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## Relationship satisfaction moderates the associations between male partner responses and depression in women with vulvodynia: A dyadic daily experience study



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### ABSTRACT

Vulvodynia is a prevalent vulvovaginal pain condition that interferes with women's psychological health. Given the central role of sexuality and relationships in vulvodynia, relationship satisfaction may be an important moderator of daily partner responses to this pain and associated negative sequelae, such as depression. Sixty-nine women (M age = 28.12 years, SD = 6.68) with vulvodynia and their cohabiting partners (M age = 29.67 years, SD = 8.10) reported their daily relationship satisfaction, and male partner responses on sexual intercourse days (M = 3.74, SD = 2.47) over 8 weeks. Women also reported their depressive symptoms. Relationship satisfaction on the preceding day moderated the associations between partner responses and women's depressive symptoms in several significant ways: (1) On days after women reported higher relationship satisfaction than usual, their perception of greater facilitative male partner responses was associated with their decreased depression; (2) on days after women reported lower relationship satisfaction than usual, their perception of greater negative male partner responses was associated with their increased depression; (3) on days after men reported higher relationship satisfaction than usual, their self-reported higher negative responses were associated with decreased women's depression, and higher solicitous responses were associated with increased women's depression, whereas (4) on days after men reported lower relationship satisfaction than usual, their self-reported higher negative responses were related to increased women's depression, and higher solicitous responses were associated with decreased women's depression. Targeting partner responses and relationship satisfaction may enhance the quality of interventions aimed at reducing depression in women with vulvodynia.

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## 1. Introduction

Vulvodynia is an under-reported idiopathic gynaecological pain condition [26]. With a prevalence of 12% in the general population, the most common subtype is provoked vestibulodynia (PVD), a recurrent pain elicited via pressure to the vulvar vestibule [39].

Interpersonal factors increase the risk for developing and maintaining chronic pain conditions and associated depression [35], including vulvodynia [7,44]. The valued activity with which vulvodynia interferes is sexuality, and more broadly, the romantic relationship, suggesting that interpersonal variables may exert a stronger influence on adaptation to this condition than in other types of chronic pain. In vulvodynia, partners trigger the pain during sexual activity and the couple suffers negative consequences [6,15,21,31,38]. One important consequence is that women with vulvodynia report more depressive symptoms than women without this condition [15,21].

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Although there are no differences in relationship satisfaction between women with vulvodynia and those without [52], fears of losing or disappointing one's partner are noted [18,24,51], illustrating that relational stressors may lead to more distress. Further, greater relational adjustment is associated with lower pain and depression in these women [37]. Greater relationship satisfaction may facilitate adaptive and reduce maladaptive daily appraisals of pain, leading to improved psychological health [35,53]. Thus, relationship satisfaction may be an important moderator of depressive symptoms in women with vulvodynia.

Fordyce's [19] operant behavioural theory suggests that patient pain behaviours communicate pain to a significant other who may respond in a reinforcing or punishing manner, thus affecting the patient's pain experience. Evidence in chronic pain [12,43] and PVD [16,44,45] support this theory. Alternatively, partner responses may impact the emotional regulation and intimacy of the couple, with effects on pain and psychosocial adjustment [10,13]. Partner responses can be solicitous (demonstrations of sympathy), negative (demonstrations of hostility), and facilitative (encouragement of adaptive coping). Greater partner solicitous and negative responses and lower facilitative responses are associated with greater pain and depression in chronic pain patients [8,11,33,41], and in women with PVD in cross-sectional studies [16,44,45]. One study demonstrated a positive association between negative responses and depression only among the relationally satisfied [54], another only among the relationally dissatisfied [33], and 2 studies found no significant interactions [41,42]. Although partner responses have been associated with relationship satisfaction in PVD [46], the moderating influence of relationship satisfaction has not been examined in this population.

An 8-week dyadic daily experience study was conducted to investigate the moderating role of relationship satisfaction in the associations between male partner responses to women's pain during intercourse and depression. There is a robust cross-sectional relationship in chronic pain populations between negative partner responses and depression [35]. It was therefore hypothesized that a woman's depressive symptoms would increase on days when she perceived greater negative male partner responses than usual, and on days when her male partner reported greater negative responses than usual. Given prior inconsistent findings, no hypotheses were formed regarding the moderating role of relationship satisfaction in the associations between male partner responses and depression.

## 2. Method

### 2.1. Participants

Women were recruited at their regularly scheduled clinical appointments to the study co-investigator physicians and through print and online advertisements in a North American city. The sample included 21% recruited at clinic visits, 70% recruited through advertisements, and 9% recruited by word of mouth. There were no differences between groups on any sociodemographic variables. Women's eligibility was assessed by telephone using a structured interview and they were asked to confirm their partners' participation. Women were then scheduled for a gynaecological examination if they had not already done so. The inclusion criteria for women were: (1) pain during intercourse which was subjectively distressing, occurs(ed) on 75% of intercourse attempts in the last 6 months, and had lasted for at least 6 months; (2) pain limited to activities involving pressure to the vestibule; (3) pain during the diagnostic gynaecological examination, which involved a validated, standardized form of the "cotton swab test" – the recommended gynaecological procedure to diagnose PVD [5]. The

