Note that VPA increases with sexual arousal, whereas CBV tends to decrease.

correlations (Suschinsky et al., 2015). Interestingly, for women with lower desire or arousal scores, the strength of concordance (based on effect sizes) was similar whether genital responses predicted SSA or vice versa; for those with higher desire or arousal scores, the magnitude of concordance was weaker when changes in SSA predicted genital responses, particularly for clitoral concordance.

These patterns correspond with some evidence that changes in genital responses do not always precede subjective arousal. The information-processing model of sexual response suggests that genital responses should precede subjective responses in early stages of sexual response, but that later stages involve integration and bidirectional feedback between genital and subjective responses (Janssen et al., 2000). Prause and Heiman (2010) found that women with lower sexual desire (based on a median split of Sexual Desire Inventory scores; Spector, Carey, & Steinberg, 1996) had their maximum time-lagged correlation between changes in labial temperature and subjective responses when changes in SSA preceded changes in genital response by up to 40 seconds. Conversely, women higher in sexual desire exhibited their maximum correlation with zero lag time, indicating that the relationship between genital response and SSA was strongest when they changed simultaneously. Another recent study with sexually healthy women revealed that, for the first 30 seconds of a sexual stimulus, sexual concordance was strongest when VPA preceded SSA, whereas for most of the remainder of the 10-minute stimulus, concordance was strongest when SSA preceded VPA (Huberman et al., 2017).

Brotto, Chivers, Millman, and Albert (2016) studied the effects of mindfulness-based sex therapy on sexual concordance in women who met *DSM-5* (APA, 2013) criteria for SIAD. The authors noted that sexual concordance increased significantly following treatment, with changes in SSA predicting changes in genital response. The reverse relationship (genital response predicting SSA) did not change following treatment. Clearly, the relationship between genital and subjective sexual responses is not straightforward, and changes in SSA may precede changes in genital response, particularly in women with sexual difficulties. This finding has implications for our models of sexual response as well as clinical implications. For example, clinical interventions that improve subjective arousal may also lead to changes in genital responding.

Relationship between sexual concordance and sexual functioning

Consistent with previous research examining sexual responses in women with and without sexual difficulties (e.g., Meston et al., 2010), we did not find differences in the magnitude of VPA during a sexual stimulus between women with and without sexual difficulties. These results are also consistent with Gerritsen et al. (2009), who noted no differences in CBV between women diagnosed with hypoactive sexual desire disorder and/or female sexual arousal disorder from the *DSM-IV-TR* (APA, 2000) and unaffected women. Likewise, women considered as having sexual difficulties reported similar degrees of SSA as those without sexual difficulties (based on FSFI total scores). These results support the notion that impaired genital or subjective responses alone are not necessarily linked to impaired sexual functioning, but that the integration of these two aspects of sexual response may be important.

We expected that sexual concordance would be significantly and positively related to sexual functioning. MLM analyses revealed that individual variation in the strength of vaginal and clitoral concordance was related to sexual functioning (sexual desire and arousal), but only when SSA predicted the genital measures. In the models in which sexual concordance did significantly interact with sexual desire and arousal, SSA significantly predicted increases in VPA and decreases in CBV (reflecting more sexual responsivity) in all women. These relationships, however, were stronger for women with low arousal and desire. Specifically, the same amount of change in SSA elicited larger increases in VPA and greater reductions in CBV for women with arousal and desire difficulties relative to women without such difficulties. Similarly, within-subject correlations revealed that greater agreement between CBV and subjective responses was associated

with lower arousal, although vaginal concordance was not significantly correlated with sexual arousal or desire. We therefore found similar *patterns* of results with both MLM and correlations.

Our findings correspond with accumulating evidence that sexual functioning and sexual concordance may be related; however, the direction of our effects runs contrary to previous investigations, which generally showed lower concordance in women with greater sexual desire or arousal difficulties (Chivers et al., 2010; Laan et al., 2008; Meston et al., 2010; Morokoff & Heiman, 1980; see Brotto et al., 2004, for an exception). Given that we observed a significant relationship with sexual functioning when self-reported arousal predicted genital responses, but not vice versa, our findings may coincide with those of Prause and Heiman (2010) reported above. Together with our results, the subjective experience of arousal may predict genital responses to a stronger extent in women with more sexual arousal and/or desire difficulties.

