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ORIGINAL PAPER

Investigating Female Sexual Concordance: Do Sexual Excitation and Sexual Inhibition Moderate the Agreement of Genital and Subjective Sexual Arousal in Women?

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Abstract The agreement of subjective and genital sexual response, also referred to as sexual concordance, shows substantial variability between women. Identifying predictors of sexual arousal and sexual concordance is important to improve our understanding of female sexual response and its relationship to sexual function or dysfunction. The aim of this study was to assess the relevance of sexual excitation and sexual inhibition as predictors of subjective sexual arousal, genital arousal, and sexual concordance. In a laboratory setting, sexual arousal was induced by erotic video stimuli. Subjective sexual arousal was assessed continuously during stimulus presentation and genital arousal was measured with vaginal photoplethysmography. Data of 58 women (M age = 24.95, SD = 4.65) were analyzed using multilevel analyses (HLM). This data analytic technique estimates the within-subject associations of subjective and genital arousal, by controlling for between-subject differences. An interaction term of sexual excitation and sexual inhibition significantly predicted genital sexual arousal. In exploratory analyses, two lower order factors of sexual inhibition (Concerns about Sexual Function and Arousal Contingency) were predictive of sexual concordance. Further examination of these associations might increase our knowledge of female sexual function and deepen our understanding of how sexual excitation and sexual inhibition affect sexual arousal and consequently, impact sexual behaviors, in women.

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Introduction

Female sexual arousal is a multifaceted and dynamic process that includes emotional, behavioral, and physiological components that are interrelated, but also at least partly independent (Laan & Everaerd, 1995). The subjective or psychological dimensions of sexual arousal (SSA) includes cognitive processes and represent an individual's experience or feeling of being sexually excited, aroused, or "turned on" (Chivers, 2010). The genital sexual response is a centrally and peripherally controlled neurovascular process that includes increased blood flow to the genitals, resulting in a swelling of the clitoris, vagina, and vulva as well as vaginal lubrication (Levin & Wylie, 2008; Traish, Botchevar, & Kim, 2010). The level of agreement between subjective and genital arousal is called sexual concordance (Chivers, Seto, Lalumière, Laan, & Grimbos, 2010) or sexual coherence (Clifton, Seehuus, & Rellini, 2015).

There is substantial variation in female sexual concordance: While some women exhibit very high sexual concordance, others show only very low or even negative associations between subjective and genital arousal (Chivers et al., 2010). It is important to identify predictors of sexual arousal and sexual concordance in order to revise or refine our models of sexual response, to deepen our understanding of female sexual function and dysfunction, and to improve our psychometric assessment of sexual response (Chivers et al., 2010). These reasons are particularly relevant with respect to the female sexual response and concordance. Compared to men, women often demonstrate much lower, and more variable, sexual concordance (Chivers et al., 2010). The dual control model of sexual response as proposed by Bancroft

and Janssen (2000) offers a useful theoretical framework that allows for a theory-driven investigation of sexual arousal and concordance. The main objective of this study was to assess the relationship between the model's factors, called sexual excitation and sexual inhibition, and female sexual arousal and concordance.

Measurement of Sexual Arousal

The easiest method to assess subjective sexual arousal is to ask participants about the level of sexual arousal that they are feeling (e.g., *To what degree do you feel sexually aroused right now?*). The advantage of this method is convenient administration and applicability for both questionnaire and laboratory studies. In experimental or lab-based settings, arousal ratings are usually made before and after the presentation of sexually arousing stimuli (e.g., Rieger et al., 2015). Alternatively, SSA can be continuously measured during stimulus presentation (e.g., Rellini, McCall, Randall, & Meston, 2005). Benefits of this method lie in the elucidation of the time course of sexual arousal and the reduction of response biases (Laan & Everaerd, 1995). Continuous SSA ratings as well as change scores, calculated as differences between ratings before and after arousal induction, are less susceptible to impression management biases relative to post-stimulus ratings alone (Huberman, Suschinsky, Lalumière, & Chivers, 2013).

Women's genital sexual response in laboratory settings is most commonly measured with a vaginal photoplethysmograph, a tampon-shaped device that measures vaginal blood-flow. Vaginal pulse amplitude (VPA) is a valid and reliable measure for female genital arousal (Laan & Everaerd, 1995; Prause & Janssen, 2006; Suschinsky, Lalumière, & Chivers, 2009), although its use is not without difficulties. These include the lack of an absolute VPA scale that can be compared across women, and the lack of comparability to arousal measurements in men (Kukkonen, Binik, Amsel, & Carrier, 2007; Prause & Janssen, 2006). Nevertheless, the usefulness of the VPA measure has been shown in a large body of research (Chivers et al., 2010; Kukkonen, 2015).

Determining Sexual Concordance

Generally speaking, sexual concordance can be operationalized as the correlation between VPA and SSA. Because of interpersonal differences in VPA, designs that calculate sexual concordance using between-subject correlations of VPA and SSA have to be interpreted with caution (Prause & Janssen, 2006). Alternatively, within-subject correlations can be calculated using contiguously measured subjective and genital arousal (Meston, Rellini, & McCall, 2010; Rellini et al., 2005). Hierarchical linear modeling (HLM) can be used to analyze repeated measurement data nested within individuals. HLM does not require independent measurements, improves estimate of effects within subjects, simultaneously estimates variance and covariance components for within- and between-subjects levels of analysis, and has lower Type 1 error rates (Gelman & Hill, 2007; Raudenbush & Bryk, 2002). With this approach individual differences in VPA do not pose a problem, because the analysis is conducted within participants and the between-subject comparisons are based on the strength of the within-subject relationships between VPA and SSA.

Predictors of Sexual Concordance in Women

The search for meaningful moderator variables that explain the differences in sexual concordance between women has not borne fruit so far. In their meta-analysis, Chivers et al. (2010) reviewed the existing literature on sexual concordance and evaluated several, mostly methodological, variables as possible moderators for the agreement of genital and subjective sexual response. Neither stimulus modality (visual vs. non-visual), number of stimulus trials, timing of the subjective arousal measurement (post-trial vs. continuous), nor the type of correlation used (i.e., between- vs. within-subject) significantly predicted sexual concordance in women. Variety of stimulus modality or content, however, was significantly associated with greater sexual concordance in women. Asking women to report on perceived genital sensations—compared to overall feelings of sexual arousal—resulted in lower sexual concordance. Neither age nor the use of oral contraceptives was a significant moderator of sexual concordance.

There is no evidence that low sexual concordance is problematic per se. Chivers et al. (2010) concluded that it is still unclear if sexual concordance and sexual functioning are related in women. They analyzed data from ten studies that compared sexual concordance between women with and without sexual dysfunctions. In six of these studies, sexual concordance was higher in women without sexual dysfunctions (e.g., Palace & Gorzalka, 1992; Payne et al., 2007). One study reported similar levels of concordance (Meston & McCall, 2005) and three studies reported non-significant correlations for many study conditions, resulting in non-significant group differences when averaging the levels of concordance across conditions (Palace & Gorzalka, 1990). Meston et al. (2010), however, found that, compared to women with orgasmic disorder and healthy controls, women with sexual arousal disorder had significantly lower sexual concordance. This finding suggests that sexual concordance might be lower in women with arousal related sexual problems, but not in women with other sexual dysfunctions.