examination included a randomized palpation using a dry cotton swab of 3 locations around the vestibule surrounding the hymeneal ring (ie, 3–6–9 o'clock), to which participants rated their pain at each site on a scale of 0 (*no pain*) to 10 (*worst pain ever*); (4) cohabiting with a male partner for at least 6 months. Exclusion criteria were presence of one of the following: active infection previously diagnosed by a physician or self-reported infection, vaginismus (involuntary tightness of the pelvic floor muscles during attempted penetration, as defined by the *Diagnostic and Statistical Manual of Mental Disorders*, 4<sup>th</sup> edition, text revision) [2], pregnancy, and age <18 or >45 years. The inclusion criterion for male partners was age > 18 years. Of 126 interested participants, 45 (36%) were ineligible: 19 (42%) were not in a relationship, 8 (18%) did not receive a diagnosis of PVD by the gynaecologist, 9 (20%) partners declined participation, and 9 (20%) were ineligible for other reasons (eg, non-English speaking, pregnancy). Of the 81 (64%) women who met eligibility criteria and agreed to participate along with their partners, 9 (11%) couples reported not engaging in intercourse during the study, and 3 couples (4%) dropped out, resulting in a final sample size of 69 couples.

### 2.2. Procedure

Couples came to an orientation session where they each provided informed consent, then completed online questionnaires assessing demographic information and other self-report measures unrelated to the present study. Participants were instructed to complete the daily diaries for 8 consecutive weeks through links to a secure survey server site that was e-mailed individually to each participant. They were asked to begin the diaries that same day and to complete them at the same time each day (reflecting on the previous 24 hours), and independently from their partner. Several strategies promoted participation: (1) a research assistant helped participants to create implementation intentions for their daily goal of completing a diary. Implementation intentions are if-then statements detailing the when, where, and how of goal attainment and have consistently been found to enhance the uptake of a new behaviour [23]; (2) a research assistant called participants 3 times a week as a reminder; and (3) participants were given a flyer to post in their home. This protocol resulted in only 3 couples dropping out, representing an attrition rate of 4%. Daily measures included relationship satisfaction and variables not relevant to the present study, as well as an item about whether or not the participant had vaginal intercourse in the preceding 24 hours. If the participant indicated that intercourse had occurred, then women completed measures of perceived male partner responses to her pain and depressive symptoms, and men completed measures of his own responses to the woman's pain. The overall rate of diary completion was 86.12% (6655 diaries of a possible 7728), with a mean number of 3.74 (SD = 2.47; range = 1–14.5) sexual intercourse events over the course of the study. The online survey software tracked the timing of diary completion, and participants were also asked to enter the date they completed the diaries. Of 921 sexual activity diaries and the same number of diaries reporting relationship satisfaction on the preceding day (1842 diaries total), 5 (<1%) sexual activity diaries and 0 relationship satisfaction diaries indicated a mismatch of more than 24 hours between the participant-reported time of completion and the time stamp, and 22 (2%) sexual activity diaries and 9 (<1%) relationship satisfaction diaries indicated with the time stamp that participants were completing more than one diary on the same day and time. The aforementioned instances of diary completion were considered to be invalid and these days were removed prior to analyses.

Some participants reported a lack of Internet access over the 8-week course of the study (eg, due to travel). Of the 1788 valid sexual activity and relationship satisfaction diaries, 153 (9%) were

therefore completed by paper and pen (by 27 participants, 15 couples). To respect confidentiality, participants were asked to enter the data themselves once they had access to the Internet again. Although the integrity of these data cannot be specifically verified, studies have shown that both paper and electronic diary methods yielded data that were comparable in compliance rates, psychometric properties, and pattern of results [25]. Together with the low rate of invalid data (<3%) for the electronic diaries, we elected to include diaries completed both electronically and by paper in our analyses, resulting in 894 valid sexual events, and the same number of valid reports of relationship satisfaction on the preceding day, reported by 138 participants (69 couples). Each participant received \$20 for completing the orientation session and \$12 per week for the diaries (\$116 total). This study was approved by our university health centre's institutional review board.

### 2.3. Measures

#### 2.3.1. Partner responses

Women's perceived partner responses refer to the perception of her male partner's responses to her pain during intercourse, whereas men's self-reported partner responses refer to his perception of his own responses to the woman's pain during intercourse. Solicitous and negative partner responses were measured with the well-validated Significant Other Response Scale, a subscale of the West Haven-Yale Multidimensional Pain Inventory [34] and the partner version of this scale [50]. These scales assess perceived negative (4 items, eg, "expresses frustration at me") and solicitous (6 items, eg, "suggests we stop engaging in current sexual activity") responses. Items were previously adapted for women with PVD and their male partners [45]. A confirmatory factor analysis indicated that the adapted items maintained the original structure of the measures. Participants reported the frequency of male partner responses on a scale ranging from 1 (*never*) to 6 (*very frequently*), with higher scores indicating a greater frequency. Scores could range from 6 to 36 on the solicitous and 4 to 24 on the negative subscales. Within-person reliability estimates as indexed by Omega, the most recent technique for estimating reliability in multilevel models [22], were 0.72 and 0.73 for women and 0.85 and 0.74 for partners, for the solicitous and negative subscales, respectively.

Facilitative partner responses were measured with the facilitative subscale of the Spouse Response Inventory and the partner version of this scale, which have been shown to have good validity and reliability [49]. Items were previously adapted to women with PVD (6 items; eg, "tells me that I am pleasuring him"; [44]) and their male partners. Confirmatory factor analysis indicated that the items maintained the structure of the original measure. Respondents indicated facilitative male partner responses to the woman's pain during or after intercourse, on a scale ranging from 1 (*never*) to 6 (*very frequently*). Scores could range from 6 to 36. Higher scores indicate a greater frequency of partner responses. Omega for women and partners was 0.86 and 0.91, respectively.