Other factors could be associated with stronger concordance among women with poorer sexual functioning. There is mixed evidence that one's awareness of internal physiological states, or *interoception*, is associated with stronger sexual concordance. For example, Handy and Meston (2016) found that interoceptive awareness was associated with stronger concordance in women, but Suschinsky and Lalumière (2012, 2014) did not find a similar association. Handy and Meston (2016) found that one aspect of interoceptive awareness (listening to one's body for insight) was associated with stronger concordance between genital response and perceived genital responses in women with impaired genital responses. Concordance between genital responses and SSA was not significantly affected by interoceptive awareness, however.

Interestingly, Velten and Brotto (2017) found that several dimensions of interoceptive awareness, including listening to, trusting, and noticing one's body, being aware of the relationship between body sensations and emotional states, and one's ability to regulate distress by attending to bodily sensations, were surprisingly predictive of *lower* sexual concordance in women with sexual arousal or desire difficulties. Velten and Brotto suggested that women with greater awareness may be more likely to attend to all sensations within the body, which could ultimately distract them from focusing on sexual sensations. Thus, it is possible that the women with better sexual functioning in our study were more immersed in their overall bodily sensations and were not attending to their genital responses specifically. Given the equivocal nature of results using both community and clinical samples, further research is needed to better understand the relationship between sexual concordance, sexual functioning, and interoception.

Limitations

Despite being a valid measure of sexual functioning, the FSFI is not without its limitations; Meyer-Bahlburg and Dolezal (2007) noted several, including that some items do not include an option to indicate zero sexual activity in the specified time frame and that the questions are limited to partnered sexual activities. We excluded a substantial proportion of our sample for analyses using the FSFI Arousal subscale because these participants did not engage in partnered sexual activity in the four weeks prior to testing. This limited power for these analyses and led to uneven sample sizes between arousal scale analyses ($n = 44$) and desire scale analyses ($n = 64$). More data were available for desire scale analyses given that recent sexual activity was not required. While this somewhat limited our comparisons across analyses, we found consistent patterns and chose to prioritize maximizing sample size and power for each analysis in order to arrive at the most accurate conclusions possible for each measure.

Furthermore, although the FSFI can discriminate between women with and without sexual difficulties (Wiegel et al., 2005), it is not as sensitive as interview methods. For instance, Meston et al. (2010) grouped participants based on data collected from semi-structured interviews related to *DSM-IV-TR* (APA, 2000) criteria. As well, the *DSM-5* (APA, 2013) diagnosis of SIAD for women is only given if a woman experiences distress related to her low desire or arousal, while

the FSFI does not assess psychological or emotional stress related to low arousal or desire. Future research could use diagnostic criteria in conjunction with self-report measures of sexual functioning to better characterize sexual dysfunction in participants and address the relationship between concordance and sexual functioning. The current analyses nonetheless provide important information on the relationship between sexual concordance and somewhat typical levels of variation in sexual arousal and desire.

Some unique characteristics of our sample may have contributed to our results running contrary to some previous research. Our sample is relatively large when compared with other studies of its kind, and potentially more representative. We had complete FSFI data for sexual arousal analyses for 44 women, 15 of whom reported arousal difficulties; sexual desire analyses had a larger sample ($n = 64$), with 38 women reporting desire difficulties. Meston et al. (2010) recruited 62 women and divided the participants into subgroups based on *DSM-IV-TR* diagnostic criteria (APA, 2000), with sample sizes ranging from nine to 16 participants. Sarin et al. (2016) had a larger sample ($N = 84$), but again, divided participants into subgroups ranging in size from 18 to 25. On average, our sample was also younger ($M = 20.1$ to 23.1 years old) than both Meston et al.'s ($M = 24.7$ to 29.8 years old) and Sarin et al.'s ($M = 26.2$ to 27.9 years old) samples. Thus, our sample may be less sexually experienced relative to others, perhaps resulting in poorer sexual concordance. However, recent research showed no association between sexual experience and concordance in women (Gerard et al., 2015).