The Role of Sexual Excitation and Sexual Inhibition

According to the dual control model of sexual response, the occurrence of sexual arousal is dependent on an individual's balance of sexual excitation and sexual inhibition. Sexual excitation, which can be described as a gas pedal, facilitates sexual arousal and affects how easily one becomes aroused

by internal (e.g., arousing thoughts, fantasies) or external (e.g., a sexually attractive partner, erotic video) cues. Sexual inhibition, which can be conceptualized as a brake pedal, diminishes sexual arousal and discourages sexual behavior when the circumstances are inappropriate or the pursuit of sexual activities poses a threat to the individual. Both propensities differ between individuals with a close to normal distribution (Carpenter, Janssen, Graham, Vorst, & Wicherts, 2008; Pinxten & Lievens, 2015), can be reliably measured with self-report questionnaires (Graham, Sanders, & Milhausen, 2006; Janssen, Vorst, Finn, & Bancroft, 2002a), and are associated with sexual function (Bancroft & Janssen, 2000; Sanders, Graham, & Milhausen, 2008, Velten, Scholten, Graham, & Margraf, 2016b), and sexual risk behaviors (Nguyen et al., 2012; van Lankveld, Platteau, van Montfort, Nieuwenhuijs, & Syroit, 2015; Velten, Scholten, Graham, & Margraf, 2016c). Although the predictive value of sexual excitation and sexual inhibition has mostly been tested with respect to behavior-related outcomes (e.g., sexual activities), both factors should also directly be associated with sexual response. If we imagine that specific aspects of these propensities (e.g., sexual excitation related to unusual settings or partner characteristics) might be more strongly related to either subjective or genital sexual response, they might thereby moderate the relationship between these response levels (Janssen & Bancroft, 2007). (For an overview of the dual control model, see Bancroft, Graham, Janssen, & Sanders, 2009.)

Few studies have investigated the predictive value of sexual excitation and sexual inhibition for sexual arousal and sexual concordance. In one study of 40 men without sexual dysfunctions, sexual arousal was induced by threatening and non-threatening erotic video stimuli. Higher sexual excitation was associated with greater subjective and genital sexual arousal, while low sexual inhibition related to the threat of negative consequences of sexual behaviors was associated with greater genital response only to the threatening sexual video (Janssen, Vorst, Finn, & Bancroft, 2002b).

In an unpublished study by Janssen (1998, cited in Janssen & Bancroft, 2007), men without sexual dysfunctions watched a series of erotic films while threatened by electric shocks. Sexual excitation was unrelated to genital response, but one sexual inhibition scale related to the anxiety of performance failure was actually positively related to genital arousal. The authors discussed the possibility that the shock-threat, combined with a moving bar that reflected the current level of threat on the computer screen, acted as a distractor from otherwise arousal-reducing worries e.g., about erectile failure (Janssen & Bancroft, 2007). None of these studies, however, specifically investigated the influence of sexual excitation or sexual inhibition on sexual concordance in men.

To date, only one study has investigated the relationship between sexual excitation, sexual inhibition, and sexual concordance in women. Using a multilevel approach, Clifton et al. (2015) reported that sexual excitation and sexual inhibition, measured by the Sexual Excitation/Sexual Inhibition Inventory for Women (SESII-W; Graham et al., 2006), were not predictive of subjective or genital sexual arousal in a sample of 29 sexually active women. Clifton et al. (2015) suggested that sexual excitation should be associated with both genital and subjective arousal while sexual inhibition might only influence the subjective, more conscious, sexual response. One explanation for this is that women's sexual response has been shown to be relatively automatic and independent from a subjective evaluation of a stimulus as arousing (Chivers & Bailey, 2005). To date, there is no conclusive evidence that sexual inhibition, for example in the form of a high distractibility from sexual cues by external factors or inhibiting thoughts, is only associated to subjective arousal, not genital arousal. In Clifton et al.'s study, sexual excitation, however, was a significant moderator of sexual concordance, with higher levels of sexual excitation associated with greater agreement of subjective and genital arousal. Post hoc analyses were conducted to assess which subscales of sexual excitation contributed to this effect. No lower order factor of sexual excitation was predictive of genital arousal, but the Partner Characteristics and Setting subscales were positively, and the Sexual Power Dynamics subscale negatively, predictive of subjective arousal. The only significant predictor of sexual concordance was Sexual Power Dynamics, with greater levels of this factor associated with lower rates of sexual concordance. The authors emphasized the preliminary nature of these findings, as these were not based on a priori assumptions, and concluded that "the coherence between physiological and psychological arousal is clearly a complex phenomenon that we are only beginning to understand, and the findings so far suggest that there is a meaningful cognitive influence on this relationship." (p. 966).

Previous studies have indicated that, in comparison to the more general higher order factors, the lower order factors of sexual excitation and sexual inhibition might be more informative (Graham et al., 2006) and stronger predictors of specific outcome variables, such as sexual risk behavior (Velten et al., 2016c) or sexual function (Velten et al., 2016b). The lower order factors of sexual inhibition in particular might represent different mechanisms in which sexual response or sexual behaviors are consciously or subconsciously inhibited (Bancroft et al., 2009).

The Present Study

The aim of this study was to investigate the predictive value of the general propensities of sexual excitation and sexual inhibition, as well as their specific lower order domains, for genital and subjective sexual arousal measured in a laboratory setting, and the concordance between genital and subjective arousal in women. The following hypotheses were formulated based on the assumptions of the dual control model and the evidence from the one study that investigated the associations between sexual excitation, sexual inhibition, and sexual response in women using a similar data analytic approach (Clifton et al., 2015). We thereby aimed to investigate the pattern of results from the study by Clifton et al. (2015)

using a larger sample of women without sexual dysfunctions, and by including all lower order factors of sexual excitation and sexual inhibition in our analyses.

H1 VPA will be a positive predictor of SSA;

H2 SSA will be a positive predictor of VPA;

H3 Sexual excitation will be a positive, and sexual inhibition a negative, predictor of SSA;

H4 Sexual excitation will be a positive, and sexual inhibition a negative, predictor of VPA;

H5 Sexual excitation will be a positive and sexual inhibition will be a positive or negative predictor of sexual concordance.

In addition, we investigated on an exploratory basis if specific lower order factors of sexual excitation and sexual inhibition would be predictive of SSA, VPA, and sexual concordance.

Method

Participants

Pre-menopausal, heterosexual German-speaking women above the age of 18 that had had experienced either a gynecological exam or vaginal intercourse were eligible. This selection criterion was used to ensure that participants were able to insert the vaginal probe without experiencing significant discomfort or pain. Participants were recruited via flyers at the university's campus and via social media. In total, 69 women completed both the questionnaires and the laboratory experiment, including genital and subjective arousal measurements. Prior to data analyses, eleven women had to be excluded because of low quality of the physiological data, most likely due to a wrong placement of the vaginal probe or because they did not show any genital arousal response to the erotic stimuli, operationalized as no difference or a negative difference between the baseline and the sexual arousal condition. It is not uncommon for a small percentage of women to show no increase in VPA in response to erotic videos; such participants have also been excluded in comparable studies (Clifton et al., 2015; Rellini et al., 2005). Rerunning the analyses presented in this study with our complete sample i.e., without excluding these participants did not alter the results with respect to model fit, significant, and non-significant parameters.

Thus, data from 58 women (M age = 24.95, SD = 4.65) were analyzed. Most of these women were in a steady relationship (56.9 %) and had no children (94.8 %). Two-thirds of the women (70.7 %) defined themselves as exclusively heterosexual; one-third (29.3 %) identified as mostly heterosexual. Forty women (69.0 %) indicated taking hormonal contraception. The majority of the participants were students (79.3 %). Overall sexual function, measured with the Female Sexual Function Index (FSFI; Rosen et al., 2000), was high (M = 28.84, SD = 6.09). Sexual function was, however, unrelated to VPA and SSA in our study. Table 1 shows a summary of the sample characteristics.