#### 2.3.2. Relationship satisfaction

Women and men's relationship satisfaction was assessed with the Kansas Marital Satisfaction Scale [48]. This brief scale was chosen to reduce participant burden, which is a common concern in daily experience studies. It consists of 3 items that were modified slightly for cohabitating (but not necessarily married) couples and for the daily context. The items included "how satisfied are you with your relationship with your partner today?" "how satisfied are you with your partner today?" and "how satisfied are you with your overall marriage/common-law relationship today?" Ratings were made on a scale of 1 (*very unsatisfied*) to 7 (*very satisfied*) and summed responses yielded a daily total score whereby higher

scores indicated higher satisfaction. Prior studies have established the internal consistency, test-retest reliability, and concurrent and discriminant validity of the Kansas Marital Satisfaction Scale [48]. Omega for both women's and partners' satisfaction scores was .92.

#### 2.3.3. Pain

Women reported their pain intensity, with reference to their intercourse pain experienced in the last 24 hours, by indicating their level of pain during intercourse using a horizontal numerical rating scale ranging from 0 (*no pain*) to 10 (*worst pain ever*). This measure has been shown to detect significant treatment effects in women with PVD [5] and positively correlates with other pain intensity measures [14]. Intraclass correlation for pain scores was .53, suggesting that relatively equal amounts of variance were accounted for by individual differences in pain and by event-specific characteristics (and error).

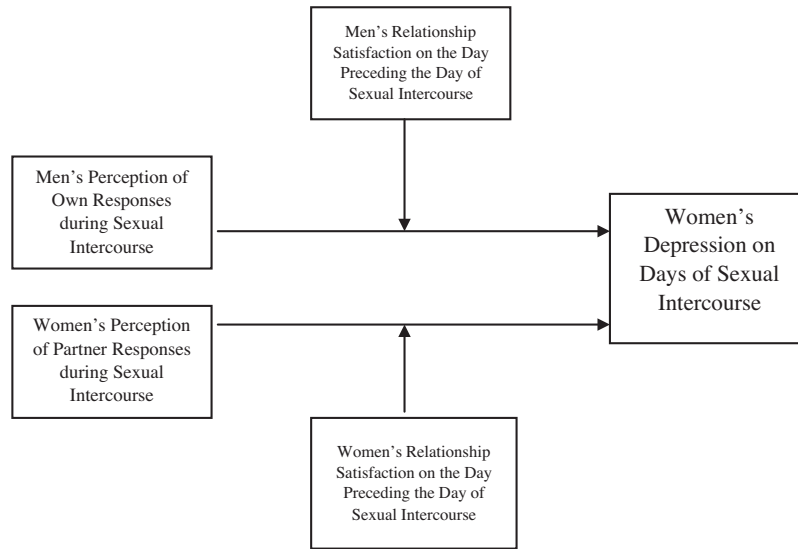
#### 2.3.4. Depression

Women reported their depressive symptoms using the depression subscale of the Profile of Mood States [36]. This commonly used brief measure of mood has well-established reliability and validity [36]. The depression subscale consists of 4 items (sad, discouraged, hopeless, worthless) to which women rated the extent to which they had experienced these feelings in the past 24 hours on a 5-point scale ranging from 0 (*not at all*) to 4 (*extremely*). Responses were summed to yield a daily total score where high scores indicated greater depressive symptoms. Omega for women's depression scores was .76.

### 2.4. Data analysis

Women's perceived partner responses refer to the perception of her male partner's responses to her pain, whereas men's self-reported partner responses refer to his own responses to the woman's pain. First, we determined whether there were gender differences in demographics and mean daily predictor variables aggregated across the study period using *t*-tests and  $\chi^2$  comparisons. Within-person correlations among diary variables were also examined.

The primary analyses were based on a multilevel modeling approach, which addresses the nonindependence of the observations and unbalanced data structure. A model was constructed to estimate simultaneously the main effects of women's perceived and men's self-reported partner responses and their interactions with women and men's previous-day relationship satisfaction on women's depression (Fig. 1). Specifically, the lower level (ie, within-person) of the data modeled the associations between daily reports of women's depression and (1) women's perception of partner responses, (2) partners' self-reported responses, (3) women's previous-day relationship satisfaction, (4) partners' previous-day relationship satisfaction, (5) the interaction between women's perception of partner responses and their previous-day relationship satisfaction, and (6) the interaction between partners' self-reported responses and their previous-day relationship satisfaction. Partner responses and depressive symptoms were assessed after the sexual interaction because partner responses referred specifically to responses to pain during or after sexual activity, and we were interested in examining women's depressive symptoms at the same time that these responses occurred. In contrast, using lagged scores of relationship satisfaction in comparison to the same-day satisfaction scores provided a clearer indication of the temporal order of the associations (ie, that satisfaction contributed to the associations between partner responses and depression). The between-person effects of the means of the daily variables on women's depression were modeled at the upper level. Significant interactions were probed by calculating simple



**Fig. 1.** Overview of model to be tested regarding the moderating role of previous-day relationship satisfaction on the associations between partner responses and women's depression.

intercepts and slopes for previous-day relationship satisfaction scores that were  $\pm 1$  SD from the sample mean [40].

For the random component we explored models with alternative parameterizations that increased in complexity ranging from a model with only a random intercept parameter to a model with a random intercept, slopes, and first-order autoregressive covariance structure. The deviance test statistic, which was used to examine the best-fitting model, suggested that a model with only a random intercept provided the best-fitting model.