We did find some similarities with previous research. Specifically, the vaginal concordance estimates for women without difficulties were similar to those reported in a meta-analysis of 108 samples of over 2,000 participants ($r = .26$; Chivers et al., 2010). Likewise, similar to our models where subjective arousal predicted genital responses, Prause and Heiman (2010) found that SSA *preceded* genital responding in women with low sexual desire. Further research using larger, more diverse samples is required to better understand if or how sexual functioning moderates sexual concordance in women.

Conclusions

Using self-report measures to assess sexual functioning in community samples of women, we found that the strength of the predictive relationship between self-reported sexual arousal and both vaginal and clitoral responses varied by sexual functioning. Women with lower levels of sexual desire and arousal had stronger sexual concordance, specifically when changes in subjective arousal predicted changes in genital responses. These results coincide with previous research suggesting that the subjective experience of arousal may be particularly important in influencing genital responses in women with sexual desire and arousal difficulties (Brotto et al., 2016; Prause & Heiman, 2010). Therapeutic approaches that enhance women's emotional or subjective experiences of sexual arousal may therefore be beneficial for improving sexual functioning.

ORCID

Meredith L. Chivers http://orcid.org/0000-0002-5495-9263

Funding

Funding for the research described was provided by grants awarded to Meredith L. Chivers from the Canadian Institutes of Health Research Queen's University Senate Advisory Research Council and postdoctoral fellowships awarded to Kelly D. Suschinsky from the Canadian Institutes of Health Research and Queen's University Senate Advisory Research Council.

References

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, CA: Sage Publications.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC. Author.

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. doi:10.18637/jss.v067.i01

Both, S., Everaerd, W., Laan, E., & Janssen, E. (2007). Desire emerges from excitement: A psychophysiological perspective on sexual motivation. In E. Janssen (Ed.), *The psychophysiology of sex* (pp. 327–339). Bloomington, IN: Indiana University Press.

Boyer, S. C., Pukall, C. F., & Holden, R. R. (2012). The relationship between female sexual arousal and response bias in women with and without provoked vestibulodynia. *Journal of Sex Research*, *49*(6), 519–532. doi: 10.1080/00224499.2011.604747

Brotto, L. A., Basson, R., & Gorzalka, B. B. (2004). Psychophysiological assessment in premenopausal sexual arousal disorder. *Journal of Sexual Medicine*, *1*(3), 266–277. doi: 10.1111/j.1743-6109.04039.x

Brotto, L. A., Chivers, M. L., Millman, R. D., & Albert, A. (2016). Mindfulness-based sex therapy improves genital-subjective arousal concordance in women with sexual desire/arousal difficulties. *Archives of Sexual Behavior*, *45*(8), 1907–1921. doi:10.1007/s10508-015-0689-8

Chivers, M. L., & Brotto, L. A. (2017). Controversies of women's sexual arousal and desire. *European Psychology*, *22*(1), 5–26. doi: 10.1027/1016-9040/a000274

Chivers, M. L., Seto, M. C., Lalumiere, M. L., Laan, E., & Grimbos, T. (2010). Agreement of self-reported and genital measures of sexual arousal in men and women: A meta-analysis. *Archives of Sexual Behavior*, *39*(1), 5–56. doi: 10.1007/s10508-009-9556-9

Clifton, J., Seehuus, M., & Rellini, A. H. (2015). Testing cognitive predictors of individual differences in the sexual psychophysiological responses of sexually functional women. *Psychophysiology*, *52*(7), 957–968. doi: 10.1111/psyp.12423

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159. doi: 10.1037/0033-2909.112.1.155

Edwards, L. J., Muller, K. E., Wolfinger, R. D., Qaqish, B. F., & Schabenberger, O. (2008). An R^2 statistic for fixed effects in the linear mixed model. *Statistics in Medicine*, *27*(29), 6137–6157. doi: 10.1002/sim.3429

Frijda, N. H. (1986). *The emotions*. Cambridge University Press, Cambridge: UK.