Measures

Sexual Excitation and Sexual Inhibition

Sexual excitation and sexual inhibition were assessed with the German version of the SESII-W (Graham et al., 2006; Velten, Scholten, Graham, & Margraf, 2016a) a 36-item questionnaire that measures sexual excitation and sexual inhibition in women. Items include a series of statements about factors influencing sexual response and are rated on a Likert scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Via factor analysis, two higher order factors (sexual excitation and sexual inhibition), and eight lower order factors were identified. Five

Table 1 Sample characteristics regarding sociodemographic variables

Age (in years), M (SD)	Sample (N = 58) 24.95 (4.65) n[a] (%)
Partnership status	
Exclusive relationship or marriage	33 (56.9)
Non-exclusive relationship	4 (6.9)
Single with sexual contacts in the last year	19 (32.8)
No sexual contacts in the last year	2 (3.4)
Partnership duration	
<6 months	9 (15.5)
6 months to 2 years	23 (39.6)
2–5 years	12 (20.7)
>5 years	14 (24.1)
Number of children	
No children	55 (94.8)
1 child or more	3 (5.2)
Sexual orientation	
Exclusively heterosexual	41 (70.7)
Mostly heterosexual	17 (29.3)
Education	
Primary school	1 (1.7)
Secondary school	51 (87.9)
College degree	6 (10.3)
Occupation	
Full-time occupation	8 (13.8)
Part-time occupation	2 (3.4)
Student	46 (79.3)
Other	2 (3.4)
Hormonal contraception	
No	18 (31.0)
Yes	40 (69.0)

[a] Numbers vary due to missing data

lower order factors reflect different domains of sexual excitation. The Arousability factor describes how easily one becomes aroused by sexual fantasies or external sexual stimuli (e.g., *Fantasizing about sex can quickly get me sexually excited.*). The Partner Characteristics factor assesses how certain aspects of a potential sexual partner such as intelligence can facilitate a woman's sexual excitement (e.g., *If I see a partner interacting well with others, I am more easily sexually aroused.*). The Sexual Power Dynamics factor assesses how aspects of dominant behavior increase or diminish sexual arousal (e.g., *It turns me on if my partner "talks dirty" to me during sex.*). The Smell factor measures how arousing one perceives certain scents (e.g., *Particular scents are very arousing to me.*), and finally, the Setting (unusual, unconcealed) factor covers different aspects of the sexual situation, such as being overheard by others or the danger of being caught during sexual activity, and their influence on sexual arousal (e.g., *Having sex in a different setting than usual is a real turn on for me.*). Three lower order factors represent different domains of sexual inhibition. The Concerns about Sexual Function scale assesses how concerns about being a good lover or taking too long to reach orgasm reduce or impair sexual response and arousal (e.g., *Sometimes I feel so "shy" or self-conscious during sex that I cannot become fully aroused.*). The Arousal Contingency scale assesses how important it is for a woman's arousal that every aspect of the sexual situation is "just right" and how easily she can be "turned off" once arousal is initiated (e.g., *It is difficult for me to stay sexually aroused.*). Finally, Relationship Importance asks how different aspects of a sexual relationship e.g., mutual trust or commitment influence sexual arousal (e.g., *If I think that I am being used sexually it completely turns me off.*).

Validity and reliability of the SESII-W in the original validation study was satisfactory to good (Graham et al., 2006). The German version of the scale also exhibited good construct validity, internal consistency, and one-month test–retest validity (Velten et al., 2016a).

Stimulus Material: Selection and Description

The videos for this study were chosen following a systematic selection procedure. In the first step, five female project members screened a large number of different video clips with sexual and non-sexual content. The selection criteria for the neutral stimuli were pleasantness of the pictures, and no display of aggression or sexual behaviors. The selection criteria for the erotic stimuli included the display of different stages of sexual interaction from kissing to vaginal intercourse, consensual sexual activities between a man and a woman, attractive appearance of both actors, pleasant sound, unobtrusive setting and background. Six sexually arousing clips with a length of 5 min and four documentary films with a length of 15 min were selected for further evaluation. The Tape/Film Scale by Heiman and Rowland (1983) was used for post-stimulus ratings in a pilot study for stimulus selection. This self-report questionnaire assesses a variety of different emotional (e.g., anxious, disgusted, or excited) or physical reactions (e.g., genital warmth, perspiration, or faster heart beat) to video stimuli with 39 items. Items are answered on a 7-point Likert scale ranging from 1 (*not at all*) to 7 (*intensively*). Overall evaluation of the film clips was measured with the additional item "*How much did you like the last film-clip?*" from 1 (*not at all*) to 7 (*very much*).

Sexual stimuli were expected to be perceived as pleasant, as well as physically and subjectively arousing. Neutral stimuli were expected to be rated as neutral to pleasant, without inducing any kind of sex-related emotions or reactions. It was not expected that videos from either category would evoke negative emotions, like fear, disgust, shame, or guilt.

The pilot sample comprised 22 heterosexual women ($M_{age} = 25.36$, $SD = 3.33$) that did not participate in the laboratory study. Most of these women (81.1 %) had already watched pornographic film clips. A minority of them reported that they watched erotic movies several times a month (18.2 %). The remaining participants reported viewing pornographic videos less than once a month (22.7 %) or almost never (59.1 %).

The two sexual stimuli that were rated the most positively and the most sexually arousing were selected for this study. Both videos induced moderate levels of overall ($M = 3.77$, $SD = 1.84$) and mental/subjective sexual arousal ($M = 3.73$, $SD = 1.66$). They also induced a subjective perception of genital sexual response ($M = 3.64$, $SD = 1.78$). Both stimuli were rated as relatively pleasant ($M = 4.02$, $SD = 1.84$) and did not evoke substantial negative emotions, like anxiety ($M = 1.00$, $SD = 0.00$), disgust ($M = 1.48$, $SD = 0.93$), shame ($M = 1.07$, $SD = 0.23$), or guilt ($M = 1.02$, $SD = 0.15$). The selected neutral film was rated positively ($M = 5.52$, $SD = 1.69$). It did not induce sexual arousal ($M = 1.00$, $SD = 0.00$) or negative emotions, like anxiety ($M = 1.00$, $SD = 0.00$), and did not evoke much excitement ($M = 1.76$, $SD = 1.18$) or perceived genital reactions ($M = 1.57$, $SD = 0.98$).

The neutral video stimulus consisted of a 15-min nature documentary on penguins and was presented at the beginning of the experimental procedure. Two erotic films with a length of 5 min each were presented in counterbalanced manner. Both films included a different heterosexual couple engaging in kissing, foreplay, oral sex, and vaginal intercourse. For the present study, only the first of the two erotic film clips presented was analyzed. Distance between the participants and the computer screen was approximately 60 cm and all video stimuli were presented with a resolution of 1280 × 720 pixels (720p).

Subjective Sexual Arousal (SSA)

Subjective sexual arousal was measured in two ways. The participants rated their overall level of sexual arousal on a 9-point Likert scale from 0 (*not aroused*) to 8 (*maximally aroused*) before and after the presentation of sexual stimuli (distinct SSA). Continuous SSA was measured using a lever mounted on a potentiometer. The distance between 0 (*no arousal*) and 100 (*maximal*

arousal) was 10 cm and haptic feedback was provided by palpable markers mounted at each quarter of the scale. Women were instructed to use the lever continuously to indicate changes in sexual arousal during the 5-min duration of the erotic film. Similar devices have been used to assess SSA in previous laboratory studies (e.g., Clifton et al., 2015; Rellini et al., 2005).