To separate the within-person from between-person effects, independent variables were centered around each person's mean, which was then entered as a between-person predictor. Within-person centered scores represent the deviation of a person's daily score in a variable from the person's mean score, aggregated across all days, in the same variable. For person-level predictors, group-mean centering was applied such that the centered scores represented the person's relative standing within the sample on the person-level scores. Only findings for the covariation of daily scores are reported and discussed, as this covariation represents a more precise test of our hypotheses. Analyses were conducted using SAS version 9.3 PROC MIXED (SAS Institute Inc., New York, NY; 2012). ESTIMATE statements in PROC MIXED were used to test the significance of simple intercepts and slope estimates in the interactions.

### 3. Results

#### 3.1. Sample demographics and intercorrelations

Women who were included in the analyses were no different from those who were excluded (ie, the 3 couples who dropped out and the 9 who did not have intercourse) in terms of relationship status and household income. Included women were younger,  $b = -6.33$ ,  $t(76) = -2.77$ ,  $P = 0.01$ , less educated,  $b = -2.83$ ,  $t(76) = -3.04$ ,  $P = 0.01$ , and had been experiencing pain for a shorter period,  $b = -4.50$ ,  $t(76) = 2.87$ ,  $P = 0.01$ , than those who were excluded. Table 1 presents demographics for the sample and Table 2 presents the descriptive statistics for the daily measures, aggregated within-person across all diaries. There were no significant main effects of demographic variables on women's depressive symptoms.

Correlations among variables are presented in Table 2. At the within-person level, perceived solicitous and facilitative male

**Table 1**  
Demographics statistics ( $n = 69$  couples, unless otherwise noted).

Characteristic	M (range)	SD	%
Age (years)			
Women ( $n = 68$ )	28.12 (18–44)	6.68	-
Men	29.67 (19–55)	8.10	-
Women's duration of pain in years	5.39 (0–19)	4.40	-
Women's pain intensity	4.86 (1.36–10.00)	1.88	-
Education level (years)			
Women	15.94 (11–24)	2.72	-
Men	15.94 (12–24)	2.69	-
Marital status			
Married	29	-	42
Relationship length in years	5.54 (0–25)	5.24	-
Frequency of intercourse	3.74 (1–14.5)	2.47	-
Couple's annual income			
\$0–19,999	6	-	9
\$20,000–39,000	14	-	20
\$40,000–59,000	12	-	17
\$60,000 and over	37	-	54

partner responses were positively correlated for women ( $r = 0.26$ ) and men ( $r = 0.29$ ),  $P_s < 0.01$ . Solicitous and negative male partner responses were also positively correlated within-person for women ( $r = 0.16$ ,  $P < 0.01$ ) and men ( $r = 0.27$ ,  $P < 0.001$ ). Women's perceived and men's self-reported (1) solicitous responses were moderately correlated ( $r = 0.47$ ,  $P < 0.001$ ), (2) negative responses were correlated at low levels ( $r = 0.17$ ,  $P < 0.01$ ), and (3) facilitative responses were low-moderately correlated ( $r = 0.35$ ,  $P < 0.01$ ). Women and men's relationship satisfaction on the days preceding intercourse were not significantly correlated. Women's pain intensity and depression were correlated at  $r < .30$ , indicating no need to include pain intensity as a covariate in subsequent analyses. Interclass correlations indicate the shared variance among daily scores relative to the total score variance of a given variable. Overall, interclass correlations (see last column of Table 2) indicated significant shared variance in daily scores that reflect person-level characteristics (ie, individual differences).

#### 3.2. Within-person effects of male partner responses and relationship satisfaction on women's depression

One main effect, consistent with hypotheses, emerged for women's perception of male partner responses on women's

**Table 2**  
Descriptive statistics and correlations for dependent and independent variables (n = 69 couples).

	1	2	3	4	5	6	7	8	9	10	ICC
1. M-S											.60
2. W-S	.47***										.55
3. M-F	.29**	.19**									.65
4. W-F	-.02	.26**	.35**								.67
5. M-N	.27***	.06	.04	-.16*							.43
6. W-N	.26***	.16**	.14	-.09	.17**						.14
7. W-P	.30***	.28***	-.02	.02	.01	.23***					.53
8. W-D	.08	.02	.05	-.07	.08	.16	.10				.33
9. M-RS	-.00	.00	.13	.00	.00	.05	-.06	.01			.66
10. W-RS	-.09	.04	.05	-.04	-.03	-.04	-.05	.02	.08		.62
Mean	14.53	14.28	27.06	28.25	4.20	4.40	4.86	1.70	18.94	17.97	
SD	5.46	5.80	7.48	7.10	.52	.70	1.88	1.84	2.94	2.93	
Range	6.00–25.33	6.00–29.00	7.70–36.00	10.21–36.00	4.00–6.89	4.00–7.13	1.36–10.00	0–7.43	7.00–21.00	7.25–21.00	

Note: Analyses based on 894 (M = 3.74; SD = 2.47; Range = 1–14.5) observations from 138 participants.

1: Men reported solicitous responses; 2: Women perceived solicitous responses; 3: Men reported facilitative responses; 4: Women perceived facilitative responses; 5: Men reported negative responses; 6: Women perceived negative responses; 7: Women pain; 8: Women depression; 9: Men prior-day relationship satisfaction; 10: Women prior-day relationship satisfaction.

ICC, intraclass correlation.