Gerard, M., Parada, M., Amsel, R., St-Pierre, A., Drury, S., & Binik, Y. M. (2015). *Does practice make perfect? Female and male sexual concordance through the lenses of sexual experience.* Poster presented at the annual meeting of the International Academy of Sex Research, Toronto, Ontario, Canada.

Gerritsen, J., Van Der Made, F., Bloemers, J., Van Ham, D., Kleiverda, G., Everaerd, W., … Tuiten, A. (2009). The clitoral photoplethysmograph: A new way of assessing genital arousal in women. *The Journal of Sexual Medicine*, *6*(6), 1678–1687. doi: 10.1111/j.1743-6109.2009.01228.x

Handy, A. B., & Meston, C. M. (2016). Interoceptive awareness moderates the relationship between perceived and physiological genital arousal in women. *Journal of Sexual Medicine*, *13*(12), 1907–1914. doi: 10.1016/j.jsxm.2016.09.018

Henson, C., & Rubin, H. B. (1978). A comparison of two objective measures of sexual arousal of women. *Behaviour Research and Therapy*, *16*(3), 143–151. doi: 10.1016/0005-7967(78)90060-8

Huberman, J. S., Dawson, S. J., & Chivers, M. L. (2017). Examining the time course of genital and subjective sexual responses in women and men with concurrent plethysmography and thermography. *Biological Psychology*, Online ahead of print.

Janssen, E., Everaerd, W., Spiering, M., & Janssen, J. (2000). Automatic processes and the appraisal of sexual stimuli: Toward an information processing model of sexual arousal. *Journal of Sex Research*, *37*(1), 8–23. doi: 10.1080/00224490009552016

Laan, E., Everaerd, W., & Evers, A. (1995). Assessment of female sexual arousal: Response specificity and construct validity. *Psychophysiology*, *32*(5), 476–485. doi: 10.1111/j.1469-8986.1995.tb02099.x

Laan, E., Van Driel, E. M., & Van Lunsen, R. H. (2008). Genital responsiveness in healthy women with and without sexual arousal disorder. *The Journal of Sexual Medicine*, *5*(6), 1424–1435. doi: 10.1111/j.1743-6109.2008.00827.x

Lake Polan, M., Desmond, J. E., Banner, L. L., Pryor, M. R., McCallum, S. W., Atlas, S. W., … Arnow, B. A. (2003). Female sexual arousal: A behavioral analysis. *Fertility and Sterility*, *80*(6), 1480–1487. doi:10.1016/S0015-0282(03)02210-6

Meston, C. M., & Gorzalka, B. B. (1995). The effects of sympathetic activation on physiological and subjective sexual arousal in women. *Behaviour Research and Therapy*, *33*(6), 651–664. doi: 10.1016/0005-7967(95)00006-J

Meston, C. M., Rellini, A. H., & McCall, K. (2010). The sensitivity of continuous laboratory measure of physiological and subjective sexual arousal for diagnosing women with sexual arousal disorder. *Journal of Sexual Medicine*, *7*(2), 938–950. doi: 10.1111/j.1743-6109.2009.01548.x

Meyer-Bahlburg, H. F. L., & Dolezal, C. (2007). The Female Sexual Function Index: A methodological critique and suggestions for improvement. *Journal of Sex & Marital Therapy*, *33*(3), 217–224. doi: 10.1080/00926230701267852

Morokoff, P. J., & Heiman, J. R. (1980). Effects of erotic stimuli on sexually functional and dysfunctional women: Multiple measures before and after sex therapy. *Behaviour Research and Therapy*, *18*(2), 127–137. doi: 10.1016/0005-7967(80)90107-2

Page-Gould, E. (2016). *Multilevel modeling*. In J. T. Cacioppo, L. Tassinary, & G. Berntson (Eds.), *The handbook of psychophysiology* (4th ed., pp. 662–678). New York, NY: Cambridge University Press.