Physiological Sexual Arousal

VPA was used as a measure of physiological sexual responses using a vaginal photoplethysmograph equipped with an orange-red spectrum light source (Technische Handelsonderneming Coos, The Netherlands) during the experimental procedure. The signal was sampled 1000 Hz times per second during the entire experimental procedure and the amplitude of each vaginal pulse wave was recorded in millivolts (mV). Data were acquired and processed using a data acquisition unit Model MP100 and AcqKnowledge version 3.9. (BIOPAC Systems, Inc.). On-line, a notch filter was applied to the data (50 Hz).

Procedure

After completion of a short web-based screening questionnaire, eligible participants were contacted in order to schedule an appointment for the laboratory session. The date was scheduled so that participant's menses did not interfere with the psychophysiological assessment. Participants were asked to refrain from alcohol and caffeine consumption prior to the appointment. Upon arrival, each participant was provided with a study information sheet and provided written informed consent. Trained female psychologists conducted clinical interviews in order to identify psychological disorders, such as major depressive symptoms, that might interfere with a woman's ability to participate in the study. One woman was excluded prior to the experimental procedure and referred to an outpatient clinic due to major depressive symptoms.

After explanation of the study procedures and of the vaginal plethysmograph, the experimenter left the room. The testing room was located next to the control room in which the experimenter supervised the testing procedure. Due to safety concerns the door between these two rooms was not locked, but all participants were assured that no one would enter the room without their explicit consent. Once the participants had inserted the vaginal probe, they sat in a reclining chair and received instructions via intercom. Participants carried out a short training procedure in order to become familiar with the continuous arousal measurement device. Once they felt ready to use the device without looking at it, participants started the experimental procedure, which included a series of video stimuli and short questionnaires. After completion of the 60-min laboratory session, participants received a small reimbursement (15 Euro) or course credit for their efforts. The Ethics Committee of the Faculty of Psychology at [Ruhr-Universität Bochum] approved the study procedures.

Data Analyses

Off-line, plethysmograph-data was band-pass filtered (0.5–20 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 purposes (Prause & Janssen, 2006). Data inspection and manual artifact rejection were performed using ANSLAB version 6.0 (Wilhelm & Peyk, 2005). The last 5 min of the neutral and the entire 5 min of the erotic stimuli were analyzed. Data from the potentiometer and the vaginal plethysmograph were averaged across 15-s intervals, resulting in 20 data points for each condition per participants.

To increase comparability of our results to previous studies that used a different data analytical approach, we calculated the mean subjective and genital response for each stimulus category. Mean genital response is reported as mean VPA during the erotic stimulus, percentage increase from baseline, and mean difference from baseline. The single-item measure of SSA and the mean of the continuously measured SSA are reported.

Two baseline models, specified only with a fixed intercept and a random intercept, were run to calculate intraclass correlation coefficients (ICC) for VPA and SSA as dependent variables. The ICC is an effect size that indicates to which degree observations from the same participant covary for a dependent variable (Cohen, 1992; Page-Gould, 2016). ICC values above .10 indicate a small, above .30 a medium, and values above .50 a large effect size (Cohen, 1992). The ICC was .75 for VPA and .51 for SSA, which demonstrates that the arousal measurements were significantly clustered within participants.

Therefore, hierarchical linear modeling (HLM) was chosen as the appropriate data analytic technique. All analyses were carried out in the R environment (R Development Core Team, 2010) using the package nlme (Pinheiro, Bates, DebRoy, & Sarkar, 2015). For this study, the major advantage of HLM 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. Thus, the predictive qualities of for example, sexual excitation and sexual inhibition (Level 2 predictors, i.e., inter-individual differences) as well as continuously measured VPA or SSA (Level 1 predictors, i.e., intra-individual changes) could be tested. To address our research questions, a series of models were estimated. Table 2 shows the equations for these models.

All predictor variables were grand mean centered before data analysis. Data were estimated using maximum-likelihood estimation, because it allows an estimation of the predictive value of fixed and random effects by facilitating comparisons between fit indices of different models (Field, Miles, & Field, 2012). The slopes and intercepts for each model were allowed to vary across participants in order to take into account within-subject differences in the baseline levels and time courses of the continuously

measured VPA or SSA. A linear and a quadratic time variable were added as fixed factors to improve model fit and to account for linear and non-linear time courses of sexual arousal (Pulverman, Hixon, & Meston, 2015).

We specified the covariance matrices of all tested models as first-order autoregressive structures with a continuous time covariate in order to fit our model to the correlation between the repeated measures within participants (for an overview, see Singer & Willett, 2003). When significant two-way interaction effects were identified, post hoc simple slope analyses were conducted to determine if the slopes of the two predicted lines differed from zero (Cohen, Cohen, West, & Aiken, 2013).

Results

Descriptive Analyses

Table 3 shows the sample characteristics for all relevant predictor and outcome variables.

In order to estimate the generalizability of our results, the levels of sexual excitation and sexual inhibition were compared to those of previous relevant study samples. The total scores of sexual excitation ($M = 2.89$, $SD = 0.35$) were higher compared to the validation study of the German version of the SESII-W (Velten et al., 2016a), but lower than the levels that were reported in another lab study (Clifton et al., 2015). The total scores of sexual inhibition ($M = 2.48$, $SD = 0.40$) were lower than both the German validation sample and other laboratory studies that used comparable psychophysiological testing (Clifton et al., 2015; Velten et al., 2016a). The effect sizes of all these group differences were minimal to small, with Cohen's d between .12 and .34.

Correlational Analyses

In order to compare the results of this study to studies that did not use a hierarchical data analysis approach, bivariate Pearson correlation coefficients were calculated between sexual excitation, sexual inhibition, and the averaged sexual arousal measures (Table 4).

The Concerns about Sexual Function subscale of sexual excitation was significantly associated with VPA. Greater concerns were related to lower VPA during the erotic film after correcting for baseline VPA. Setting (unusual/unconcealed) was positively correlated with both continuous, $r(56) = .29$, $p = .027$, and distinct, $r(55) = .32$, $p = .015$), measures of SSA. Absolute and baseline-corrected levels of VPA, $r(53) = .78$, $p < .001$, as well as both continuously measured and single-item assessments of SSA, $r(55) = .64$, $p < .001$, were highly correlated. Ignoring the hierarchical and longitudinal structure of the data, SSA and VPA measurements between participants were not significantly correlated. VPA during the erotic film and the single-item measure of SSA showed a trend towards significance, $r(55) = .24$, $p = .076$. The within-subject correlation using 20 data points per participant, $r(1264) = .22$, $p < .001$, was significant.

Sexual Concordance

Table 5 shows the results of SSA predicted by VPA.