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

**Table 3**  
Within-person effects of male partner responses and relationship satisfaction on women's depression.

Effects	$b^a$ (SE)	df	F	P	95% CL Lower–Upper	$r^b$
Intercept	1.66(.24)	60	54.02	<0.001	1.18–2.14	
Women's perceived solicitous responses	-.02(.03)	363	.61	.44	-.08 to .03	.00
Men's reported solicitous responses	.02(.03)	363	.52	.47	-.04 to .09	.00
Women's perceived facilitative responses	-.03(.03)	363	1.46	.23	-.09 to .02	.00
Men's reported facilitative responses	.02(.02)	363	1.05	.31	-.02 to .07	.00
Women's perceived negative responses	.33(.09)	363	14.22	<0.001	.16–.50	.04
Men's reported negative responses	-.21(.25)	363	.72	.40	-.70 to .28	.00
Women's satisfaction	-.06(.05)	363	1.34	.25	-.16 to .04	.00
Men's satisfaction	11(.05)	363	3.93	<0.05	.00–.21	.01
Women's perceived solicitous × women satisfaction	-.01(.01)	363	.40	.53	-.03 to .02	.00
Men's reported solicitous × men's satisfaction	.05(.01)	363	14.60	<0.001	.02–.07	.04
Women's perceived facilitative × women's satisfaction	-.04(.01)	363	11.62	<0.001	-.06 to -.02	.03
Men's reported facilitative × men's satisfaction	-.01(.01)	363	2.45	.12	-.02 to .02	.00
Women's perceived negative × women's satisfaction	-.11(.03)	363	11.27	<0.001	-.18 to -.05	.03
Men's reported negative × men's satisfaction	-.29(.08)	363	12.27	<0.001	-.45 to -.13	.03

Note: Analyses were based on 446 observations from 69 participants.

<sup>a</sup> Unstandardized regression coefficients.

<sup>b</sup> Effect sizes were computed using the procedure recommended by Rosenthal and Rosnow [47], using the formula:  $r = \text{square root of } (F/F + df)$ .

depressive symptoms. On days of sexual interaction when women perceived greater negative male partner responses than usual, they reported more depressive symptoms ( $\beta = .23$ ). All other main effects of male partner responses (as perceived by women and self-reported by men) on women's depression were not significant. Similarly, no main effects of women or men's relationship satisfaction (on the previous day) on women's depression were found.

### 3.2.1. Moderating role of women's relationship satisfaction (Table 3, Figs. 2 and 3)

The effect of previous-day relationship satisfaction in moderating the associations between the predictor variables and women's depression was next examined by constructing interactions with predictor variables as perceived by the same person only (eg, the interaction between women's relationship satisfaction and women's perceived solicitous male partner responses, predicting women's depression).

First, on days after women reported higher relationship satisfaction than usual, their perception of greater facilitative male partner responses was associated with their decreased depression,

$\beta = -.13$ ,  $t(363) = -3.24$ ,  $P < 0.01$ . However, on days after women reported lower relationship satisfaction than usual, their perception of partners' facilitative responses was not related to their depression,  $\beta = .06$ ,  $t(363) = 1.62$ , ns.

Second, on days after women reported lower relationship satisfaction than usual, their perception of greater negative male partner responses was associated with their increased depression,  $\beta = .61$ ,  $t(363) = 4.61$ ,  $P < 0.001$ ; however, this association was not significant on days after women reported higher relationship satisfaction than usual,  $\beta = .04$ ,  $t(363) = .50$ , ns.

### 3.2.2. Moderating role of men's relationship satisfaction (Table 3, Figs. 4 and 5)

First, on days after men reported higher relationship satisfaction than usual, their self-reported higher negative responses were associated with decreased women's depression,  $\beta = -.93$ ,  $t(363) = -2.41$ ,  $P < 0.05$ . Whereas on days after men reported lower relationship satisfaction than usual, their self-reported higher negative responses were related to increased women's depression  $\beta = .51$ ,  $t(363) = 2.11$ ,  $P < 0.05$ .