Prause, N., & Heiman, J. R. (2010). Reduced labial temperature in response to sexual films with distractors among women with lower sexual desire. *Journal of Sexual Medicine*, *7*(2), 951–963. doi: 10.1111/j.1743-6109.2009.01525.x

Rellini, A. H., McCall, K. M., Randall, P. K., & Meston, C. M. (2005). The relationship between women's subjective and physiological sexual arousal. *Psychophysiology*, *42*(1), 116–124. doi: 10.1111/j.1469-8986.2005.00259.x

Rosen, R., & Beck, J. G. (1988). *Patterns of sexual arousal: Psychophysiological process and clinical applications*. New York, NY: Guilford Press.

Rosen, R., Brown, C., Heiman, J., Leiblum, S., Meston, C., Shabsigh, R., … D'Agostino, J. R. (2000). The Female Sexual Function Index (FSFI): A multidimensional self-report instrument for the assessment of female sexual function. *Journal of Sex & Marital Therapy*, *26*(2), 191–208. doi: 10.1080/009262300278597

Sarin, S., Amsel, R., & Binik, Y. M. (2016). A streetcar named "derousal"? A psychophysiological examination of the desire-arousal distinction in sexually functional and dysfunctional women. *Journal of Sex Research*, *53*(6), 711–729. doi: 10.1080/00224499.2015.1052360

Spector, I. P., Carey, M. P., & Steinberg, L. (1996). The Sexual Desire Inventory: Development, factor structure, and evidence of reliability. *Journal of Sex and Marital Therapy*, *22*(3), 175–190. doi: 10.1080/00926239608414655

Suschinsky, K. D., & Lalumière, M. L. (2012). Is sexual concordance related to awareness of physiological states? *Archives of Sexual Behavior*, *41*(1), 199–208. doi: 10.1007/s10508-012-9931-9

Suschinsky, K. D., & Lalumière, M. L. (2014). The relationship between sexual concordance and interoception in anxious and nonanxious women. *Journal of Sexual Medicine*, *11*(4), 942–955. doi: 10.1111/jsm.12250

Suschinsky, K. D., Lalumière, M. L., & Chivers, M. L. (2009). Sex differences in patterns of genital arousal: Measurement artifact or true phenomenon? *Archives of Sexual Behavior*, *38*(4), 559–573. doi: 10.1007/s10508-008-9339-8

Suschinsky, K. D., Shelley, A. J., Gerritsen, J., Tuiten, A., & Chivers, M. L. (2015). The clitoral photoplethysmograph: A pilot study examining discriminant and convergent validity. *The Journal of Sexual Medicine*, *12*(12), 2324–2338. doi: 10.1111/jsm.13047

Velten, J., & Brotto, L. A. (2017). Interoception and sexual response in women with low sexual desire. *PLoS One*, *12*(10), e0185979. https://doi.org/10.1371/journal.pone.0185979

Velten, J., Scholten, S., Graham, C. A., Adolph, D., & Margraf, J. (2016). Investigating female sexual concordance: Do sexual excitation and sexual inhibition moderate the agreement of genital and subjective sexual arousal in women? *Archives of Sexual Behavior*, *45*(8), 1957–1971. doi: 10.1007/s10508-016-0774-7

Waxman, S. E., & Pukall, C. F. (2009). Laser Doppler imaging of genital blood flow: A direct measure of female sexual arousal. *The Journal of Sexual Medicine*, *6*(8), 2278–2285. doi: 10.1111/j.1743-6109.2009.01326.x

Wiegel, M., Meston, C., & Rosen, R. (2005). The Female Sexual Function Index (FSFI): Cross-validation and development of clinical cut-off scores. *Journal of Sex & Marital Therapy*, *31*(1), 1–20. doi: 10.1080/00926230590475206