VPA was a significant predictor of SSA (Model 1). Additionally, a linear as well as a quadratic time variable were predictive of

Table 2 Equations for all hierarchical mixed models

Model number (hypotheses)	
Baseline SSA	$SSA_{it} = \beta_0 + \beta_1(time)_{it} + \beta_2(time^2)_{it} + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$
Baseline VPA	$VPA_{it} = \beta_0 + \beta_1(time)_{it} + \beta_2(time^2)_{it} + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$
Model 1 (H1)	$SSA_{it} = \beta_0 + \beta_1(time)_{it} + \beta_2(time^2)_{it} + \beta_3(VPA)_{it} + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$
Model 2 (H2)	$VPA_{it} = \beta_0 + \beta_1(time)_{it} + \beta_2(time^2)_{it} + \beta_3(SSA)_{it} + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$
Model 3 (H3, H5)	$SSA_{it} = \beta_0 + \beta_1(time)_{it} + \beta_2(time^2)_{it} + \beta_3(VPA)_{it} + \beta_4(SE)_i + \beta_5(SI)_i + \beta_6(SE * SI)_i + \beta_7(SE * VPA)_{it} + \beta_8(SI * VPA)_{it} + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$
Model 4 (H4, H5)	$VPA_{it} = \beta_0 + \beta_1(time)_{it} + \beta_2(time^2)_{it} + \beta_3(SSA)_{it} + \beta_4(SE)_i + \beta_5(SI)_i + \beta_6(SE * SSA)_{it} + \beta_7(SE * SSA)_{it} + \beta_8(SI * SSA)_{it} + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$
Model 5 (exploratory analysis)	$SSA_{it} = \beta_0 + \beta_1(time)_{it} + \beta_2(time^2)_{it} + \beta_3(VPA)_{it} + \beta_4(Aro)_i + \beta_5(Par)_i + \beta_6(Pow)_i + \beta_7(Sme)_i + \beta_8(Sett)_i + \beta_9(Conc)_i + \beta_{10}(Coni)_i + \beta_{11}(Rel)_i + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$
Model 6 (exploratory analysis)	$VPA_{it} = \beta_0 + \beta_1(time)_{it} + \beta_2(time^2)_{it} + \beta_3(SSA)_{it} + \beta_4(Aro)_i + \beta_5(Par)_i + \beta_6(Pow)_i + \beta_7(Sme)_i + \beta_8(Sett)_i + \beta_9(Conc)_i + \beta_{10}(Conti)_i + \beta_{11}(Rel)_i + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$
Model 7 (exploratory analysis)	$SSA_{it} = \beta_0 + \beta_1(time)_{it} + \beta_2(time^2)_{it} + \beta_3(VPA)_{it} + \beta_4(Conc * VPA)_{it} + \beta_5(Conti * VPA)_{it} + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$
Model 8 (exploratory analysis)	$VPA_{it} = \beta_{0i} + \beta_1(time)_{it} + \beta_2(time^2)_{it} + \beta_3(SSA)_{it} + \beta_4(Conc * SSA)_{it} + \beta_5(Conti * SSA)_{it} + r_{0i} + r_{1i} * (time)_{it} + \varepsilon_{it}$

$_t$ = varying across time within individuals (level 1), $_i$ = varying across individuals (level 2)

VPA genital arousal, *SSA* subjective arousal, *SE* sexual excitation, *SI* sexual inhibition, *Aro* arousability, *Par* partner characteristics, *Pow* sexual power dynamics, *Sme* smell, *Sett* setting, *Conc* concerns about sexual function, *Conti* arousal contingency, *Rel* relationship importance

Table 3 Descriptive values of sexual excitation, sexual inhibition, and the different sexual arousal measures

	M	*SD*	Range (min–max)
Sexual excitation (total)	2.89	0.35	1.73–3.66
Arousability	3.03	0.38	2.11–3.78
Partner characteristics	2.94	0.54	1.75–4.00
Sexual power dynamics	2.87	0.48	1.00–3.75
Smell	3.12	0.74	1.50–4.00
Setting	2.48	0.54	1.25–3.25
Sexual inhibition (total)	2.48	0.40	1.69–3.25
Concerns about sexual function	2.50	0.62	1.25–3.50
Arousal contingency	2.02	0.49	1.00–3.33
Relationship importance	2.92	0.55	1.67–4.00
Subjective sexual arousal (SSA)			
Single-item subjective arousal	5.07	1.57	1.00–8.00
Continuous subjective arousal (0–10)	3.20	1.55	0.82–7.18
Genital sexual arousal (baseline-corrected)			
Difference score	2.30	1.49	0.47–7.93
Change in percent	124.03	88.59	15.79–462.35

Table 4 Bivariate correlations between sexual excitation, sexual inhibition, and different measures of sexual arousal

	1	2	3	4	5	6	7	8	9	10	11	12	13
Predictor variables													
1. Sexual excitation	1												
2. Arousability	.62**	1											
3. Partner characteristics	.66**	.32*	1										
4. Sexual power dynamics	.67**	.26*	.31*	1									
5. Smell	.69**	.37**	.34**	.22	1								
6. Setting	.57**	.23	.16	.47**	.07	1							
7. Sexual inhibition	−.18	−.10	.02	−.23	−.10	−.20	1						
8. Concerns about sexual function	−.02	−.01	.04	.02	−.09	.02	.79**	1					
9. Arousal contingency	−.13	−.25	−.03	−.12	.00	−.12	.69**	.36**	1				
10. Relationship importance	−.27*	.02	.03	−.44**	−.11	−.35**	.68**	.28*	.20	1			
Outcome variables													
11. Genital sexual arousal	−.01	−.02	−.05	−.06	.12	−.09	−.12	−.24	.01	−.01	1		
12. Genital sexual arousal, baseline-corrected	−.08	−.05	−.05	−.06	−.07	−.03	−.09	−.28*	.06	.06	.78**	1	
13. SSA after erotic film	.03	.13	−.15	.12	−.20	.32*	−.15	.04	−.18	−.20	.24	.17	1
14. SSA during erotic film	.09	.06	−.02	.09	−.07	.29*	−.11	−.04	−.11	−.11	.17	.14	.64**

SSA subjective sexual arousal

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

SSA, indicating that SSA increased with the duration of the erotic video, but that this increase was attenuated over the course of the video. The relationship between VPA and SSA showed significant variance in intercepts, but not in slopes across participants. The inclusion of VPA as a fixed effect significantly improved model fit compared to the baseline model without VPA, $\chi^2(1) = 18.86$, $p < .001$.

Table 6 shows the results of VPA predicted by SSA.

SSA was also a significant predictor of VPA (Model 2). Both time variables were also predictive of VPA. The relationship between VPA and SSA showed significant variance in intercepts and slopes across participants. This indicates that there were different levels of VPA between participants as well as differences in regard to the associations of SSA with

Table 5 Prediction of subjective sexual arousal by time and genital arousal

Outcome	Subjective sexual arousal (SSA)							
	Baseline SSA				Model 1			
Fixed effects	*b*	*SE* (*b*)	*t* (*df*)	*p* value	*b*	*SE* (*b*)	*t* (*df*)	*p* value
Time	12.82	1.25	10.28 (1100)	<.001	12.14	1.34	9.08 (1084)	<.001
Time^2	−8.11	0.72	−11.20 (1100)	<.001	−7.59	0.73	−10.46 (1084)	<.001
Genital arousal (VPA)					0.14	0.04	3.62 (1084)	<.001
Random effects	Variance estimates	*SD*	χ^2 (*df*)	*p* value	Variance estimates	*SD*	χ^2 (*df*)	*p* value
Intercept	0.00	0.02	435.94 (1)	<.001	0.11	0.33	423.23 (1)	<.001
Slope	0.00	0.01	0.00 (2)	1.00	0.02	0.14	4.08 (2)	.130

Table 6 Prediction of genital sexual arousal by time and subjective sexual arousal

Outcome	Genital sexual arousal (VPA)							
	Baseline VPA				Model 2			
Fixed effects	*b*	*SE* (*b*)	*t* (*df*)	*p* value	*b*	*SE* (*b*)	*t* (*df*)	*p* value
Time	5.48	0.97	5.68 (1085)	<.001	4.38	0.99	4.42 (1084)	<.001
Time^2	−4.22	0.49	−8.68 (1085)	<.001	−3.54	0.51	−6.92 (1084)	<.001
Subjective arousal (SSA)					0.08	0.02	3.79 (1084)	<.001
Random effects	Variance estimate	*SD*	χ^2 (*df*)	*p* value	Variance estimate	*SD*	χ^2 (*df*)	*p* value
Intercept	0.68	0.83	1065.53 (1)	<.001	0.68	0.82	1071.43 (1)	<.001
Slope	0.02	0.15	26.00 (2)	<.001	0.02	0.14	28.26 (2)	<.001

VPA. The inclusion of SSA as a fixed effect significantly improved model fit compared to the baseline model, $\chi^2(1) = 14.48$, $p < .001$.