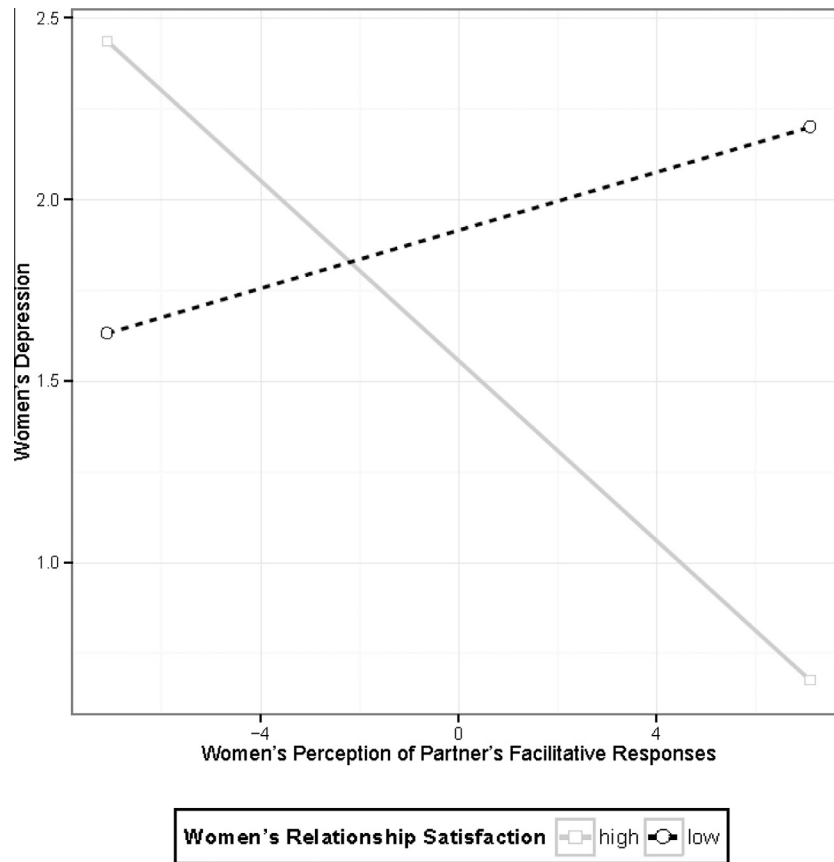


Fig. 2. Women's relationship satisfaction as a moderator of women's perception of facilitative partner responses on women's depression.

Second, on days after men reported higher relationship satisfaction than usual, their self-reported higher solicitous responses were associated with increased women's depression,  $\beta = .14$ ,  $t(363) = 2.94$ ,  $P < 0.01$ . Whereas on days after men reported lower relationship satisfaction than usual, their self-reported higher solicitous responses were associated with decreased women's depression  $\beta = -.09$ ,  $t(363) = -2.19$ ,  $P < 0.05$ .

#### 4. Discussion

This study examined the moderating role of relationship satisfaction in the daily associations between male partner responses – as perceived by women and self-reported by their male partners – and the depressive symptoms of women with PVD. A woman's depressive symptoms increased on days when she perceived greater negative male partner responses than usual. Previous-day relationship satisfaction moderated several associations: (1) On days after women reported higher relationship satisfaction than usual, their perception of greater facilitative male partner responses was associated with their decreased depression; (2) on days after women and men reported lower relationship satisfaction than usual, greater negative male partner responses (as perceived by women and self-reported by men) were associated with increased women's depression; (3) on days after men reported higher relationship satisfaction than usual, their self-reported higher negative responses were associated with lower women's depression; and (4) on days after men reported higher relationship satisfaction than usual, their self-reported higher solicitous responses were associated with increased women's depression, whereas on days after men reported lower relationship satisfaction than usual, their self-reported higher solicitous

responses were associated with decreased women's depression. Results support recent research indicating strong associations between daily interpersonal factors and the psychological health of couples [17,27], including those with chronic pain [3,53]. The moderating role of relationship satisfaction may be of great significance because the primary interference of the pain is with couple's sexuality and relationships.

A woman's depressive symptoms increased on days of sexual interactions in which she perceived greater negative male partner responses than usual. Several studies have indicated that women with vulvodynia fear losing or disappointing their partners [18,24,51]. Negative partner responses may maintain and perpetuate such fears, or, consistent with intimacy models, may convey a lack of empathy for the person in pain, leading to greater depression. Recent evidence has linked greater partner invalidation to more negative partner responses to pain [10]. In turn, interactions that are marked by negative partner responses may disrupt emotion regulation [20] and lead to less intimacy [4] in the couple, ultimately increasing depression.

Regarding the moderating role of relationship satisfaction, first, on days after women reported higher relationship satisfaction than usual, their perception of greater facilitative male partner responses was associated with their decreased depression. Positive relational experiences may have led women to feel more emotionally supported by their partners, creating a more positive interpersonal context for sexual activity and for partners' encouragement of adaptive coping, and reducing depression. Further, being more relationally satisfied has been linked to being more motivated to engage in sexual activity for positive outcomes, such as a desire for closeness with the partner [29]. In the current sample, such positive motives may promote facilitative responding, or women

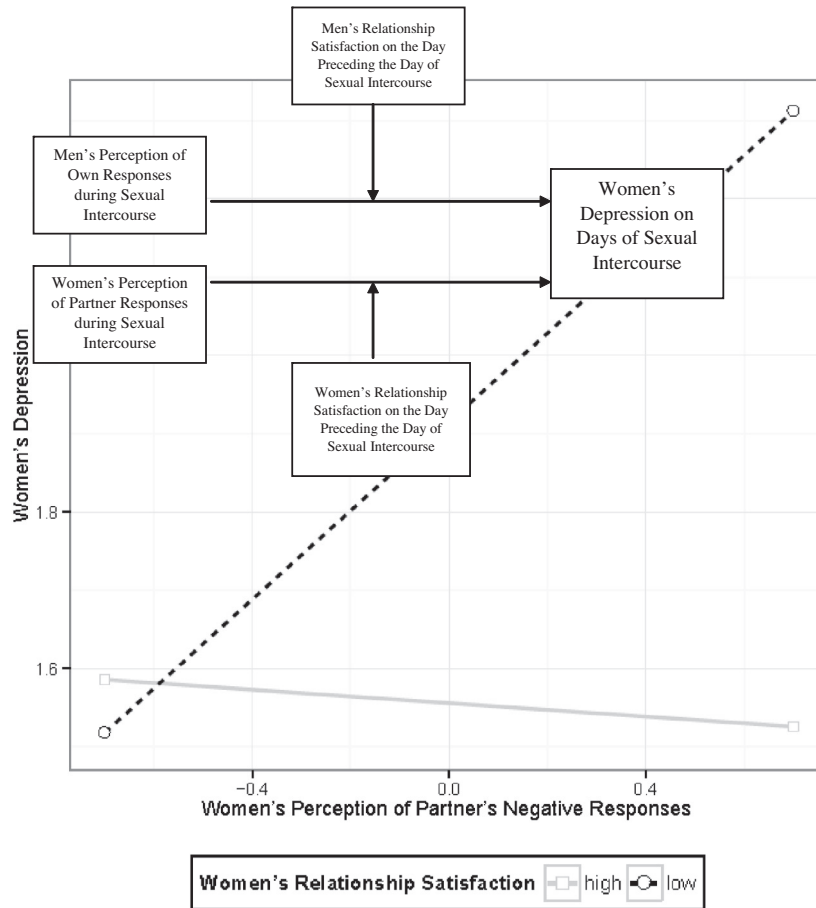


Fig. 3. Women's relationship satisfaction as a moderator of women's perception of negative partner responses on women's depression.

may benefit more from this response style, resulting in improved mood.