Sexual Excitation and Sexual Inhibition as Predictors of Sexual Arousal and Sexual Concordance

Table 7 shows the results of two models that estimate the predictive value of sexual excitation and sexual inhibition as well as their interaction for SSA (Model 3) or VPA (Model 4).

Sexual excitation and sexual inhibition did not significantly predict SSA and the relationship between VPA and SSA was not moderated by sexual excitation and sexual inhibition (Model 3). Overall, inclusion of sexual excitation and sexual inhibition did not significantly improve model fit compared to Model 1, $\chi^2(5) = 1.85$, $p = .869$.

Figure 1 shows the interaction effect between sexual excitation and sexual inhibition that did significantly predict levels of VPA in Model 4.

The post hoc simple slopes analyses indicated that the slope of the line that described the relationship between sexual excitation and VPA for women who scored low on sexual inhibition (−1 *SD*) was significantly positive ($\beta = .28$, $SE = .04$, $t = 6.53$, $p < .001$) and the slope of the line for women who scored high on sexual inhibition (+1 *SD*) was significantly negative ($\beta = -.45$, $SE = .04$, $t = -10.54$, $p < .001$). This indicates that for women with low sexual inhibition, the relationship between sexual excitation and VPA was positive, while for women with high levels of sexual inhibition, sexual excitation and VPA were negatively associated. To illustrate this pattern, a second simple slope analysis that described the relationship between sexual inhibition and VPA was conducted. For women who scored low on sexual excitation (- 1 *SD*), the slope of the regression line was positive ($\beta = .29$, $SE = .05$, $t = 6.27$, $p < .001$), but for women with high sexual excitation (+SD), the slope of the regression line was negative ($\beta = -.44$, $SE = .04$, $t = -11.07$, $p < .001$). Inclusion of sexual excitation and sexual inhibition as fixed factors showed a trend towards improving model fit compared to Model 1, $\chi^2(5) = 10.78$, $p = .056$.

Lower Order Factors of Sexual Excitation and Sexual Inhibition as Predictors of Sexual Arousal

Table 8 shows the results of two models that predict either SSA (Model 5) or VPA (Model 6) by the eight lower order factors of sexual excitation and sexual inhibition.

Table 7 Prediction of sexual arousal by time, genital or subjective arousal, sexual excitation, and sexual inhibition

Outcome	Subjective arousal (SSA)				Genital arousal (VPA)			
	Model 3				Model 4			
Fixed effects	*b*	*SE* (*b*)	*t* (*df*)	*p* value	*b*	*SE* (*b*)	*t* (*df*)	*p* value
Time	12.16	1.33	9.12 (1082)	<.001	4.37	1.00	4.38 (1082)	<.001
Time^2	−7.62	0.73	−10.44 (1082)	<.001	−3.53	0.51	−6.97 (1082)	<.001
Genital arousal (VPA)	0.13	0.04	3.33 (1082)	<.001				
Subjective arousal (SSA)					0.08	0.02	3.80 (1082)	<.001
Sexual excitation (SE)	0.06	0.08	0.70 (54)	.484	−0.09	0.09	−1.04 (54)	.303
Sexual inhibition (SI)	−0.02	0.10	−0.23 (54)	.820	−0.08	0.09	−0.92 (54)	.362
SE * SI	−0.10	0.09	−1.11 (54)	.274	−0.25	0.09	−2.75 (54)	.008
SE * VPA/SSA	0.00	0.04	0.07 (1082)	.946	0.02	0.02	0.78 (1082)	.437
SI * VPA/SSA	0.01	0.01	0.38 (1082)	.707	0.01	0.02	0.45 (1082)	.651
Random effects	Variance estimates	*SD*	χ^2 (*df*)	*p* value	Variance estimates	*SD*	χ^2 (*df*)	*p* value
Intercept	0.09	0.30	402.86 (1)	<.001	0.61	0.78	1023.25 (1)	<.001
Slope	0.02	0.14	3.37 (2)	.185	0.02	0.15	31.91 (2)	<.001

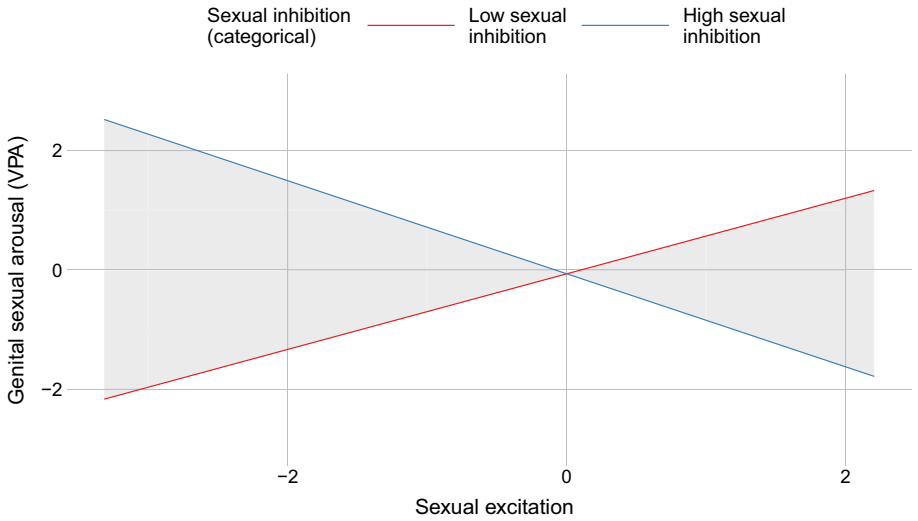

Fig. 1 Conditional effect of sexual excitation and sexual inhibition on vaginal pulse amplitude (standardized scores)

Only the Setting (unusual/unconcealed) subscale of sexual excitation showed a trend towards significance in the prediction of SSA. Greater levels of this subscale were associated with greater SSA. The Concerns about Sexual Function subscale of Sexual Inhibition was a negative predictor of VPA. Inclusion of the lower order factors did not improve model fit for the prediction of SSA compared to Model 1, $\chi^2(8) = 4.69$, $p = .790$, and did not improve model fit for the prediction of VPA compared to Model 2, $\chi^2(8) = 9.63$, $p = .292$.

Lower Order Factors of Sexual Excitation and Sexual Inhibition as Predictors of Sexual Concordance

To investigate if some of the lower order factors of sexual excitation and sexual inhibition moderated the relationship between subjective and genital arousal, we tested two models that included all eight lower order factors as well as the interaction between these factors and SSA or VPA, respectively. Two lower order factors of sexual inhibition (Concerns about Sexual Function and Arousal

Table 8 Prediction of sexual arousal by time, genital or subjective arousal and the eight lower order scales of sexual excitation and sexual inhibition