Second, on days after women and men reported lower relationship satisfaction than usual, greater negative male partner responses (as perceived by women and self-reported by men) were associated with increased women's depression. Previous reports of this association in individuals with pain have been mixed [33,41,54]. Considering the well-established relationship between marital distress and depression [55], and between lower relationship satisfaction and greater negative partner responses in chronic pain and in PVD [30,33,46], it follows that the detrimental impact of negative partner responses on women's depression would be bolstered on days following lower relationship satisfaction. In PVD, women who are less relationally satisfied may be primed to focus on the negative aspects of the sexual interaction, or may be more susceptible to the emotional toll (eg, guilt, shame) of negative partner responses, leading to greater depression. When the spouses of women with PVD are relationally dissatisfied, they may feel more resentful about the lack of, or disruption to, sexual activity, contributing to greater expressions of frustration and anger, and subsequently more depression in their female partners.

In addition, on days after men reported higher relationship satisfaction than usual, their self-reported higher negative responses were associated with lower women's depression, consistent with cross-sectional studies assessing pain patients' reports of these variables [33,54]. In this case, relational satisfaction may act as a buffer against depressive symptoms because couples may be more willing to engage in sexual activity and feel closer to one another. This may allow the woman to be more understanding of her male

partner's sexual frustrations due to the pain, and to reduce their negative impact on her mood.

Finally, on days after men reported higher relationship satisfaction than usual, their self-reported higher solicitous responses were associated with increased women's depression, whereas on days after men reported lower relationship satisfaction than usual, their self-reported higher solicitous responses were associated with decreased women's depression. On the one hand, demonstrations of attention and sympathy may be associated with less depressive symptoms in women because such responses are viewed as especially validating when they follow a day of lower relationship satisfaction, thereby enhancing pain coping and effective emotion regulation, leading to less depression [10]. On the other hand, following days of higher relationship satisfaction in men, solicitous responding may actually be a stronger reinforcing agent of women's suffering [33]. In the context of a satisfying relationship that may nevertheless be characterized by avoidance of conflict, couples may be more likely to share maladaptive cognitive appraisals that the pain is severe, uncontrollable, and should be feared.

In summary, the positive influence of facilitative responses on women's depressive symptoms was observed only on days following women's higher relationship satisfaction, suggesting that the benefits of this type of response may be restricted to women who are more relationally satisfied. Similarly, higher relationship satisfaction had a buffering effect on the association between greater negative partner responses and women's depressive symptoms. Finally, in the case of solicitous responses, women's depressive symptoms were higher on the days after men's relationship

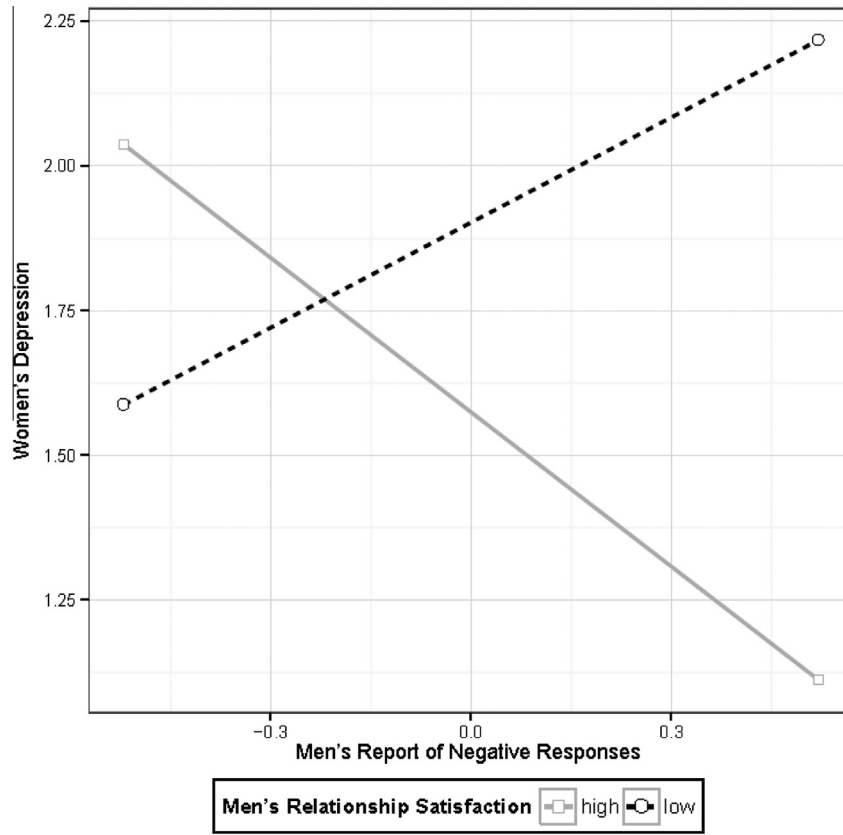


Fig. 4. Men's relationship satisfaction as a moderator of men's reported negative partner responses on women's depression.

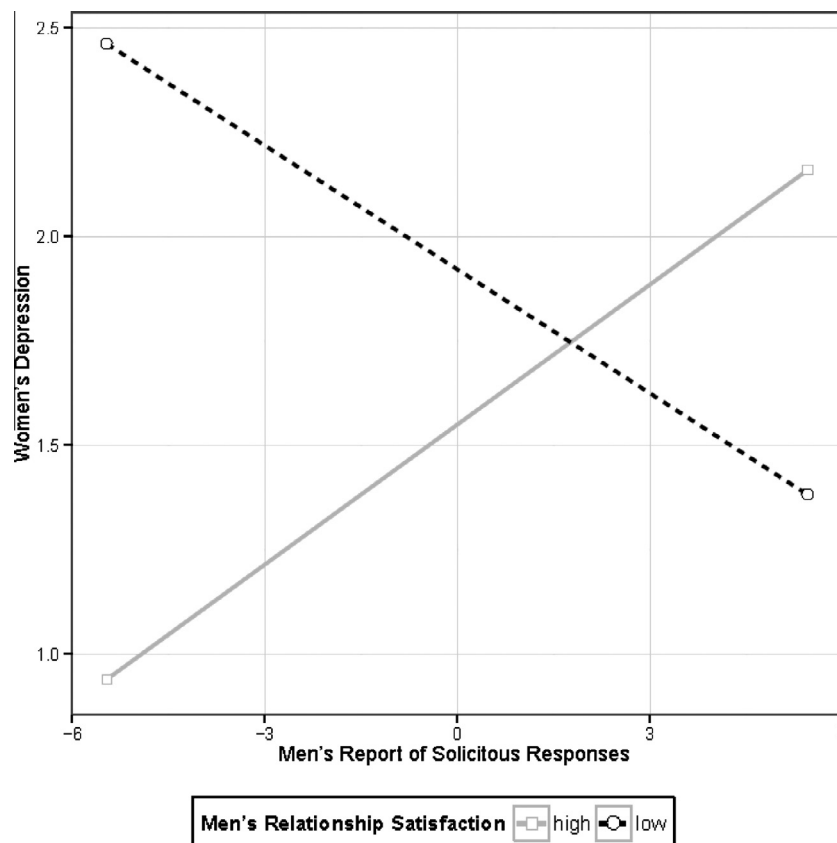


Fig. 5. Men's relationship satisfaction as a moderator of men's reported solicitous responses on women's depression.



satisfaction was high and lower on the days after men's relationship satisfaction was low, suggesting that partner solicitousness has a negative impact on women's depression only when their male partners are more satisfied with their relationship.

This study has several notable strengths. To our knowledge, only 2 prior studies have investigated daily partner responses in chronic pain [28,56]. Thus, this was the first study to examine the associations between pain-specific partner responses to pain, relationship satisfaction, and depressive symptoms in the daily lives of couples with chronic pain, and specifically in PVD. Use of dyadic daily experience methods allowed us to reduce recall biases and to examine the unique effects of each partner's report of male partner responses on women's depressive symptoms, which are known to vary considerably within and across days [3,9,53].

This study also has limitations. First, participating couples were heterosexual, and the included women were less educated and experienced pain for a shorter duration of time compared to women who were excluded, limiting generalizability. Second, analyses were correlational and causal conclusions cannot be drawn. Nonetheless, theoretical models of chronic pain provided a foundation for interpreting the findings, and using reports of relationship satisfaction on the preceding day provided stronger evidence for the temporal order of the moderation results. Third, although participants were instructed to complete their diaries at the same time each day, this timing varied among participants. In addition, the timing of sexual activity was not recorded. Fourth, women were not asked to refrain from treatment during the study, which increased ecological validity, but possibly introduced a confound. Finally, some of the effects were relatively small. Small variance effects provide meaningful information when they are relevant to the daily lives of individuals with chronic pain and may lead to substantial cumulative effects over time [1]. Repeated exposure to negative interpersonal experiences over time may progressively increase the individuals' cumulative risk for psychological and physical health problems [27]. The current findings should be replicated with other chronic pain populations to determine the magnitude of the daily associations between partner responses and depression.

In conclusion, daily relationship satisfaction may protect couples against male partner difficulties in regulating himself (as expressed by negative partner responses) vis-à-vis the painful sex situation, and may potentiate more adaptive partner responses such as facilitative responses. The finding that partner-reported daily variables influenced women's depression supports recent efforts to focus on the social context of chronic pain [32]. Clinically, cognitive-behavioural and/or intimacy-enhancing interventions may assist couples in modulating male partner responses and the general quality of the relationship by teaching partners how to assist patients' coping efforts and to respond empathically to the pain. Conceptualizations of partner responses to pain should expand beyond strictly operant models, to include theories of emotion regulation and intimacy [10,13]. Intimacy models seem all the more pertinent in PVD, a pain condition whereby the highly valued activity with which the pain interferes is the sexual relationship: an integral component of the overall intimate relationship. Additional research is needed to clarify how operant and intimacy models coincide, diverge, or can be integrated into an overarching framework, in order to improve our understanding of social factors in chronic pain.

#### Conflict of interest statement

The authors have no conflicts of interests to declare.

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