Outcome	Subjective arousal (SSA)				Genital arousal (VPA)			
	Model 5				Model 6			
Fixed effects	*b*	*SE* (*b*)	*t* (*df*)	*p* value	*b*	*SE* (*b*)	*t* (*df*)	*p* value
Time	12.13	1.32	9.17 (1084)	<.001	4.33	1.00	4.33 (1084)	<.001
Time^2	−7.58	0.73	−10.41 (1084)	<.001	−3.52	0.51	−6.96 (1084)	<.001
Genital arousal (VPA)	0.14	0.04	3.69 (1084)	<.001				
Subjective arousal (SSA)					0.08	0.02	3.88 (1084)	<.001
Arousability	0.04	0.09	0.48 (49)	.631	0.08	0.10	−0.69 (49)	.491
Partner characteristics	−0.06	0.09	−0.67 (49)	.504	−0.07	0.09	−1.00 (49)	.320
Sexual power dynamics	−0.01	0.10	−0.14 (49)	.887	−0.09	0.11	−0.82 (49)	.416
Smell	−0.04	0.09	−0.48 (49)	.631	−0.09	0.09	1.35 (49)	.182
Setting	0.16	0.09	1.80 (49)	.078	0.13	0.09	0.16 (49)	.873
Concerns about sexual function	0.01	0.09	0.15 (49)	.878	0.02	0.09	−2.06 (49)	.044
Arousal contingency	−0.01	0.09	−0.13 (49)	.899	−0.19	0.09	0.21 (49)	.836
Relationship importance	0.01	0.10	0.08 (49)	.938	0.02	0.10	0.28 (49)	.780
Random effects	Variance estimates	*SD*	χ^2 (*df*)	*p* value	Variance estimates	*SD*	χ^2 (*df*)	*p* value
Intercept	0.07	0.27	343.01 (1)	<.001	0.63	0.80	864.70 (1)	<.001
Slope	0.02	0.13	2.61 (2)	.271	0.02	0.15	25.49 (2)	<.001

Contingency) were moderators of the agreement between VPA and SSA and one lower order factor of sexual excitation (Smell) showed a trend towards significance. Table 9 shows the two models that include the relevant interaction terms for the prediction of SSA (Model 7) and VPA (Model 8).

Greater levels of Concerns about Sexual Function significantly predicted greater sexual concordance in Model 7 and showed a trend towards significance in Model 8. The post hoc simple slope analysis showed that even though both subsamples of women exhibited significant sexual concordance, the agreement between VPA and SSA was lower for women with lower scores on Concerns about Sexual Function ($\beta = .17$, $SE = .04$, $t = 4.68$, $p < .001$) compared to women with higher scores on Concerns about Sexual Function ($\beta = .27$, $SE = .04$, $t = 7.22$, $p < .001$). Figure 2 illustrates the effect of this significant moderating variable.

High sexual inhibition related to the Arousal Contingency scale was associated with lower levels of sexual concordance (Model 7). The post hoc simple slope analysis showed that women with high levels of Arousal Contingency (+1 *SD*) did not show a significant level of sexual concordance ($\beta = .12$, $SE = .04$, $t = 0.30$, $p = .770$), while women with low levels of Arousal Contingency showed a positive association between VPA and SSA ($\beta = .39$, $SE = .04$, $t = 10.4$, $p < .001$). Figure 3 illustrates this moderating effect.

Additionally, higher scores on the sexual excitation Smell subscale showed a non-significant tendency to predict greater concordance in Model 8. The post hoc analysis showed that women with low and high levels of the Smell subscale of sexual excitation showed significant sexual concordance, but that the levels of concordance were higher for women who scored high on the Smell subscale ($\beta = .29$, $SE = .04$, $t = 6.92$, $p < .001$), compared to women who scored low ($\beta = .18$, $SE = .04$, $t = 4.51$, $p < .001$). Inclusion of the moderating variables improved model fit for the prediction of SSA compared to Model 1, $\chi^2(4) = 11.52$, $p = .021$, and for the prediction of VPA compared to Model 2, $\chi^2(4) = 11.71$, $p = .020$.

Discussion

The aim of this study was to investigate the value of sexual excitation and sexual inhibition in predicting subjective and genital sexual arousal, and the agreement of these two levels of sexual response (sexual concordance). Additionally, the unique contributions of the different lower order factors of sexual excitation and sexual inhibition were tested in order to explore possible correlations between specific aspects of sexual excitation and sexual inhibition. The strengths of our study include the use of a sufficiently large sample size, the use of both distinct and continuous subjective arousal measurements, and the utilization of a data analytic technique that allowed for control of between-subject differences in genital response.

Our findings indicate significant agreement of subjective and genital sexual arousal in women. Using a multilevel approach and within-subject correlations, both variables were significantly predictive of each other. As reported in previous studies, the between-

Table 9 Prediction of sexual arousal by time, genital or subjective sexual arousal and the eight lower order scales of sexual excitation and sexual inhibition

Outcome		Subjective arousal (SSA)				Genital arousal (VPA)			
		Model 7				Model 8			
Fixed effects		*b*	*SE* (*b*)	*t* (*df*)	*p* value	*b*	*SE* (*b*)	*t* (*df*)	*p* value
Time		12.18	1.34	9.06 (1082)	<.001	4.50	1.01	4.47 (1082)	<.001
Time^2		−7.60	0.72	−10.56 (1082)	<.001	−3.56	0.51	−6.97 (1082)	<.001
Genital arousal (VPA)		0.14	0.04	3.77 (1082)	<.001				
Subjective arousal (SSA)						0.08	0.02	3.80 (1082)	<.001
Smell * SSA						0.03	0.02	1.77 (1082)	.077
Concerns about sexual function * VPA/SSA		0.08	0.03	2.66 (1082)	.008	0.03	0.02	1.76 (1082)	.079
Arousal contingency * VPA		−0.09	0.04	−2.49 (1082)	.013				
Random effects	Variance estimates	*SD*	χ^2 (*df*)	*p* value	Variance estimates	*SD*	χ^2 (*df*)	*p* value	
Intercept	0.11	0.34	380.89 (1)	<.001	0.63	0.79	989.76 (1)	<.001	
Slope	0.02	0.16	5.53 (2)	.063	0.02	0.15	30.65 (2)	<.001	

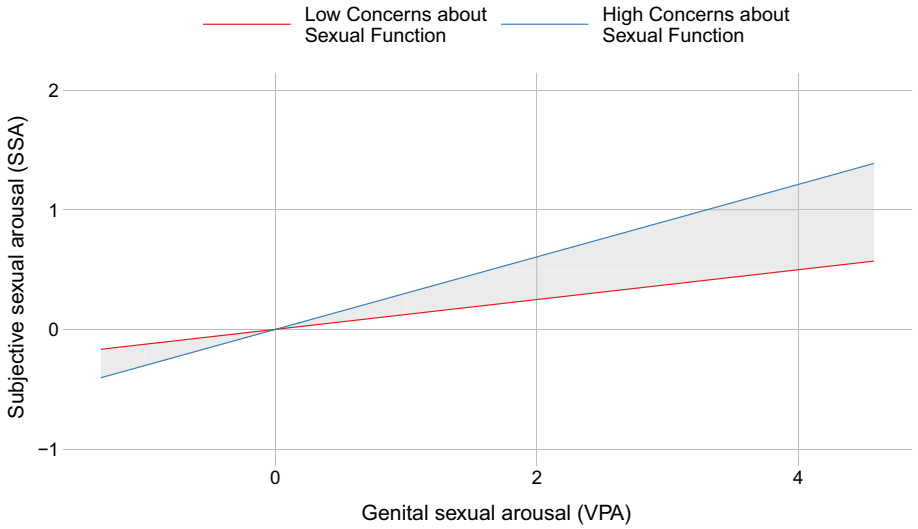

Fig. 2 Concerns about sexual function factor as moderator of sexual concordance (standardized scores)

subject correlations, however, were smaller and not different from zero (Chivers et al., 2010). These results are in line with studies that either found a non-significant or low agreement of genital and subjective arousal in women using between-subject analyses (Chivers et al., 2010; Clifton et al., 2015).

According to the dual control model of sexual response, sexual excitation reflects how easily an individual becomes aroused by a variety of stimuli that can be internal, such as sexual fantasies, or external, like the erotic videos that we presented in our study. Sexual inhibition prevents or inhibits sexual arousal, in situations where it might be disadvantageous for the individual to become aroused or to pursue sexual behaviors.

The higher order factors of sexual excitation and sexual inhibition were not predictive of either genital or subjective arousal, but the interaction between sexual excitation and sexual inhibition significantly predicted genital sexual arousal. This finding, although somewhat surprising, offers an interesting perspective on female sexual response. For women who were not particularly sexually inhibited, greater levels of sexual excitation were, as expected, associated with higher levels of VPA. For women who were (relatively) sexually inhibited, this association was reversed. For them, high levels of sexual excitation were related to lower levels of genital response. One possible explanation is that for women who are high in both propensities for excitation and

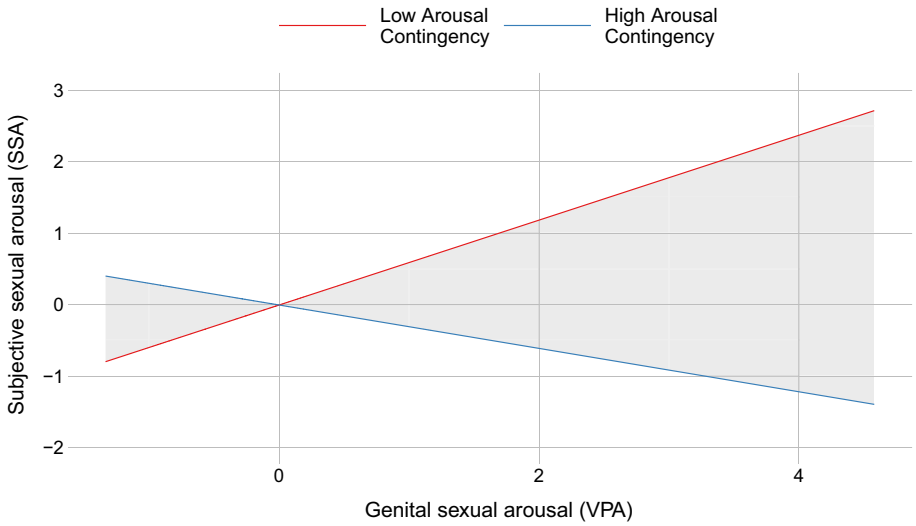

Fig. 3 Arousal Contingency factor as moderator of sexual concordance (standardized scores)

inhibition, the sexual stimuli presented in our study elicited mixed responses, being both interesting but also activating inhibiting thoughts or worries that interfered with their arousal. This interaction effect might also explain the null effect of sexual excitation and sexual inhibition as predictors of VPA and SSA in this and a previous study (Clifton et al., 2015). The effect can also be seen as a confirmation of the relatively independent nature of sexual excitation and sexual inhibition. It underlines the need to distinguish between sexually excitatory and inhibitory factors instead of having one single bipolar dimension (Bancroft et al., 2009).

The lower order factor Setting (unusual/unconcealed) showed a trend towards being a significant predictor of SSA. Women who reported being easily aroused by the danger of being caught or overheard during sexual activities reported higher arousal during the stimulus presentation, which is in line with previous findings (Clifton et al., 2015) and may implicate that the laboratory setting can indeed be a "turn-on," at least for some women.

Two subscales of sexual inhibition that are associated with sexual problems or difficulties, Concerns about Sexual Function and Arousal Contingency (Bloemendaal & Laan, 2013; Sanders et al., 2008) were predictors of genital sexual response and/or sexual concordance. Women who reported greater worries concerning their sexual function showed lower levels of VPA. This finding is particularly interesting because it was hypothesized that sexual inhibition would be more closely related to the psychological or subjective dimension of arousal (Clifton et al., 2015) and not to the more reflexive or automatic genital response (Laan & Janssen, 2007). Moreover, this subscale was a positive predictor of sexual concordance in our study. In contrast to our expectations, sexual inhibition related to worries about taking too long to get aroused or to reach orgasm was thus related to *greater* concordance in our sample. Possibly, some women who worry more about their sexual arousal and response focus *more* on their physical and genital sensations during sexual activity and are therefore able to predict their genital responses more accurately. The second subscale, Arousal Contingency, was a negative predictor of sexual concordance. Women who felt the need for everything to be "just right" for sexual arousal to occur or to be maintained did not show substantial agreement of their genital and subjective sexual responses. This finding is interesting, because this subscale was described as a potential risk factor or vulnerability for sexual difficulties or dysfunctions (Sanders et al., 2008).

Taken together both inhibitory factors, Arousal Contingency and Concerns about Sexual Function, seem to be associated with women's sexual function as well their sexual concordance. The link between sexual function and sexual concordance in women is not yet clear. Chivers et al. (2010) reported that the differing operationalization of sexual function as well as the combined evaluation of different sexual problems (i.e., arousal difficulties, sexual pain, or problems to reach orgasm), might be responsible for the lack of consistent findings in this regard. Further research should investigate how these factors interrelate and if sexual function and/or sexual concordance can be improved by psychological interventions (e.g., by mindfulness meditation; Brotto et al., 2008; 2014) that specifically target sexual concerns or high distractibility during sexual activity; two aspects of sexual inhibition that are presumably relevant for women's sexual problems.

Limitations

Several limitations challenge the internal validity and generalizability of our results. The volunteer bias that is known in sexuality related research may have been particularly relevant for our study (Wiederman, 1999). Our sample consisted of young and highly

educated, but also sexually healthy and relatively sexually uninhibited, women. Compared to previous questionnaire studies, our sample had higher levels of sexual excitation and lower levels of sexual inhibition (Graham et al., 2006). The restricted range of sexual excitation and sexual inhibition in our sample might have prevented the detection of meaningful associations between both propensities and sexual responses. In the light of our results regarding lower order scales of sexual inhibition being moderators of sexual concordance, we recommend that researchers should screen participants for their level of sexual inhibition. Recruiting women with high levels of sexual inhibition should be done to further examine this specific relationship.

To induce sexual arousal in a laboratory setting is by definition an artificial situation. Thus, generalizing the results of this study to the agreement of genital and subjective sexual responses in real life settings is problematic. For example, the impact of inhibitory cognitions (e.g., "*Will I get lubricated enough to have pain-free vaginal intercourse*?" or "*Am I a good enough lover to please my partner*?") on sexual arousal and response might be very different when there is an actual partner involved. Some lower order factors of sexual excitation also refer to aspects, like certain scents, that are of limited relevance for arousal in a laboratory setting. The inclusion of more personally relevant situational cues, like pictures of their current sexual partner or self-selected arousing stimuli, might increase the transferability the results (Suschinsky et al., 2009).

Conclusions

Our study supports the notion that there is substantial variability in sexual concordance between women. The interaction between sexual excitation and sexual inhibition influenced genital sexual arousal in such a way that high sexual excitation was associated with greater genital response, but only in women with low sexual inhibition. Inhibitory cognitions related to concerns about sexual function were associated with lower genital response and greater sexual concordance. Women who are easily distracted from sexual arousal or have the need for every aspect of a situation to be "just right" for arousal to occur showed lower agreement of their subjective and genital responses. According to the assumptions of the dual control model, one might assume that the level of sexual response is positively related to sexual excitation and negatively related to sexual inhibition. Our results, however, indicate that the relationships between these two propensities and sexual arousal or sexual concordance in women are more complex, with certain lower order factors interacting in a way that either facilitates or diminishes sexual arousal and concordance in women.

Compliance with Ethical Standards

Conflict of Interest All authors declare that they have no conflict of interest.

Informed consent Informed consent was obtained from all individual participants included in the study.

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